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Employing starch cryogenic structures for quercetine encapsulation

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ABSTRACT

Introduction. These are the keeping and transporting of biologically active substances due to the inclusion into natural high-molecular combination structures that play the role of microcapsules. Encapsulation helps to make some compounds dissolvable, what increases their digestion rate. Proteins, polysaccharides and starch particularly have been widely used for the encapsulation.

Materials and methods. Starch was the object of the investigation. It was received due to the freezing of the starch paste and the starch-quercetine reaction by-product. Gained products were investigated with the help of the LEO 1420 scanning electronic microscope (Germany). The X-ray phase analysis was conducted be means of HZG4A X-ray diffractometer (Carl Zeiss, Jena, Germany). The composition was investigated by visible UV-spectroscopy on the Thermo scientific Evolution 600, UV-VIS device.

Results and discussion. We prepared the samples of starch cryogenic structures received due to the freezing of the corn starch suspension with the concentration of 5 and 10 %. These samples were used for the quercetine encapsulation. The chemical reaction between the starch molecules and quercetine was found after the comparison of the received uv-vis spectra of starch, quercetine and sorption product of quercetine on the starch. The X-ray phase analysis (XPA) showed the changes in the crystalline rate that appear when starch is modified by freezing. XPA of the starch-quercetine reaction by-product showed that quercetine has non-crystalline form when amorphous-crystalline structure of porous starch is preserved.

Conclusions. Conducted research showed the possibility of the dissolvable quercetine formation with corn starch cryogenic structures. This opens new perspectives for the construction of new nutrients with healthy effect.

Introduction

There are questions of high importance for the research. These are the keeping and transporting of biologically active substances due to their inclusion into natural high-molecular combination structures that have a role of microcapsules.

Encapsulation increases the stability of vitamins and mineral supplements, which are easily affected by UV-radiation, light, oxygen, humidity and temperature changes. Encapsulation helps to make some compounds dissolving, that increases their digestion rate.

Proteins, polysaccharides and particularly starch have all been widely used for the encapsulation [1].

Starch paste freezing in particular conditions can lead to the extraction of starch with a developed pore surface. The porous starch is formed as a result of the freezing of water that was absorbed by starch polysaccharides in the process of gelatinization. Meanwhile the starch polysaccharides form stable frames with included ice crystals [2]. Starch cryogenic structures can have pores of different size depending on the conditions of the freezing process. This type of starch is supposed to absorb low-molecular compounds and make a protective effect on them due to its developed inner pore surface.

The research was aimed at the receiving the corn starch cryogenic structures by the starch paste freezing, the investigation of their structures and the possibility to use them as encapsulation agent for low-molecular compounds.

Materials and methods

Starch was the object of the investigation. It was received due to the freezing of the starch paste and the starch-quercetine reaction by-product. When the pastes of low concentrations (3–5 %) are frozen, a porous starch with wide range of pore diameter is formed. When the concentration is increased up to 9 %, the pore range is decreased and smaller pore prevail. The average pore diameter and the distance between them form a power function of starch concentration in the paste [2].

The process of porous starch acquisition requires 5 – 10 % pasted water dispersions to be frozen at the temperature of –5…–10ºC. When preparing the dispersion you should avoid strong mechanical influence (shakes, stirring, homogenization etc.) thus preventing swollen starch granules from destruction. The received melt porous mass was first evaporated be means of hydrophilic alcohol and then dried.

We prepared the samples of starch cryogenic structures received due to the freezing of the corn starch suspension with the concentration of 5 and 10 %. These samples were used for the quercetine encapsulation. Gained products were investigated with the help of the LEO 1420 scanning electronic microscope (Germany). The X-ray phase analysis was conducted be means of HZG4A X-ray diffractometer (Carl Zeiss, Jena, Germany). The composition was investigated by visible UV-spectroscopy on the Thermo scientific Evolution 600, UV-VIS device.

The rate of crystallization was calculated with the proportion of the intensities $I_\text{к}/I_\text{о}$, where $I_\text{к}$ is the intensity of X-ray diffraction on crystallized areas, I_o– is a general X-ray diffraction.

Results and discussion

The results of the phase structure investigation of different porous starch samples are depicted on the Fig.1 and in the table.

The photo (fig. 2), made by means of scanning electronic microscope, shows a system of channels that were formed in the process of gradual freezing and rapid melting of water corn starch pastes. The drying was conducted at room temperature; the samples were fragmented and sieved. Mechanical fragmentation could cause the destruction of inner starch channels.
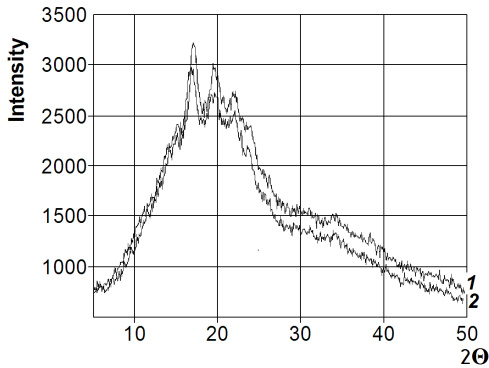
Fig. 1. X-ray photographs of porous starch, received from frozen paste:
1 – 5 %, 2 – 10 %
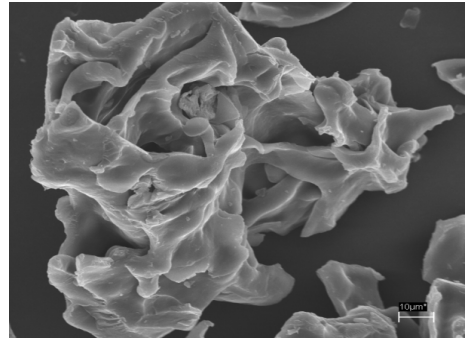
Fig. 2. Scanning electronic microphotography of porous starch

Water is of great importance for the formation of starch amorphous-crystalline structure. The porous starch, received when starch paste массовым содержанием сухих веществ 5 % was frozen at the temperature of -10ºC, has the relative crystalline rate 28,5 %, and the samples with 10 % concentration, have the rate of 26,2 % (that is 2,3 % less).

Peculiarities of the phase structure of porous starch

№	Concentration of the starch paste,	Relative crystalline rate, %	Relative amorphousness rate, %
1	5 %	28,5	71,5
2	10 %	26,2	73,8

When the quantity of water in the paste is increased, its structuring abilities become stronger. Water structuring ability is applied when it forms the bindings between the atoms of hydrogen and oxygen in the starch.

The received samples of starch cryogenic structures were used for the quercetine encapsulation.

The actuality of using the plant drugs has increased during the last decades. The positive aspects of them are low toxicity and possibility to apply it durably without the risk of side-effects. Flavonoids take an important place among them, being the constituent element of almost all plants.

Flavonoid compounds can assist in more than 40 different biological activities, they make an anti-oxidant effect, particularly they prevent the ascorbic acid and adrenalin from oxidation. In medical sphere they often use the flavonoids like rutin and quercetine, which belong to the P Vitamin group.

It is widely known that water-dissolvent vitamin drugs are the best to be implemented into the foodstuff. That's why the abstraction of quercetine vitamin complex by means of its sorption on hydrophilic medium is an urgent issue.

Quercetine sorption was conducted in different suspensions of starch under different conditions in acetone. The sorption of quercetine on the starch was investigated by visible UV-spectroscopy method on the Thermo scientific Evolution 600, UV-VIS device.

Comparing the received uv-vis spectra of starch, quercetine and the product of the quercetine sorption on the starch (fig. 3), we can observe the shift of the maximum of quercetine absorption from 420 nm to 375 nm in the product of the quercetine sorption on the starch. This fact manifests the chemical reaction between the molecules of starch and quercetine.

The X-ray phase analysis (XPA) of corn starch cryogenic structures, quercetine and the product of the quercetine sorption on the starch showed the changes in the crystalline rate that appear when starch is modified. XPA of the starch-quercetine reaction by-product showed that quercetine has non-crystalline form (or in the form of crystals smaller then 10^{-9} м) when amorphous-crystalline structure of porous starch is preserved.
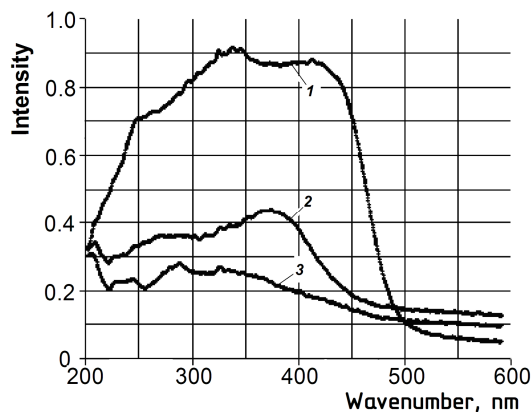
Fig. 3. Spectra of the diffused reflexing:
1 – quercetine; *2* – starch cryogenic structures with quercetine; *3* – corn starch cryogenic structures

The thermal stability of received samples was proved by the thermogravimetic method. The beginning of the destruction in different samples is different. The peak of the endothermic effect, corresponding to the maximum speed of evaporation, takes place at a narrow interval of 3,5°C. It's interesting that the maximum temperature for natural porous starch is 98°C. And the received product at the maximum of 101,5°C.

Starch cryogenic structures with quercetine are particular for their higher temperature of destruction – 218°C. This fact manifests the appearance of a new compound with different physical and chemical properties.

Conclusions

The conducted research helped to find out that the freezing of low concentration starch water dispersing enables the production of modified starch with highly-developed surface that can be used in the role of low-molecular organic compound encapsulation agent. Quercetine experiments showed that this substance is well-absorbed on the starch, making chemisorption-type chemical bindings. This enables to enrich foodstuff with the mentioned vitamin using the starch cryogenic structures. Pure quercetine does not dissolve in water and is difficult for the organism to digest. Thus the conducted research showed the possibility of the dissolvable quercetine formations with corn starch cryogenic structures. This opens new perspectives for the construction of new nutrients with healthy effect.

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Influence particle size of emulsions on quality and stability of beverages

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ABSTRACT

Introduction. It is necessary to determine the effect of particle size on the stability of emulsions during storage and use in drinks.

Materials and methods. Investigated samples of emulsions with different stabilizers (gum arabic, modified starch), the size of 0,1-1,0 microns and about 1.0 microns. In determining the stability of the emulsion particle diameter determined by laser granulometry and placement on the stability of soft drink for 180 days, which was used emulsion.

Results and discussion. Technologies emulsion preparation of gum arabic and starch differ. For emulsions of slices to 1 micron important to choose a certain pressure homogenizer for water and oil phases. During storage products with particle size of 1.0 microns appear more «creaming», which is associated with disruption of the structure and transformation of oil emulsion particles into larger and their ascent to the surface. In products with particle sizes 0,1-1,0 micron emulsions such changes were observed. In the manufacture of emulsion products, in order to maintain their stability and quality, particle size emulsion should not exceed 1.0 mm. The research results can be used in the production of emulsions for beverages.

Introduction

Some foods, especially beverages that are made using emulsions containing 1-1000 nm particle size and treated as objects of classical colloid chemistry.

Of great importance for the stability of these products is the size of the particles. In the case where known information about the particle size emulsion, then you can control their stability and quality. It is known that the diameter of the emulsion depends on a process of manufacturing technology, the recipe emulsion. To prepare emulsions, ie dispersion of one liquid in another, in practice, using mechanical means, which allow disperse phase.

There is a theory about the mechanism of emulsification [1]. The first stage of this process lies in the tension drops of liquid dispersion in a field environment. Pulling drops in thread accompanied by an increase of the surface and flow of work to overcome the molecular forces of surface tension. This extended liquid drop becomes so unstable that

spontaneously breaks into small spherical droplets. This is the second stage of the formation of emulsions, which is accompanied by a decrease in surface and spontaneous process. Then comes the next, third stage, when formed droplets on the one hand, coagulated in collisions, and the other - again stretching into smaller parts to equilibrium. The basis of increasing dispersion emulsion is spontaneous decay drops learned to unstable size [2, 3, 4].

Found that a stable, emulsions are closely associated with the mechanism of dispersion and depends on many factors, such as oil content, type and concentration of emulsifier, the route of administration phases, time and intensity and degree of dispersion and temperature. Study of factors that ensure stability of emulsion, led to the conclusion that the critical degree of dispersion [5-9].

Experiments found that for each type of emulsifier has its own optimum concentration that provides the highest resistance obtained emulsions [7]. For an introduction to emulsify oils (for each concentration of emulsifier) is also optimum in which the most stable emulsion is obtained, that are determining the optimal ratio between the aqueous and oil phases. Introduction of excess oil causing stratification. Thus for each emulsifier is its optimum concentration, the corresponding amount of oil in the emulsion [8].

The optimum concentrations of emulsifiers for certain ratios of the phases in obtaining stable emulsions are not fixed and depend on the degree of dispersion. The use of high-speed mixing [9], and especially increasing pressure homogenizer leads to increased dispersion, viscosity and the formation of more stable emulsions [10].

Materials and methods

The aim of the study particle size effects on the stability of emulsions during storage and use in the manufacture of beverages and their stability during 180 days. As materials for research received samples of emulsions prepared with various stabilizers (gum arabic, modified starch) under two versions of recipes. Two variants of emulsions prepared with particle size:

- From 0.1 microns to 1.0 microns
- More than 1.0 microns.

Emulsions received under recipe, below.

Emulsion for drinks. Recipe for 100 liters of finished product

Name of raw materials	unit	variations recipes	
		1	2
Arabic gum	kg	-	14
Modified starch	kg	15	-
Vegetable oil *	kg	6,4	1,5
Rezynogum	kg	4,7	1,4
Flavor **	kg	1	3
Citric acid	kg	0,2	0,2
Sodium benzoate	kg	0,17	0,17

* - For emulsion - type orange, tangerine, grapefruit, tropic used orange, grapefruit, tangerine oil, for lemon - lemon oil, for After that, mango, peach and apricot -peach butter.
** - For each emulsion using the correct flavor.

To provide color used synthetic and natural dyes and mixtures of dyes in certain quantities. Recommended dosage emulsion: 1,5 kg/1000 liter drink.

Investigation of the stability of emulsions was carried out by determining the size of the diameter of the particles by laser granulometry and placement on the stability of soft drink, which was used emulsion for 180 days. In the production of emulsions initially prepared aqueous and lipid phases, mixed them turbo-mixer and received pre-emulsion with particle size of about 3.0 microns. In the next step, by homogenizing the emulsion obtained with particle size from 0.1 to 1.0 microns. During the preparation of the aqueous phase in water soluble all items that are part of this phase: stabilizers (gum arabic, modified starch), acid dyes, water soluble, preservatives, antioxidants (ascorbic acid). In practice, the most important stabilizer in the manufacture of emulsions for soft drinks are: gum arabic and modified starch. To protect the product from microbial spoilage used preservative sodium benzoate. Acidification lemon emulsion or malic acid to pH 4,0 bolsters preservative as well as a positive effect on the effective viscosity of the emulsion.

An important factor in the production of emulsions is a significant difference in density between oil and water. Essential oils have an average density of about 0.845 g / l, while the density of water is 1.0 g / l. It is therefore necessary to align low-density essential oil by adding substances that increase density. Substances that increase density is rezynogum (estergum or damargum).

Results and discussion

Technology of preparation of emulsions with gum arabic is different from the technology of emulsifying starch. An important factor for emulsions with particles up to 1 micron is the selection pressure homogenizer for some water and oil phases.

The optimal parameters of emulsion technology using gum arabic, given its dissolution features:

- The temperature of the aqueous phase 31 ° C;
- Temperature-fat phase 42 ° C;
- Pre-emulsion-temperature 30-35 ° C, using turbo-mixer high-speed turns, stirred for 10 minutes, get diameter particles 3mk
- The temperature homogenization pre-emulsion 30-35 ° C
- -Pressure homogenizer at 280/50 bar (homogenization spend 2 times) get to 1mk diameter particles.
- The optimal parameters of emulsion technology using starch, especially given its dissolution:
- The temperature of the aqueous phase 42 ° C (dissolution of starch is carried out with stirring at a low rate of speed mixer, 30 pp. injected fat phase and stirrer speed increased to maximum, stir 2 min);
- Fat-temperature phase 20-22 ° C;
- Pre-emulsion temperature 20-22 °C, particles 5 microns in diameter, turbo-mixer high-speed turns are not used, since the formation of foam you want to stand for several days.
- Pressure homogenizer at 230/50 bar (homogenization spend 2 times) get diameter particles at 1mk.

Dissolve gum arabic is faster and easier than with the dissolution of starch as emulsion obtained using gum arabic, stable in quality and more expensive in value compared with emulsions prepared by using starch. For the selection of optimal parameters emulsion in

quality and in value, sometimes replacing 18% of the total gum arabic in an emulsion of 12% starch.

Found that during storage products with particle size more than 1.0 microns appear so-called "creaming" which involves breaking the structure of the emulsion and the conversion of oil into larger particles and floating them to the surface. In contrast, the products manufactured using the emulsion with a particle size of 0.1 microns to 1.0 microns above changes were observed.

Conclusion

Aromatic emulsions are promising for application in the food industry. Getting emulsions - a process that depends on many factors - ingredients composition, technological regimes and specific equipment. The technological scheme of obtaining food emulsions.

The main parameters to be controlled in the manufacturing process:
- temperature conditions for the preparation of emulsifiers and phases;
- the speed and intensity of mixing of the components in the formulation pre-emulsion;
- pressure in Homogenizers, by which regulated particle size;
- number of cycles (duration) homogenization.
Basic control in the finished emulsion:
- the size of particles;
- rheological properties (density, viscosity system);
- optical properties (color, transparency);
- microbiological stability;
- toxicological parameters monitored necessarily because further scope emulsions are food.

Thus, as a result of the studies found that the manufacture of emulsion products, in order to maintain their stability and quality, to consider particle size emulsion, which should not exceed 1.0 microns.

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Technology development of kumis functional drink

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ABSTRACT

Introduction. The purpose of this work is to develop the production technology and trade analysis assessment of kumis drink, which is functional food product.

Materials and methods. The mare's milk, kumis, kumis drink made of cow's milk rich in iodine and inulin was investigated. The content of mass concentration of iodine, lead, copper, zinc and cadmium in them using "Ecotest-VA" was determined. The antioxidant properties of inulin and inulin-iodine complex were determined by the chemiluminescence analysis.

Results and discussion. New objective measure of quality trade analysis of kumis and kumis drinks is developed. There has been developed a modified method for the chemiluminescence analysis using $1 \cdot 10^{-1}$ M solution of azodiisobutyronitrile acting as the initiator of free radical lipid peroxidation. The method of rapid assessment of qualitative characteristics of kumis by chemiluminescence analysis has been given scientific credence – it determines light sum and the maximum chemiluminescence luminosity in kumis. With the values ranging from $0,93 \pm 0,07$ pH to $2,17 \pm 0,26$ pH and from $0,57 \pm 0,05$ pH to $1,92 \pm 0,41$ pH, the product is assessed as a quality product having preserved a biological value. Production technology of kumis drink enriched with inulin and iodine is developed. For this technology there has been carried out laboratory and industrial testing. Experimental models of iodine deficiency in rats show that kumis drink rich in iodine and inulin, gives physiological activity. The calculation of economic efficiency for kumis drink production is defined. Implementation of development in dairy plants will allow to provide the population by health functional food.

Introduction

Development of technologies for industrial production of functional food products is one of the priorities enunciated as a state policy of the Russian Federation № 1873 - p dated 25.10.2010 "On the State Policy of the Russian Federation in the field of healthy nutrition for the period up to 2020".

Lack of protein, vitamins, dietary fiber, macro- and micronutrients in the diet causes the growth of socially dangerous diseases. It is known that insufficient intake of iodine in the human body leads to violations in the structure and function of the thyroid gland, inadequate production of thyroid hormones and the emergence of endemic goiter and diseases associated with dysfunction of various organs and systems, an imbalance of the immune system. Thus, malfunction of the thyroid gland causes diseases of the upper respiratory tract, and pulmonary tuberculosis particularly.

It is known that kumis being a product of therapeutic and prophylactic purposes, refers to a high-performance antituberculous means. Unfortunately, mare's milk kumis is produced only in the areas of Russian horse herd farming. In other areas mare's milk is not produced due to lack of raw materials and the impossibility of its long-term storage, though the need for kumis is very substantial. Therefore, the development of production technology of iodinated kumis drink, as close as possible to the natural, is of great and social importance. Making kumis drink along with the organization of industrial production has broad prospects for its use as an effective functional beverage.

The aim of this work is the development of production technology and trade analysis of iodinated kumis drink.

In accordance with the purpose of the investigation, the aims of the study are stated as follows:

- developing a method for rapid assessment of the quality characteristics of kumis and kumis drinks by chemiluminescence analysis;
- investigating the intensity dynamics of lipid peroxidation in kumis drink by chemiluminescence analysis, determining the concentration of malondialdehyde;
- developing the formulation and production technology of iodinated kumis beverage;
- carrying out a comprehensive trade analysis of kumis beverage;
- assessing the economic efficiency of production of iodinated kumis beverage;
- developing scientific and technical documentation for the iodinated kumis drink.

Materials and methods

This work has been carried out at the Branch of Razumovsky Moscow State University of Technology and Management in Meleuz in the Research Laboratory "Food Technology", accredited according to the analytical laboratory accreditation system GOST R ISO / IEC 17025-2006 (International Standard ISO / IEC 17025:2005), on the basis of Production Laboratory of JSC "Meleuz Milk Factory" and the joint expert laboratory of the National Union of Milk Producers "Soyuzmoloko". The objects of study are: mare's milk, kumis, kumis drink made of bovine milk, rich in iodine and inulin. The content of the mass concentration of iodine, lead, copper, zinc and cadmium has been determined in the mare's milk, kumis and kumis drink, it was done with the device "Ecotest-BA" (Guidelines № 001-110-01, 001-91-00). To evaluate the antioxidative properties of inulin and inulin-iodine complex by the chemiluminescence analysis there were used model test systems that simulated formation of reactive oxygen species and lipid peroxidation reactions. As the model system 1, there were used 20 ml of phosphate buffer with the addition of sodium

citrate and luminol (R. Farkhutdinov, 2003). As the model system 2, there was used a suspension of egg-yolk lipoproteins containing lipoprotein complexes (G. Klebanov et al, 1988).

Results and discussion

In developing the method of rapid assessment of kumis quality, we have chosen a method based on the study of super-weak luminescence intensity of the objects under investigation.

In order to conduct trade analysis there were produced experimental batches of kumis beverage under JSC "Meleuz Milk Factory" – kumis drink with potassium iodide and inulin 1.5% fat content - recipe number 1 (sample number 1), kumis drink with potassium iodide and inulin 0.05% fat - recipe number 2 (sample number 2). As a control there were used kumis drinks fat 0.05% (sample number 3) and 1.5% (sample number 4), prepared according to the same recipes, but without adding potassium iodide and inulin.

Kumis drinks were stored in a refrigerator at a temperature of 4 ± 2ºC. Physical, chemical and organoleptic characteristics were evaluated in the samples, their safety was determined on the basis of microbiological research, as well as the intensity of lipid peroxidation.

As seen in Figure 1, inulin has a significant effect on the titratable acidity in kumis drinks. So, if indicators of acidity in kumis drinks 1.5% fat and 0.05% without introducing inulin increased by 45.64 % and 44.2 %, in kumis drinks containing inulin the similar figure increased respectively by 57.1 % and 55.4 % on the 10th day. Consequently, inulin has an inhibitory effect on the formation of free fatty acids and other acidic compounds in the functional food product.
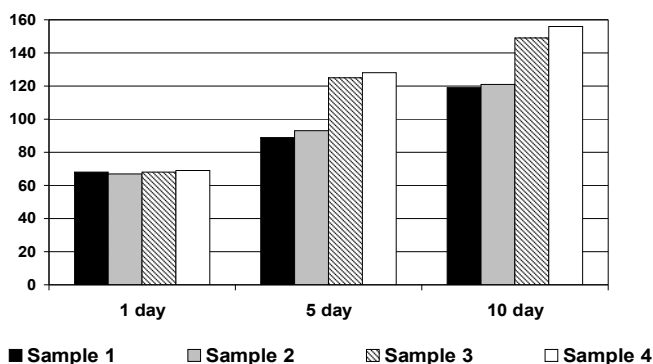
Figure 1. Titratable acidity indicators.

Results of studies for determining fat, protein, MSNF (milk solids non-fat) and density on the 10th day of storage showed that they did not significantly change during storage, remaining within a similar data determined on the 5th day of storage. Consequently, the introduction of inulin and potassium iodide in the kumis drinks 1.5% fat and 0.05% contributes to the preservation of physical and chemical parameters.

The results of organoleptic examination of kumis beverages enriched according to recipes number 1 and number 2 on the 10th day of storage are as follows: the taste is specific, fermented, refreshing, with the flavour and smell of yeast, a little spicy, nipping, without foreign tastes and odors; the consistency presents homogeneous, aerated and slightly foaming liquid with impaired clot. Kumis drinks without inulin, that is samples 3 and 4, had a sour taste and smell.

From the results obtained in determining the level of toxic elements, aflatoxin M_1, pesticides, antibiotics and microbiological parameters it is revealed that kumis drink rich in iodine and inulin is safe to use and meets the Sanitary Standards 2.3.2. - 1078 - 2003.

Kumis drink enriched with potassium iodide and inulin is produced by the reservoir method. The main technological stages of production are: acceptance, preparation of kumis mixture, homogenization, pasteurization, enrichment of kumis mixture with potassium iodide and inulin, fermentation, acidification, filling, packing, cooling and maturation.

Milk is separated and then sent for recycling. Dry cheese whey is reduced in the drinking water, heated to 50-55 °C until the mass fraction of solids comprises at least 9.5 %. After that it is pasteurized at a temperature of 70-74 °C with exposure to 15-20. Other raw milk is pasteurized at a temperature of 83-87 °C with exposure to 15-20. Homogenization of the mixture takes place at a temperature of 61- 65 °C and at pressure of 10-12 mPas. Potassium iodide and inulin are introduced into the mixture cooled to 31-35 °C.

For fermentation the production fermentation mixture is applied, it consists of acidophilous bacteria, Lactobacilli bulgaricus, and milk yeast in a ratio of 2:2:1 introduced in an amount of 0.9 liters per 3.0 liters of the mixture (from 20 % to 30% of the weight of the fermenting mixture) with the expectation that the acidity of fermented mixture makes 50-60 $^{\circ}$T. Fermentation continues till acidity rises to 68-70 $^{\circ}$T maintaining temperature of 26-30 °C, then the product is poured into a consumer package, hermetically sealed and placed on a maturation period of 2-2.5 hours at a temperature of (28 ± 2)°C. Ripened product in a consumer package is placed in a cooling chamber for cooling to the temperature of (2-4) °C. When this temperature is reached, the shelf life of the product makes 10 days.

Conclusions

Studies on the development of production technology of iodinated kumis drink lead to the following conclusions:

1. A new objective trade index for making quality analysis of kumis and kumis drinks is suggested, it is based on the study of super-weak luminescence intensity of the product. The modified method of the chemiluminescence assay has been worked out. This method uses $1 \cdot 10^{-1}$ M solution of azodiisobutyronitrile as initiator of free radical lipid peroxidation.

2. The method of rapid assessment of qualitative characteristics of kumis by chemiluminescence analysis is given scientific credence: the light sum and maximum luminosity of kumis chemiluminescence is determined. Ranging from $0,93 \pm 0,07$ pH to $2,17 \pm 0,26$ pH and from $0,57 \pm 0,05$ pH to $1,92 \pm 0,41$pH the product is evaluated as a quality product having a definite biological value.

3. In experimental models of iodine deficiency in rats, it is shown that kumis beverage enriched with inulin and iodine is characterized by a physiological activity.

4. The choice of inulin for giving antioxidant properties to kumis drinks is proved. It is found that inulin inhibits the processes of formation of ROS (reactive oxygen species) in the model test system, reducing the light sum emission by 40.4 %, the amplitude of the

flash by 79.4 %, and the maximum luminosity by 48.7 % relative to the control, which is used as a test system containing no inulin.

5. Laboratory and industrial testing of developed technology of kumis drinks enriched with inulin and iodine is carried out under JSC "Meleuz Milk Factory".

6. There has been developed and approved regulatory and technical documentation for kumis drink, rich in iodine and inulin, in "Bashkir center for certification and expertise" Ltd.

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Studying the phase transitions "Water – ice" in plant raw materials

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ABSTRACT

Introduction. For working out the optimal parameters of freezing, it is necessary to determine the temperature intervals of crystallizing water that takes about 90 per cent of raw material mass. The objectives of this paper are studying the phase transitions "water – ice" in different varieties of plant raw during freezing and further ice melting.

Materials and methods. The objects of our studies are wide-spread in Ukraine wild and cultivated berries – black currant, blueberries, eglantine, cranberries, strawberries etc. We conducted the research with a help of differential scanning calorimetric method that would give a great deal of information about both the state of water inside the cells and the correlation between free and constrained water in researched materials.

Results and discussions. The received data allowed us defining the temperature intervals for the most efficient freezing of different raw materials from the viewpoint of maximal storage of all the precious biologically active components in raw and keeping the fruit and berries undamaged.

Introduction

One of the main problems in modern food technologies is the loss of precious biologically active components during raw material procession. Henceforth, it is necessary to work out and realize the new technologies that would allow obtaining new food products whose composition is adequate to the needs of a modern human; these are food products with healthy, preventive, and functional destination.

The experience accumulated in the world can show that the usage of artificial cold in transporting, processing, storing, and realizing the food raw is the most efficient way to solve the mentioned problem. Artificial cold causes the minimal changes in nutritional and biological value of an initial raw and its organoleptic indices. Along with that, freezing as a method of food raw preservation has some great advantages in comparison with thermal processing methods like pasteurization, sterilization, drying etc.

Unfortunately, the assortment of fresh frozen products issued in Ukraine is not enough large by now. Just the private enterprises with low productivity do produce small amounts

of it; their production is mostly of low quality and gets spoiled quickly because of the lack of efficient freezing technologies.

So the objective of this article is defined as studying the phase transitions "water – ice" to determine a temperature interval that would be most adaptable to freeze certain varieties of fruit and berry raw material, from the viewpoint of maximal storage of all the precious biologically active components in a frozen semi product.

Materials and methods

Studying the process of water crystallization in any systems by differential scanning calorimetric method (DSC) will give a large amount of information about not only the state of water within cells and intercellular space, but also the researched object as a whole.

The fruit and vegetable raw material had not been investigated enough that way (See *Simakhina 2009, 7*). Thenceforth, in studying the dependence of thermal capacity of its samples on the temperature in phase transition **water – ice**, we obtained the sufficient experimental data about the amount of frozen (free) and non-frozen (constrained) water in all the samples in relation to their initial humidity. Those data became a base for working out a technological regime of sublimation dehydration of different plant materials.

Results and discussion

The obtained data are presented in tables 1 to 6. These are the average results of three parallel experiments, which were processed with the method of mathematical statistics. According to the table figures, crystallization of free water during researched samples' freezing began at the significant overcooling, and its initial temperature got lower along with samples' initial humidity decrease.

The comparative analysis of the tables showed that the adaptability to overcooling depended on the kind of a material, the grade of its maturity, its chemical composition, and initial humidity. High-molecular compositions and hydrophilic colloids, which are inclined to swelling and water constraining, play the significant role in this process.

There is well-known (See *Kaatze 2004*) that the presence of stable embryos is necessary for development of crystallization process in the solution. Embryos got created in the certain grade of overcooling in the system; as in our experiments, this grade varied from –7 ºC to –32 ºC (particularly, for black currant this index was 14ºC below zero).

The subsequent growing of ice crystals depended not on temperature, but on time; ice "grew" in the entire volume of liquid. As it was seen from the tables, the temperature of stable germs' growing depends on initial relative humidity of the samples, *ceteris paribus*; further both of these indices grow lower.

Analyzing the results obtained on the base of DSC curves, we are to witness the more or less lasting temperature interval of water crystallization for each of the carbohydrate-containing raw samples in our studies.

Dissolved substances, as a rule, would decrease the water freezing temperature. They provide the osmotic pressure in a solution. One gram-molecule of an ideal non-dissociative and non-associative substance, being dissolved in 1,000 grams of water with pressure of 760 mmHg, lowers the temperature of its freezing on 1.86 Celsius degrees.

Experimental data of crystallization / melting of apple water

Relative humidity	Freezing water	Non-freezing water, % to the main mass	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
80.77	76.74	23.26	-23.0	-6.5	-2.5
80.28	80.28	74.05	-23.0	-11.5	-2.0
77.32	70.67	29.33	-26.5	-13.5	-3.5
76.79	65.22	34.78	-24.5	-12.5	-6.5
68.82	62.12	37.88	-26.5	-9.5	-4.5
62.28	54.23	44.60	-26.5	-11.5	-7.5
58.07	46.17	53.83	-26.5	-8.5	-9.5
57.09	40.99	59.01	-26.5	-11.5	-9.5
54.58	35.33	64.67	-26.5	-17.5	-11.5
38.44	-	100.00	-	-	-

Experimental data of crystallization / melting of eglantine water

Relative humidity	Freezing water	Non-freezing water (% to the main mass)	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
73.20	69.98	30.02	-8.0	-20.0	-1.0
67.25	60.65	39.35	-9.2	-13.0	-0.5
57.91	56.48	43.52	-11.0	-14.0	-2.0
56.89	64.84	35.16	-10.0	-20.2	-1.0
39.94	35.60	64.40	-12.0	-18.0	-2.0
39.39	38.64	61.36	-13.5	-20.0	-2.5
38.17	26.81	73.19	-16.0	-18.8	-2.0
34.15	26.91	73.09	-16.0	-20.0	0
24.43	2.01	97.99	-18.6	-19.0	+ 1.0
22.61	-	100.00	-	-	-

Experimental data of crystallization / melting of blueberry water

Relative humidity	Freezing water	Non-freezing water (% to the main mass)	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
94.51	92.71	7.29	- 9.8	-12.5	-0.5
94.40	91.71	8.29	- 6.5	-12.5	-2.5
93.44	85.71	14.29	-11.7	-14.5	-1.5
86.49	75.68	24.32	- 7.9	-19.5	-2.5
75.34	70.91	29.09	-12.8	-20.5	-1.8
72.64	72.00	28.00	-19.5	-32.0	-0.2
62.50	53.92	41.08	-19.1	-27.5	-4.2
61.11	47.59	42.41	-21.8	-30.5	-4.7
39.37	36.50	63.50	-29.5	-31.5	-12.0
33.42.	-	100.00	-	-	-

Experimental data of crystallization / melting of black currant water

Relative humidity	Freezing water	Non-freezing water (% to the main mass)	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
84.45	71.15	28.85	-14.0	-21.5	-2.0
84.03	61.09	38.91	-14.5	-20.0	-2.0
83.64	75.90	24.10	-16.0	-26.0	-2.0
62.37	82.96	17.04	-	-22.0	+2.0
78.61	70.28	29.72	-16.0	-29.0	-3.0
77.42	77.17	22.83	-13.0	-21.0	+1.0
71.93	71.56	28.44	-16.0	-31.0	-3.0
67.83	52.23	47.77	-21.5	-29.0	-6.0
61.08	48.87	51.13	-21.0	-31.0	-8.0
50.94	33.86	66.14	-27.0	-29.0	-13.0
49.11	41.68	58.32	-19.0	-28.0	-8.0
38.18	-	100.00	-	-	-

Experimental data of crystallization / melting of raspberry water

Relative humidity	Freezing water	Non-freezing water (% to the main mass)	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
89.86	68.01	31.99	-12.0	-23.0	-2.0
88.36	79.26	20.74	-15.0	-21.0	-1.0
87.54	82.12	17.88	-12.0	-18.0	-2.0
87.48	78.21	21.79	-11.0	-20.0	-4.0
87.33	76.54	23.46	-12.0	-18.0	-2.0
87.14	75.65	34.35	- 9.0	-20.0	-2.0
86.85	72.71	27.29	-11.0	-15.0	-1.0
85.12	75.38	24.62	- 8.0	-20.0	-1.0
82.00	69.15	30.85	-13.0	-25.0	-2.5
80.56	71.07	28.93	-12.0	-22.0	-2.0
80.07	71.86	28.14	-10.0	-21.0	-1.0
79.13	59.71	40.29	-	-	-2.0
72.48	62.17	37.83	-13.0	-27.0	-2.0
67.32	55.73	44.27	-16.0	-26.0	-4.5

As the behavior of real water solutions significantly differs from those ideal, the sufficient approximation to this index is observed only in infinite dissolution, i.e. extrapolation to zero concentration of the solved substance.

All mentioned above is an explanation to the fact that water from strawberry with a content of dry substances equal to 11.16 per cent (See Table 6) starts crystallization in −9.0 Celsius degrees; if the amount of dry substances reaches 46.01 per cent, then the temperature of crystallization start should be lowered to 32 Celsius degrees below zero.

Experimental data of crystallization / melting of strawberry water

Relative humidity	Freezing water	Non-freezing water (% to the main mass)	Starting crystallization temperature, °C	Starting melting temperature, °C	Maximal melting temperature, °C
14.39	-	100	-	-	-
16.83	-	100	-	-	-
53.99	51.14	48.86	-32	-28	-10.7
56.71	48.23	51.77	-17	-28	-8
57.99	55.78	44.22	-24	-40	-1.5
68.68	64.20	35.80	-15	-28	-5
76.86	71.84	28.16	-9	-27.5	-3
77.97	69.57	30.43	-21	-25	-3.5
85.71	78.52	21.48	-13	-20	-1.8
88.84	82.02	17.98	-9	-20	-0.7
89.95	74.86	25.14	-19.5	-13	0.6

In thawing the samples with velocity of 4.0 Celsius degrees per minute, starting melting temperature of crystallized water got also decreased. The consequence in temperature changes got observed in the moment of endothermic peak. The absence of first-grade phase transition on the thermograms of samples with low initial humidity was evidence that all water contained by the researched object was constrained.

The temperature of water freezing may be examined as the maximal temperature of water's transition to solid phase. The achievement of such an index is a necessary and sufficient condition for plant raw freezing before sublimation.

Selection of optimal freezing temperature should be based on the fact that the minimal melting temperature of crystallized water (note: this index gets obtained by experimental method) is quite higher than the maximal constraining temperature. It is connected with overcooling while freezing the midterm eutectic mixtures, which delays the subsequent crystallization (*Silvares 2005, 585*). Therefore, the plant raw should be cooled to the lower temperatures. The index of extreme overcooling temperature is determined with the properties of cooled object and the characteristics of matters that abide at the same environment.

According to our results, and also to the data presented in literary sources (*Schwartz 2003, 363*), the extreme overcooling temperature oscillates between 1…10 K. Thenceforth, we should take 240±5 K as the low limit of freezing temperature, and the minimal temperature of ice melting (250±5 K) will serve the high limit.

The analysis of results presented in tables 1 to 6 shows that cellular and tissue water, being influenced by cooling and freezing processes, gets crystallized in different ways due to various states – one part of water remains free, and another one gets strictly fixed by physical and chemical connections with the surface of reactively liable macromolecule groups. Hydrophilic biopolymers are able to keep a certain quantity of free and constrained water, which does not freeze in quite low temperatures, within the cell and in its closest surround.

The low freezing point for water with prevailing constrained faction is connected to its ability to concentrate the great amount of soluble substances (including ions). As a result, the high-viscose protein and mineral mixture gets formed within localized protein components of cytoplasm and membrane structures of a cell.

Table 7 represents the calculation of constrained water content in some plant objects. According to these data, various samples of raw contain 7.0 to 70 percent of the entire content of water. Such index, first of all, depends on raw's initial humidity – the fresher is raw, the lower is the content of constrained water in it, and thus this kind of raw is more adaptable to freezing and further sublimation. It is also evident that, upon the similar initial humidity, the amount of constrained water depends on the modification of raw, i.e. on its chemical content.

Table 7

The mass part of constrained water in plant raw materials

Material	General humidity, %	Constrained water, % to general amount
Eglantine	74,21	30,62
	55,83	36,46
	42,65	61,53
Amaranth	18,40	72,84
	14,48	97,80
Apples	80,74	23,36
	68,82	37,88
	57,09	59,01
Blueberry	84,51	7,29
	86,49	24,32
	72,64	28,00
	61,11	52,41
	39,37	63,50
Black currant	84,45	28,85
	78,61	29,72
	67,83	48,77
	50,94	66,14

Conclusions

1.   Freezing any biological objects, including fruit and vegetable raw, gets accomplished with a help of low temperatures in the interval from 0 to 273 Celsius degrees below zero.

2.   The stable germs are being formed in the conditions of certain overcooling in the system. Talking about our experiments, this condition is a temperature interval from 7 to 32 degrees below zero for different plant objects. The further growing of ice crystal is a question of time but not of temperature.

3.   Freezing the many-component solution that is proper for fruit and berry raw is passing two stages. First one is a prime crystallization (only water gets crystallized); second one is secondary crystallization (this process involves the solver and dissolved biocomponents in it).

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Use of mineral additives in the production of meat products

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  Corresponding author: Iryna Tymoshenko E-mail: i.timoshenko@bk.ru	**ABSTRACT** **Introduction.** Lately in the group of texturizing food additives a great emphasis is placed on stabilizing systems consisting of several components. **Materials and methods.** We determined the optimal composition of composite mixtures of factorial experiments, color using chromaticity scale, moisture-binding capacity and flexibility of mixtures pressing method using and thermal stability of beet dye by heating at different temperatures, ξ-potential of the dye solutions with nutritional supplements. **Results and discussion.** It is determined the rational composition of a model mixtures based nanocomposites and developed a red dye from beets for stabilizing technological, structural and mechanical properties of meat products and groups containing meat, meat bread. The possibility was confirmed to stabilize ξ potential of beet juice by adding buffer compound and mineral additive, as well as a viable potential for applying such compositions in production of meats and processed meats manufactured using the cooked sausage and meat loaf technology.

Introduction

Mineral substances are important components of human food. They are crucial for all processes within the human body, they are featured in hemoglobin, hormones, ferments, and provide structural material for osseous and dental tissues. Shortage of minerals reduces resistance of our organism to various diseases, accelerates ageing processes, and exacerbates the impact of adverse environmental conditions [1].

Iron, calcium, iodine, magnesium, zinc, selenium, and silicon are among the minerals in acute shortage in the modern human diet.

Oxidized form of silicon (SiO_2) is contained in the organisms of sea animals, fish, birds, chicken eggs, etc. Silicon oxide is required to ensure strength and elasticity of epithelial and connective tissue structures. Silicon is largely responsible for elasticity of skin, tendons, and blood vessels [2].

Silicon is also a component of collagen. Its primary function consists in strengthening the fibers of collagen and elastin, ensuring the strength and resilience of connective tissue,

and participation in chemical reactions. Humans consume ca. 10-20 mg of silicon daily with vegetables, fruit, meat, and other foods [3]. That quantity is required to ensure normal vital functions, growth, and development of humans. About 70 elements are not assimilated in the event of silicon shortage.

Lately in the group of texturizing food additives a great emphasis is placed on stabilizing systems consisting of several components. Their qualitative composition and proportions of components can vary, depending on the foods, their texture, processing technology, and storage conditions. Such compositions, when used in meat processing, allows creation of a range of high yield texturized products [4].

Problem Definition. Nowadays the use of mineral fool additives, combined with high-protein vegetable raw and food texturizers, in production of meats and processed meats is one of promising areas for nanotechnologies in food industry.

Materials and methods

Ascertained optimal mixture of composite systems by factorial test; worked out color, water binding capacity, thermal resistance, and plasticity in mixtures of the devised beet colorant, ξ potential of colorant solutions with food additives.

Goal. The goal of our research was developing and studying composite systems purporting to improve textural and color-forming features of a natural colorant for processed meat systems.

The technology of using a combination of red beet colorant, stabilized with a buffer compound [5], concentrated soybean extraction, mineral additive in nanocomposite form [6], in production of meats and processed meats was selected as the object of our research. During factorial tests, various levels of the soybean extraction hydration degree, buffer compound concentration stabilizing beet juice, and the content of colorant and in the mix nanocomposite ture were tried.

Results and discussion

The appropriate mixture was experimentally established for the buffer compound to stabilize beet juice: citric acid to phosphate in proportion 1:0.3. pH of the colorant solution fell within the range 4-4.5. The thermal stability of red beet pigment (betaine) was experimentally tested. 1:20 colorant solution was tested at photocolorimeter at wavelength 520 ± 5 nm. The light transmission factor measurement results of the above solution are set forth in table 1.

Table 1
Light transmission of beet colorant solution, *T, %*

Description	T, %
Solution storage time, *days*	
0 (fresh solution):	4
1	24
6	62
Solution heating temperature (0 days of storage), *°C*	
50	15
72	72

As a result of thermal impact, red beet pigment within the colorant is partly decomposed, yet the solution preserves red coloring, allowing the usage of such colorant in production of cooked sausages. The temperature inside the sausage should fall within the range 70 ± 2 °C, which determined the selection of the upper colorant heating temperature.

To investigate the stability of colorant solutions combined with food additives in the course of storage (fresh and past 6 days of storage), ξ potential was detected for the following variants: 1: beet juice; 2: red beet colorant; 3: red beet colorant + 1% of nanocomposite.

The following diagrams describe the results:
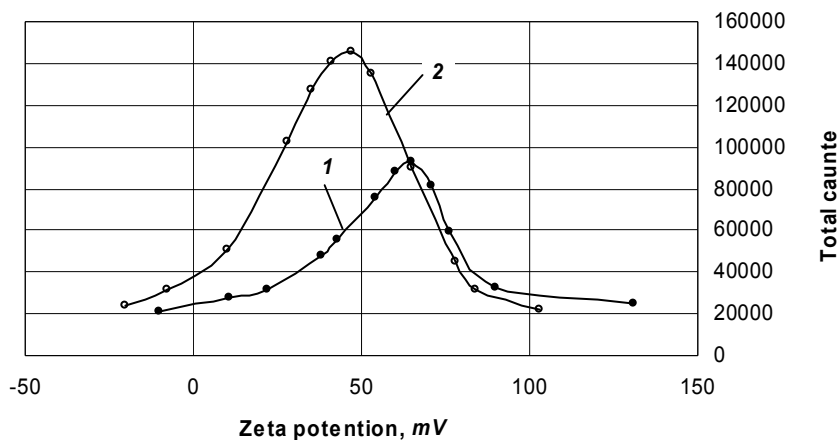
Fig. 1. ξ potential of beet juice and stabilized beet colorant on the first storage day:
1- beet juice, 2 - red beet colorant
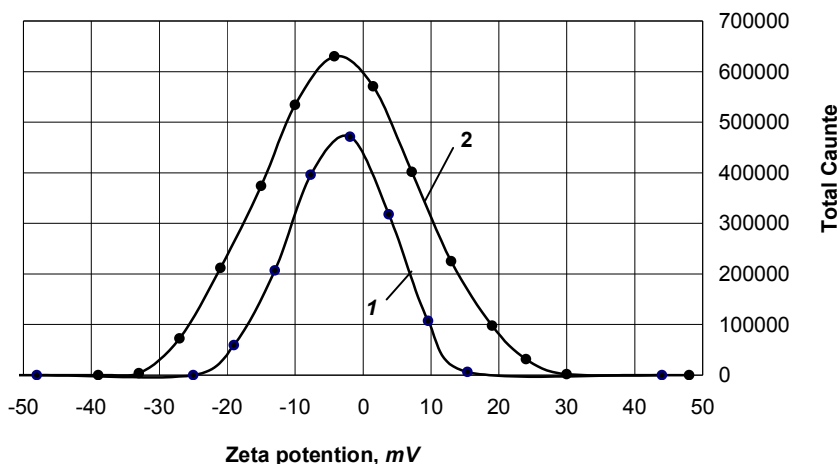
Fig. 2. ξ potential of red beet colorant on the first and sixth storage day:
1 - red beet colorant on the first day, 2 - red beet colorant on the sixth day
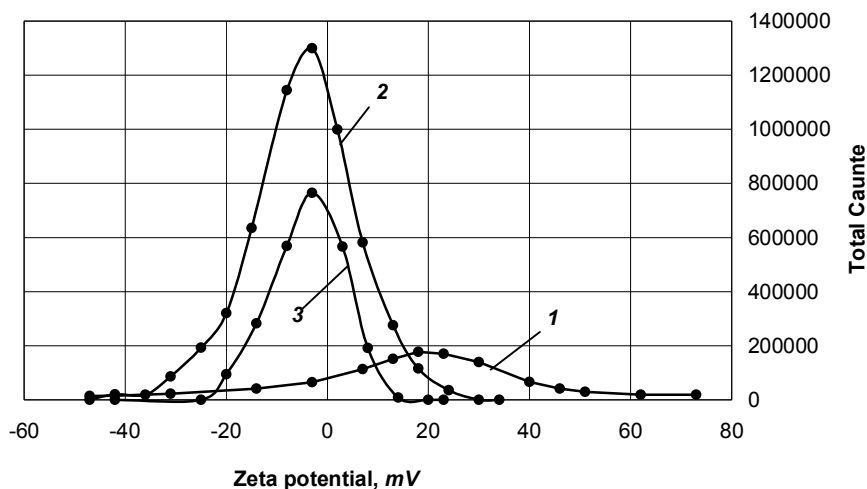
Fig. 3. ξ potential of beet juice and beet colorant with nanocomposite on the sixth storage day:
1 - beet juice, 2 - red beet colorant, 3 - red beet colorant with nanocomposite

The data on figures 1 to 3 evidence the positive impact of adding the buffer compound and mineral additive on the stability of beet juice solution ξ potential as against beet juice without any stabilizers added.

As it is evident from fig. 3, nanocomposite material added to the beet juice system requires higher ionization intensity to detect ξ potential of the solution, which, in our opinion, evidences an increased thermal stability of beet juice solutions.

To support that statement we investigated color-forming features of beet colorant by applying it to the composite mixture of hydrated soybean concentrate with nanocomposite.

We studied the influence of these mineral additives to modify, at nano-level, the texture of hydrated soybean concentrate and combined meat-and-cereal minced systems when beet colorant is added prior to cooking.

The impact of nanocomposite as texturizer was studied in model protein-containing systems of concentrated soybean extraction. The concentrated extraction was hydrated in proportions 1:4 and 1:6 to water. The resulting paste received, in different variations, 2% and 5% of stabilized beet colorant. The same sequence was applied to hydrated mass with addition of colorant plus 0.3% and 0.5% of nanocomposite. In the obtained samples, moisture binding capacity (MBC), pH, moisture content, and color prior and after cooking soybean paste at 120 °C were detected, for each of the samples, as specified in table 2.

The optimum concentration of mineral additive in the composite mixture was experimentally proved to lie within 0.3-0.5% of the weight of high-protein vegetable raw. Increased concentration of the additive failed to improve the texture and physical features of the protein system. The samples of composite system mixtures are described in table 2.

Options of beet colorant and nanocomposite applied to the mixture

Option	Colorant quantity, %	Nanocomposite quantity, %	Soybean concentrate hydration degree, %
1	5	-	1:4
2	2	-	1:4
3	0	-	1:4
4	5	0,3	1:6
5	2	0,3	1:6
6	0	0,3	1:6

The results of the conducted tests are summarized in table 3.

Process features of soybean paste for different options

Sample	Prior to cooking			After cooking (t = 120 ºC, τ = 30 min.)	
	pH	MBC, %	W, %	MBC, %	
				Heating in the pan's center	Heating on the pan's edge
1	7,9	92,0	84,3	96,0	93,2
2	7,2	90,2	83,1	85,3	82,0
3	6,6	87,0	82,0	97,3	92,3
4	7,9	56,0	88,6	66,0	70,0
5	**7,6**	**60,9**	**87,2**	**80,3**	**77,7**
6	6,8	85,2	86,0	77,5	69,0

The colors of the composite mixtures determined using the Tintorama scale are specified in table 4.

Soybean paste colors of samples according to Tintorama scale

Sample	Color prior to cooking	Color after cooking in the pan's center
1	S1060-R10B	S1060-R10B
2	S1020-R	S0530-Y90R
3	S1008-Y10R	S1008-Y10R
4	S1575-R10B	S1070-R10B
5	S0560-R10B	S0550-R
6	S1008-Y10R	S1008-Y10R

Samples 3 and 6, containing no colorant, were yellow to off-white in color, as appropriate for soybean concentrate. Samples 1 and 4, with 5% of stabilized colorant added, became bright red with purple shade, which is not the suitable color for cooked sausages. By adding 2% colorant, saturated pink color appropriate for cooked sausages was obtained, partly losing its intensity after cooking.

Sample 5, containing beet colorant combined with nanocomposite, after baking displayed the shade which is the most suitable for cooked sausages.

The tests of changes in the features of minced meat samples with adding stabilized beet juice and nanocomposite as specified in table 2 displayed an improved moisture binding capacity compared to the samples without the mineral additive, both before and after cooking.

Conclusions

The possibility was confirmed to stabilize ξ potential of beet juice by adding buffer compound and mineral additive, as well as a viable potential for applying such compositions in production of meats and processed meats manufactured using the cooked sausage and meat loaf technology.

It was worked out that 0.3% of nanocomposite and 2% of stabilized beet colorant improve the texture, physical, process, and sensory features of minced meats.

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Unit for food's temperature control during their refrigeration

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ABSTRACT

Introduction. Temperature control of foods during cooling & freezing is important for the development of refrigeration processing modes. Cryoscopic temperature determination is a one of main tasks during ice-cream production. There is no data about new ice-cream mixes. Standard method for determining cryoscopic temperature has some weaknesses.

Materials and methods. New ice-cream mixes and distilled water were studied with our experimental unit. Main parts of it were T-type thermocouples, controllers ICP I-7014, signal converter ICP I-7520 and PC with special software NDCONUTILv3 for temperature registration.

Results. Curve freezing for 20 new ice-cream mixes on a different bases are built. Cryoscopic temperature for this mixes were determined from this curves. Using of distilled water during all time of measurements allowed increasing accuracy. Simultaneously measurements for 4-5 mixes with 2-3 thermocouples in each mix allowed to increase accuracy of measurements and reduced time for it. A method for determining cryoscopic temperature using thermocouples is developed. Laboratory unit for measurements of cryoscopic temperature is designed and erected.

Introduction

Temperature control of foods during cooling & freezing is important for the development of refrigeration processing modes, because:

- It is important to know cryoscopic temperature for setting minimal temperature of cooling or supercooling, and to calculate the water share frozen off the product;
- The rate of temperature dropping during freezing impact on the course of crystallization of cellular juice in product and determines the extent of damage to its cellular structure.
- Lowering the temperature in freezer will reduce the duration of freezing, improve product quality, but will increase the power consumption.

The structure of ice cream formed during freezing determined by the shape and size of ice crystals. Higher quality ice cream can be produced if small ice crystals are more evenly distributed in the product volume. A significant content of bound water and small molecules significantly affect the nature of the process of water crystallization in the mixture.

Ice crystals in the ice-cream mixtures begin to form at cryoscopic temperature. Temperature of the mixture is decreasing during crystallization.

According to the known cryoscopic temperature we have an opportunity (Raoult's law) to establish the water share frozen off the mixture (ω) during freezing, storage and transportation of hardened ice cream:

$$\omega = 1 - t_{cr} / t$$

t_{cr} – cryoscopic temperature, ºC; t – current temperature, ºC.

Objective of our research was defining cryoscopic temperature for existing standard mixes and new mixtures for the production of ice cream (milk-based and fruit or vegetable-based).

Standard method for determining cryoscopic temperature. Cryoscopic temperature is determining with Metastatic Beckmann thermometer (fig.1, a). Test-tube with measured product is placed in the ice-salt mix reservoir with temperature approximately –40 ºC (Fig.1, b). Calibrated Beckmann thermometer is placing into product.
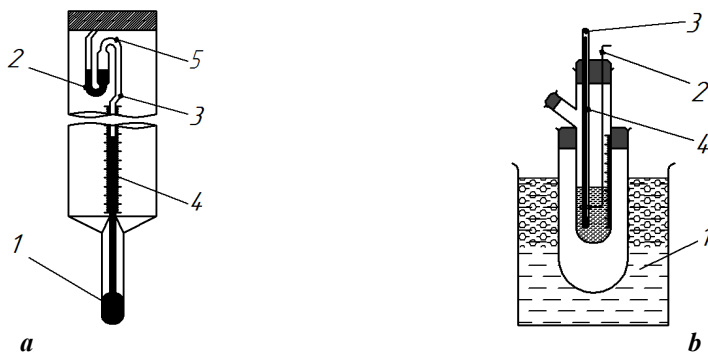
Fig. 1:
a – **Metastatic Beckmann thermometer** (1 - lower mercury reservoir; 2 - upper mercury reservoir; 3 – capillary; 4 – scale; 5 – the place of the capillary to the upper reservoir);
b – **Standard unit for measurement of cryoscopic temperature** (1 – ice-salt mix reservoir; 2 – Metastatic Beckmann thermometer; 3 – mixer; 4 –product under study).

Operator fixes indications every 10 sec during freezing. Result of measurements is a freezing curve – dependence product temperature (°C) from time (sec). Cryoscopic temperature is determining from this curve. Example of freezing curve (for distilled water) shown at the fig. 2. Cryoscopic temperature of distilled water is 0 °C.

Standard method is good because:
- has accuracy to 0,01 °C
- has lower cost
- no additional equipment is required.
 But its users have some problems:

- risk of damage to a mercury thermometer
- countdown temperatures make no more than once every 10 seconds
- subjective uncertainty
- no automatic fixation of the results
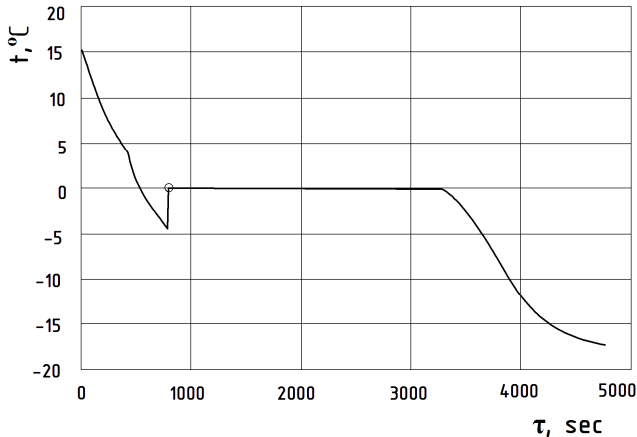
Fig. 2. Curve freezing of distilled water – dependence temperature (°C) from time (sec)
Cryoscopic temperature 0 °C

Materials and methods

For this experiments was modernized unit, which was developed at the Thermal Engineering Department of National University of food technologies [1]. Experimental unit is shown at the Figure 3. Main part of this unit is refrigerator with temperature –25ºC (1).

Metallic bottles with mixes (3) and control bottle with distilled water (4) are placed into refrigerator. Thermocouples (2) are in the bottles. Signals from thermocouples collect in controllers (5), convert in signal converter (6) and register in PC (7) with software NDCONUTILv3.

Advantages of proposed method are:
• The absence of toxic substances in the unit
• The possibility of simultaneous measurements of several mixes
• Compliance with current knowledge and experience
• The possibility of measuring with a 1-second intervals and less if necessary
•   Automatic results registration

We used controllers ICPcon I-7014 with automatic zero-compensation. Problem of
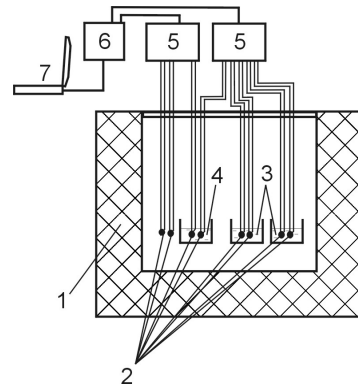
Fig 3. Experimental unit:
1 – refrigerator; 2 – thermocouples type T;
3 – bottles with mixes; 4 – control bottle with distilled water; 5 – controllers I-7014;
6 – signal converter I-7520; 7 – PC

these controllers is a less accuracy. Working controllers can make error from wrong zero-compensation, so its accuracy is 0,5…2 ºC. For increasing it we measured of distilled water freezing temperature permanently. Thermocouples data were recalculated according data from thermocouple with distilled water freezing temperature. We had accuracy up to 0,05…0,1 ºC.

Results

With this unit we built curve freezing of different ice-cream mixes and determined its cryoscopic temperatures (Tables 1)

Table 1. Cryoscopic temperatures for ice-cream mixes

№	Mix	Cryoscopic temperature, ˚C
	Milk-based mixes	
1	Milky	-2,71
2	Creamy	-2,94
3	Plombières	-3,08
4	Milky without stabilizator	-2,16
5	Milky with wheat flour (2%)	-2,38
6	Milky with wheat flour (3%)	-2,4
7	Milky with oat flour (3%)	-2,3
8	Milky-wheat with wheat germs	-2,38
9	Milky-pumpkin	-2,75
10	Milky-carrot	-2,36
11	Milky-apple	-2,66
	Fruit & vegetables-based mixes	
1	Pumpkin	-2,82
2	Apple without gelatin	-2,66
3	Apple with gelatin	-2,9
4	Apple-eggs	-3,38
5	Apple-protein	-3,54
6	Apple-oat	-3,35
7	Flavor with extract of Hibiscus	-2,20
8	Flavor with pumpkin & extract of Hibiscus	-2,86
9	Flavor mint	-2,17

Conclusion

1. A method for determining cryoscopic temperature using thermocouples is developed. Using of distilled water as an sample object allowed to increase accuracy.
• Laboratory unit for measurements of cryoscopic temperature is designed and erected. Simultaneously measurements for 4-5 mixes with 2-3 thermocouples in each mix allowed to increase accuracy of measurements and reduced time for it.

• Cryoscopic temperature of 11 milk-based mixes for ice cream and **9** fruit and vegetable-based mixes were defined.

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Research on the ways of the pectin extraction from the potatoes

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ABSTRACT

Introduction. As addition to traditional raw plant materials for pectin production - apple and citric mush, there is a possibility to use potato pulp, that is a by-product of starch production and contains approximately 2-5,5 % of pectin in dry weight (DW).

Materials and methods. Material research - potato pulp. Through the statistical processing of the experimental data of previous optimum parameters of hydrolysis-extraction of potato pectin. The structure of the resulting potato pectin studied by means of infrared spectroscopy.

Results. The precise planning of the experiment and statistical analysis of experimental data helped to determine optimal conditions for the process of potato pectin hydrolysis-extraction.The peculiarities of the output pectin structure were investigated by means of infrared spectroscopy. It was discovered that potato pectin contains a considerate quantity of ballast substances and has a low jelly-forming capacity. Micro photographing showed that outlet samples of pectin contained a considerate amount of starch that is extracted along with pectin substances and precipitates in the reaction with ethanol. In case of enzyme usage in hydrolysis pectin becomes freer from impurity.

Conclusions. The potato was investigated as a potential raw material for pectin extraction. Infrared spectra of potato pectin confirm that it contains functional (carboxyl, hydroxyl and ester-bounded) groups in the molecule of thispolysaccharide. The samples of pectin (got after processing the raw material with enzymatic agent) have a higher number of carboxyl and carbonyl groups, manifesting a partial hydrolysis of starch polysaccharides.

Introduction

A natural polysaccharide called pectin is a unique biopolymer, being the main constructing material of the plant cell wall. It is acknowledged that natural diet supplements containing pectin make a complex influence on the human body: prevent radioactive metals from absorption in the digestion tract and provoke their disposition; they have antioxidant characteristics, help the human body to dispose of xenobiotics (particularly pesticides), normalize the cholesterol level, increase resistance to allergies, improve metabolism [3,4]. The curing properties of pectin substances can be explained by their content and structure. Pectin is widely used today in food industry and medicine.

Nevertheless, the pectin production is not organized in Ukraine and the need in the substance is satisfied by import, making the price high. The problem of the pectin lack in Ukraine can be solved by means of introducing its production from cheap home raw materials.

Main part of plant raw materials processed by food industry becomes waste: beet pulp, apple and citric mush. However, these secondary raw materials can be used for the production of pectin substances. Citric mush is the main source of pectin abroad. In Ukraine there is a lot of raw potato pulp left from the production of starch. This by-product can be recycled to get pectin or dietary fibers and because of this the investigation of the ways of potato pectin extraction is of high importance.

The references analysis shows that technological regulations of the potato pulp hydrolysis process can lead to producing three end products: starch with pectin, pectin and potato fiber.

The objective of the work was the investigation of the technological conditions of the potato pectin extraction, calculating mathematical formula that help to optimize the process of the raw material hydrolysis, the investigation of the potato pectin structure.

Materials and methods

Modern industrial technology of pectin is based on the acid-thermal hydrolysis of the raw materials. The mineral and organic acids, alkali and enzymatic agent are used as hydrolyzing reagent. The catalytic effect of the Hydrogen ions on the molecules of pectin substances depends on the temperature and pH of the environment [1].

The existing technologies of pectin imply the combination of the processes of hydrolysis and extraction in one technological operation. Most technologies employ ethanol for pectin extraction [1].

In our project we used potato pulp, rinsed by water in order to wash the starch out. In the series of investigation we used potato pulp processed by bacterial α-amylase (for bound starch hydrolysis) and bacterial protease (for reducing the level of proteins that are the components of ballast compounds). The potato pulp water content was measured by applying the weight method [1]. The dry weight (DW) concentration in the pectin extract was measured by the refractometric method and pH was calculated by potentiometric measurements.

Infrared spectra (IR-spectra) were implied in the investigation process of pectin that was extracted from the potato pulp. The IR-spectra were measured in the band of 700—3600 cm^{-1} by FT-IR Nikolet spectrophotometer of Nexusproduction.

There were determined the technological parameters for the process of raw potato materials, i. e. pH, temperature and hydromodulus of the process. The hydrolysis was conducted with periodic stirring in the thermal bath, equipped by the glass thermometer.

The potato pulp was mixed with heated acid solution at a proper for hydrolysis temperature. The acid concentration as hydrolytic factor was calculated depending on the indicated hydrolysis mixture pH and the hydromodulus level [1]. The hydrolysis hydromodulus (q) is calculated from the correlation between the weight of the acid solution and the weight of potato raw material. In our experiment we made it equal to 2. 100 grams of the raw material with known water content were hydrolyzed with the acid of determined concentration. The duration of the hydrolysis process was calculated from the moment when the hydrolyzed mixture reached required temperature. After the hydrolysis the liquid phase was separated, the extract was neutralized to the 4-5 level of pH by the ammonium hydroxide solution, cooled to the temperature of 20°C and there was conducted a coagulation of pectin substances in the extract by the ethanol. Then we observed the stable hydrocolloid precipitation that floated on the surface of the liquid. The received pectin was dried by the air and grinded after additional ethanol rinse. The amount of end product (%) was calculated in relation to the dry weight.

Results and discussion

The experiment was based on the rotatable design of the second order for a three-factor experiment. The changeable factors of the experiment were the temperature, the duration of the hydrolysis and the concentration of the hydrolyzing reagent (% HCl).

Factors for levels	$-\alpha$	-1	0	+1	$+\alpha$
Acidity, *% HCl*	0,3	0,7	1,3	1,9	2,3
Temperature, *°C*	40	48	60	72	80
Duration, *min*	33	50	75	100	117

Resulting from the statistical calculations of the experimental data there have been determined optimal conditions for the process of pectin hydrolysis-extraction from the potato pulp: 1,45% concentration acid to the hydrolysis weight, 70,5 minutes of hydrolysis at the temperature of 72 °C. As a result of the experiment planning there was made a mathematical model of the raw potato materials hydrolysis. The resulting equation has a practical meaning and enables to predict the result and quality of the pectin using the information about temperature, acidity and duration of the process.

The photograph of the potato pulp (Fig. 1) was taken by means of electron microscope. The picture shows a considerable quantity of starch granules which under these particular conditions of hydrolysis are partially hydrolyzed (becoming dextrins) and are precipitated by ethanol.

Most small starch granules come into the extract and are precipitated by ethanol along with pectin substances. This statement is manifested by micro photographs of ready potato pectin powder, made by means of investigative microscope MBD-15 (fig. 2)

Infrared (IR) spectra can provide us will the detailed information about the structure of pectin substances. [2]. IR- spectra contain important information about the content and structure of substances, give an opportunity to determine the purity of the substance, relative and absolute quantity of free and bound carboxyl groups, presence of the ash component [2, 5]. IR spectra on investigation were taken of pectin substances extracted from the potato pulp in different conditions: with the preceding employment of amylolytic or proteolytic enzymatic agents and further by means of hydrolysis with employment of the chloride acid but without any enzymes. Spectrum of the pectin substances has a complicated structure (Fig. 3).
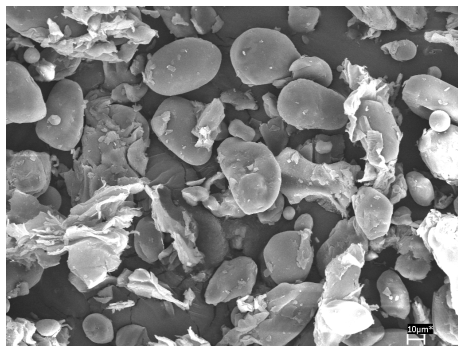
Fig. 1. Potato pulp
(scanning electron microscopy)
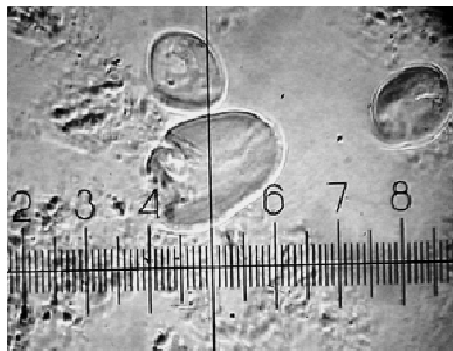
Fig. 2. Microphotograph of potato pectin
(magnified 660 times)

Valence vibration of the hydroxyl group ν(OH) belongs to the characteristic 3400…3200 cm^{-1} band. This band manifests the presence of intermolecular hydrogen bond in the polymer structures. The stripes in the band of 2900…2700 cm^{-1} correspond to the valence vibrations of the group ν(CH). Deformation area of the water molecule δ(H$_2$O)vibration is situated in the band of 1639 cm^{-1}. Inner deformational asymmetric vibration of δ_{as}(CH$_3$) take place in the band of 1460 cm^{-1}, symmetric – 1377 cm^{-1} [5].
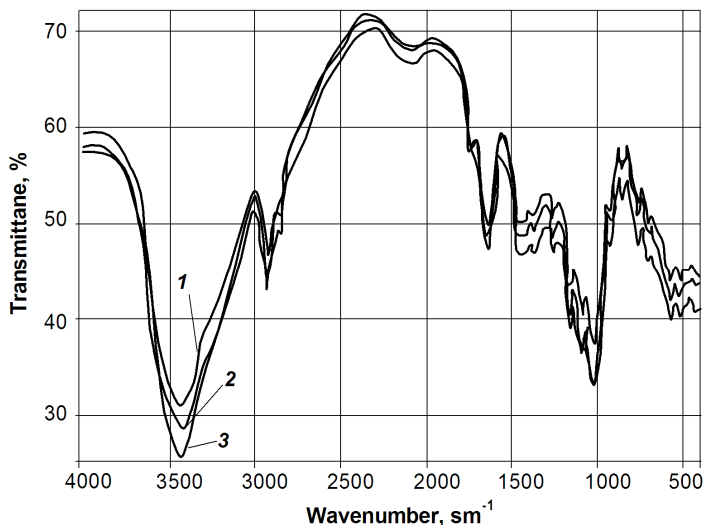
Fig. 3. IR-spectra of pectin samples from raw potato materials: 1 – without
employing enzymatic agent; 2 – employing protease ; 3 – employing α-amylase

The band of 2000-1500 cm^{-1} belong to the vibrations of the group-C= O. Absorption is possible in this case, it is related to valence vibrations n (C = O) of carboxyl and carbonyl groups: (1748-1739 cm^{-1}), (1700-1680 cm^{-1}) [2].

Interrelation between the absorption intensity rates (corresponding these groups) can change depending on the bond type that prevails (ester, acid or ionic) [2].

The stripes of absorption are seen more clearly in the samples with enzymatic agents in the band of 1740 cm^{-1}, manifesting the presence of free carboxyl groups.

Conclusions

The potato pulp was investigated as a potential raw material for pectin extraction. The extracted potato pectin contains a considerate quantity of starch granules which are extracted and precipitated along with pectin substances.

There have been determined optimal conditions for the process of pectin extraction from the potato pulp: 1,45 % concentration acid to the hydrolysis weight, 70 minutes of hydrolysis at the temperature of 72 °C. Calculated parameters coincide with the data of former experimental investigations.

Infrared spectra of potato pectin confirm that it contains functional (carboxyl, hydroxyl and ester-bounded) groups in the molecule of this polysaccharide. The samples of pectin (got after processing the raw material with enzymatic agent) have a higher number of carboxyl and carbonyl groups, manifesting a partial hydrolysis of starch and protein and possibility of extracting pure pectin.

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Vegetable oils utilization in the recipes of meat pates

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ABSTRACT

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Introduction. Modern nutritional science examines functional foods as products created by nutritionists in order to give them certain properties aimed at maintaining of vital functions. The new functional meat products, containing active ingredients as well as their physicochemical and sensory properties is an objective of active research.

Materials and methods. Sensory quality was observed on a group of 10 people. Physical and chemical properties were determined by standard methods, fatty acid composition of fats by gas chromatography according to EN ISO 5509-2002.

Results and discussion. It has been found, that the addition of vegetable oils in an amount of 7-10% has positive effect on sensory and functional and technological characteristics of the finished meat patties. Consistency becomes unguent structure, becomes more tender. The comparative analysis of the fatty acid composition of vegetable oils, allowed to justify their use of technology of pates. Enhanced meat pates and defines a rational replacement of animal fats with vegetable oils in the formulations, which is 7-10%, in order to balance the products developed by the fatty acid composition.

Introduction

The most pressing problems in feeding of the population of Ukraine is the lack of fiber, micronutrients (vitamins, minerals, fatty acids, etc.), unbalanced diet for the nutrients and energy. Abnormality in the structure of nutrition suggests the need for food, including functional meat products.

Modern nutritional science examines functional foods as products created by nutritionists in order to give them certain properties aimed at maintaining of vital functions. The basic principle of creating functional products can be considered as promoting human health by exposure to certain physiological reactions.

Research aimed at improving technologies that intensify and modify the process of food production with high quality features are of scientific and practical interest.

Key issues are to create foods with high nutritional and biological value. Pates production is not an exception. Manufacturing process involves the usage of various pates

in its properties raw materials of animal and vegetable origin, which determines the diversity of methods, used processing. Combining cooking, blanching, sauté, roasting, homogenization and other thermal and mechanical effects, are gentle product pasty consistency that differs by pleasant taste, odor and color.

One of the promising areas of research is to improve the technology and develop recipes of pates with addition of vegetable fats increased biological value, in order to improve the balance of amino acid and fatty acid composition, qualitative characteristics of the finished product and increase digestibility and expand the range of pates [1-3].

One of the advantages of using vegetable oils in the production of pates has a large content of polyunsaturated ω-3, ω-6 fatty acids, which perform a number of essential functions in the body [3-5].

Over the past 10 years, scientists proved useful properties of vegetable oils. At the same time, argue that the proceeds of these components are insufficient, because the diet of an adult receiving polyunsaturated ω-3 and ω-6 fatty acids is only 50-60% of the vital. In addition, the body is unable to produce them. That is why it is necessary for them to be obtained from food [5].

Materials and methods

The object of our study was technology of pates of increased biological value. Subject of research: flax, pumpkin, sunflower oil and walnut oil. Organoleptic tasting study was conducted by a group of 10 people. Physical and chemical properties were determined by standard methods, fatty acid composition of fats by gas chromatography according to EN ISO 5509-2002 «Fats and vegetable oils of animal and plant origin. Preparation of methyl ester fatty acid (ISO 5509:2000, IDT)» at gas chromatograph Hewlett-Packard NR6890.

Results and discussion

The aim of our work is the theoretical basis and experimental proof of the possibility of using oils of high biological value in the production of pates, improving production technology and shaping the quality of finished products.

The developed formulations of pates include chicken and turkey meat, beef liver (previously blanched), eggs, carrots, onions, bread (pre-soaked in broth) or semolina and oils of high biological value.

The main raw material we chose was poultry, including chickens and turkeys, not only due to the fact that it is invalid and relatively cheap raw materials, but also because this market segment is the largest in Ukraine and is constantly expanding. But as a source of exogenous bioantioxidants we used flax, pumpkin, sunflower oil and walnut oil. As for control pates made from classic recipes, that with the addition of animal fats were taken.

Pre-represent analyze the fatty acid composition of selected oils, determination of saturated, mono-and polyunsaturated fatty acids, particularly families ω-3 and ω-6. The results are given in Table 1.

Analyzed the fatty acid composition of the oils studied we found that the most optimal for ω -3 fatty acids is flaxseed oil, and for ω -6 fatty acids are preferred sunflower, pumpkin and peanut butter (table 1). Comparative analysis of the content of components in various vegetable oils, suggests that sunflower, flax, pumpkin and peanut oils have the most favorable for the replacement of animal fats properties. Rationale oil components used in recipes, due to their properties and functions in the human body that served as the basis for creating a product with the desired properties.

Fatty acids composition of some kinds of oils

Fatty acid	Type of oil			
	Sunflower	Flax	Pumpkin	Walnut
Myristinic	0,08	0,03	0,09	0,02
Palmitic	6,73	4,70	12,7	6,06
Stearic	3,55	5,2	6,47	2,02
Linoleic	62,58	14,31	58,40	61,36
Linolenoic	0,1	-	0,14	13,6
Palmitoleic	0,13	0,05	0,11	0,1
Arachidonic	0,23	0,18	0,43	0,08
Geneykozanic	0,17	-	0,08	0,18
SFA	11,34	10,24	19,80	8,20
MUFA	25,98	17,90	21,66	16,84
Omega 6 PUFA	62,58	14,57	58,40	61,36
Omega 3 PUFA	0,10	57,26	0,14	13,60

From the above analysis, it was suggested pate recipe using vegetable oils of high biological value. Favorite's ratio of components gives a product with high organoleptic, functional and technological indicators and a balanced chemical, fatty acid and amino acid composition.

The suggested method of developing recipes based on meat content of reducing fat phase by increasing the proportion of sources of polyunsaturated fatty acids decrease cholesterol raw materials, increasing the biological value, to prevent oxidation and microbial spoilage of the product, increasing shelf life by maintaining of natural antioxidants. Introduction to recipe vegetable oils in an amount of 3-10% due to high biological value, which is provided in vegetable oils containing vitamins A, D and high in PUFA. Options prescription compositions pates presented in the following Table 2.

Recipe formulations of some kinds of meat pates

Ingredient	Amount, %			
	№1	№2	№3	№4
Meat of chicken	20	22	20	20
Meat of turkey	19	20	20	19
Beef liver	20	20	20	20
Egg	3	3	3	3
Onion	5	5	5	5
Oil	3	5	7	10
Carrot	5	5	5	5
Semolina	10	10	10	10
Water	15	10	10	8
TOTAL	100	100	100	100
Salt	1,5	1,5	1,5	1,5
Pepper	0,1	0,1	0,1	0,1
Spices Italian herbs	0,1	0,1	0,1	0,1

The complex parameters by which we determine the quality of food, along with the physical-chemical and microbiological, one of the important places are indicators of quality, determined by organoleptic evaluation (appearance, form and color of the cut, aroma, taste, texture).

The results of organoleptic evaluation are often decisive in determining the final quality of the product, especially new products. Tasting score pates, which is shown in Table 3, showed the feasibility of using in recipes pate vegetable oils of high biological value. The test samples of vegetable oils differ by more delicate texture, had more intense color, while in samples from animal fats showed uneven concentration, "fat concentration", more dense texture that affected the overall organoleptic evaluation in points.

Table 3

Sensory scores of functional patties with different types of oil

Indicators	Samples of researched pates				
	Control	Sample №1 (with flaxseed oil)	Sample №2 (with pumpkin oil)	Sample №3 (with sunflower oil)	Sample №4 (with walnut oil)
Appearance	4,6±0,01	4,8±0,01	4,7±0,01	4,7±0,01	4,9±0,01
Color	4,7±0,013	4,7±0,01	4,7±0,01	4,7±0,01	4,8±0,01
Odor	4,7±0,012	4,9±0,01	4,9±0,01	4,9±0,01	4,9±0,01
Taste	4,5±0,013	4,9±0,01	4,8±0,01	4,8±0,01	4,8±0,01
Tenderness	4,4±0,01	4,9±0,012	4,9±0,01	4,9±0,01	4,9±0,013
Consistence	4,5±0,013	4,7±0,01	4,8±0,01	4,8±0,01	4,9±0,012
Overall	4,65±0,012	4,86±0,01	4,81±0,01	4,81±0,01	4,81±0,01

Analysis of finished products manufactured by the developed formulas can recommend the optimum amount of vegetable oil that can be entered into pates without compromising their quality is 7…10%. Making more is a slight deterioration of organoleptic characteristics.

As a result of studies found a positive effect of selected oils to water content, water holding capacity (WHC), the yield of the finished product and its rheological and sensory characteristics (table 4). Based on the behavior of vegetable oil in the experimental samples is recommended to use them in new kinds of pates functionality. This is a moderate-temperature processing of data products, which ensures the formation of delicate structure of the product.

Table 4

The attributes of functional patties, formulated with different oils

Characteristics	Control	Samples			
		1	2	3	4
pH	5,99±0,03	6,07±0,01	6,08±0,02	6,13±0,01	6,14±0,03
Water content, %	62,5±0,6	62,3±0,3	63,2±0,3	64,5±0,5	64,7±0,5
WHC, %	67,7±0,5	70,6±0,6	71,3±0,5	71,7±0,6	71,9±0,8
Degree of penetration, mm	5,4±0,2	6,6±0,3	6,6±0,2	6,6±0,2	6,7±0,2
Yield (w/w)	104,8±2,1	108,5±2,8	110,7±2,1	112,4±2,2	113,5±2,3

Thus, from the above mentioned results, we can conclude that the addition of vegetable oils in an amount of 7-10% has positive effect on sensory and functional and technological characteristics of the finished product. Consistency becomes unguent structure, becomes more tender.

As a result of our work has improved the quality of pates using in their composition of vegetable oils of high biological value. We showed the theoretical possibility of generalization and meat products using exogenous bioantioxidants oilseeds, focused on the implementation of the concept of healthy eating.

Conclusions

The comparative analysis of the fatty acid composition of vegetable oils, allowed to justify their use of technology of pates. Enhanced meat pates and defines a rational replacement of animal fats with vegetable oils in the formulations, which is 7-10%, in order to balance the products developed by the fatty acid composition.

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Chemical reagents for intensification of diffusion juice purification

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ABSTRACT

Introduction. Further improvement of the technological scheme is possible by increasing the effect of treatment directly in the extraction process, the intensification of chemical and adsorption processes, at different stages of treatment using high-molecular coagulants, flocculants and cheap natural sorbents.

Materials and methods. The traditional physical and chemical methods of researches are used in accordance with operative standarts. Rassing and decision of tasks optimization were conducted with the help of packet applied programmes MathCAD and Microsoft Excel.

Results and discussion. Investigations showed considerable advancement in the efficiency of raw juice purification by means of using $NH_4H_2PO_4$ on the primery and on the final stage of purification. That allows to intensify chemical and adsorption processes as a result of formation hydroxyapatite with a high specific surface area. Addition of 0,2% $NH_4H_2PO_4$ on filtered preliming juice permits to increase degree of precipitation and flocculation of high-molecular compounds on 84,0%, calcium salts and precipitation of anions which form insoluble lime salts – on 93,0%, colour – on 27,0%. Thin juice had purity on 2,0 units higher. Addition of 0,10…0,15% $NH_4H_2PO_4$ on filtered juice of 1st carbonatation at zone pH 11,5…9,0 degree of presipitation anions acids and calcium salts increased on 85,0%, colour – on 55,0%, high-molecular substances as protein – on 70,0%. Thin juice had purity on 2,0 units higher. The mechanism of formation of hydroxyapatite in the lime juice purification are suggested.

Conclusion. The use of ammonium dihydrogen phosphate in the first or final purification step of the raw juice helps to intensify the chemical and adsorption processes in consequence the formation of hydroxyapatite with a high specific surface area, to improve cleanliness and to reduce the viscosity of the purified juice and syrup, to increase the yield and quality white sugar. The local criterions of optimization were selected and task of optimization the ammonium dihydrogen phosphate consumption to purification were solved.

Introduction

Increasing requirements to quality of sugar, the increased energy prices, lime stone and auxiliary materials set tasks of continuous improvement of the technological scheme of production for workers of beet sugar industry.

Further improvement of the technological scheme is possible by increasing the effect of treatment directly in the extraction process, the intensification of chemical and adsorption processes, at different stages of treatment using high-molecular coagulants, flocculants and cheap natural sorbents.

The juice purification using the lime/carbonic acid treatment may be subdivided into a number of chemical reactions which ultimately affect of main target, i.e. improving the white sugar recovery and sugar quality.

The main reactions are:

- precipitation of high molecular compounds such as proteins, pectins and anions wich form insoluble or partly insoluble lime salts by addition about 0,25…0,30% lime on juice during preliming;

- alkaline degradation of invert sugar and amides to organic acids;

- elimination of nonsugars by adsorption when main part of the added calcium hydroxide is precipitation as calcium carbonate by addition of CO_2.

Using the lime and carbonic acid treatment one is able to remove up to 40 %, but under technical conditions mostly only 30 to 34 %, of nonsugars present in raw juice.

To improve the quality of purified juice were proposed use of cheap natural sorbents: bentonit, filtroperlit [1, 2].

The main criterions to make a good choise of sorbent – this is a high developed surface, presence a great amount of OH groups and high free energy of surface.

The phosphates of calcium can have three, four, five or six atoms of oxygen, connected with central atom of phosphorus, they possess high free energy of surface and well adsorb organic matters.
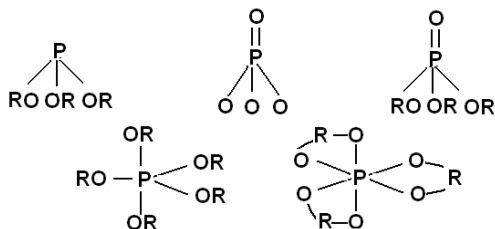
The phosphates of calcium received a wide application as at the instrument-making (lyminophores, pezoelectrics, sorbents for a chromatography) and also as of food additions, sorbents of heavy metals and radionuclides.

The special place among the large class of compounds of phosphorus occupies hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$, which with some assumptions it is possible to consider the crystallochemical analogue of mineral constituent of fabrics of skeleton of animals and people and which successfully serves as the base component of synthetics materials for orthopaedy of stomatology.

Materials and methods

The traditional physical and chemical methods of researches are used in accordance with operative standarts.

Rassing and decision of tasks optimization were conducted with the help of modern methods of the mathematical processing of data with the use of computer technologies statistical treatment of results of experimental researches, the construction of charts was executed by means of packet applied programmes MathCAD Professional 2000 and Microsoft Office Excel 2003.

Results and discussion

Methods of purifying diffusion juice are suggested, which allow to intensify chemical and adsorption processes at the first and final stages of purification by introducing in the filtered preliming juice or filtered juice 1st carbonatation chemical reagent - ammonium dihydrogen phosphate [3, 4].

After studying various methods for possible mechanisms formation of calcium phosphorus and phosphorus compounds [5, 6] we suggested the mechanism of formation of hydroxyapatite in the lime juice purification [7] using ammonium dihydrogen phosphate:

1. First, monocalcium phosphate of the least stable is formed ($Ca(H_2PO_4)_2$) :

$$Ca(OH)_2 + 2 NH_4H_2PO_4 = Ca(H_2PO_4)_2 + 2 NH_4OH$$
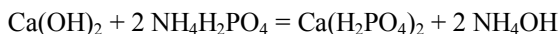
2. Monocalcium phosphate is dissolved in a large excess of water and hydrolyzed to phosphate dicalcium $CaHPO_4$:

$$Ca(H_2PO_4)_2 \xrightarrow{nH_2O} CaHPO_4 + H_3PO_4$$
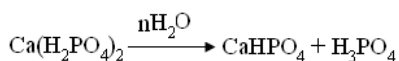
3. Dicalcium phosphate forms oktacalcium phosphate - $Ca_8(HPO_4)_2 \cdot (PO_4)_4 \cdot 5H_2O$ during hydrolysis in a narrow zone of neutral values pH:

$$8Ca(HPO_4)(s.p.) + 2Ca(OH)_2 + H_2O \rightarrow Ca_8(HPO_4)_2 \cdot (PO_4)_4 \cdot 5H_2O + 2 CaHPO_4$$
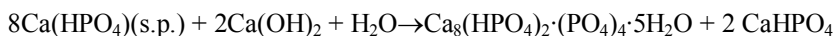
4. Metastable oktacalcium phosphate, alike as an amorphous calcium phosphate is a precursor (formed as an intermediate product) in obtaining more stable phases, such as hydroxyapatite $Ca_{10}(PO_4)_6 \cdot (OH)_2$:
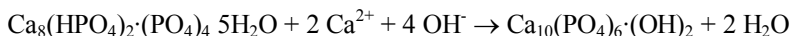
$$Ca_8(HPO_4)_2 \cdot (PO_4)_4 \, 5H_2O + 2 Ca^{2+} + 4 OH^- \rightarrow Ca_{10}(PO_4)_6 \cdot (OH)_2 + 2 H_2O$$

It is ascertained that addition $NH_4H_2PO_4$ in alkaline medium at zone pH 11,5…9,5 at the high ionic correlation Ca/P as 1,67 generated hydroxylapatite with the big specific surface ($100 m^2/g$).

Addition of 0,2% $NH_4H_2PO_4$ on filtered preliming juice permits to increase degree of precipitation and flocculation of high-molecular compounds on 84,0%, calcium salts and precipitation of anions which form insoluble lime salts – on 93,0%, colour – on 27,0%. Thin juice had purity on 2,0 units higher. Dependence of the quality indicators of filtered preliming juice from consumption of reagent are presented on *Fig. 1*.
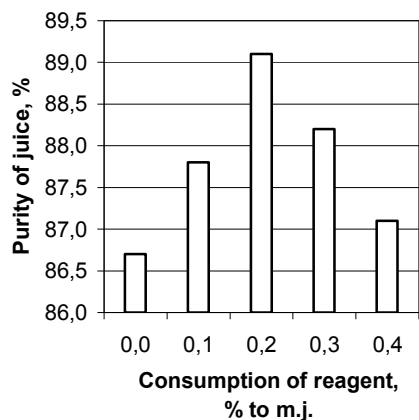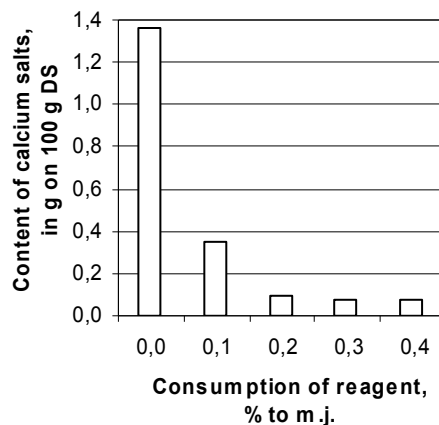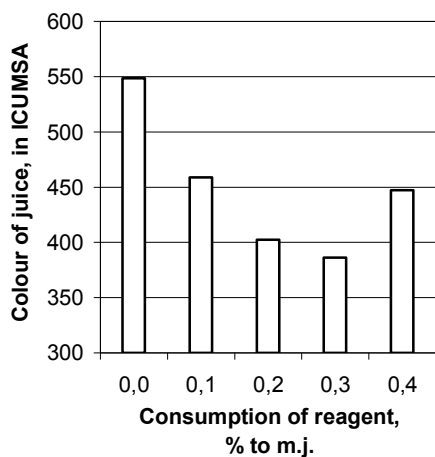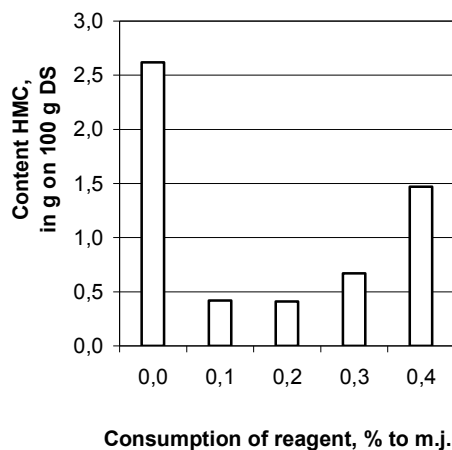
Fig 1. Dependence of the quality indicators of filtered preliming juice from consumption of
ammonium dihydrogen phosphate:
a - purity of juice; b - content of calcium salts; c - colour of juice; d - content of HMC

The optimum consumption of ammonium dihydrogen phosphate for purification filtered preliming juice varies depending on its purity. This dependence is presented on *fig. 2*.

Addition of 0,10…0,15% $NH_4H_2PO_4$ on filtered juice of 1st carbonatation at zone pH 11,5…9,0 degree of presipitation anions acids and calcium salts increased on 85,0%, colour – on 55,0%, high-molecular substances as protein – on 70,0% (on *Fig. 3*). Thin juice had purity on 2,0 units higher.
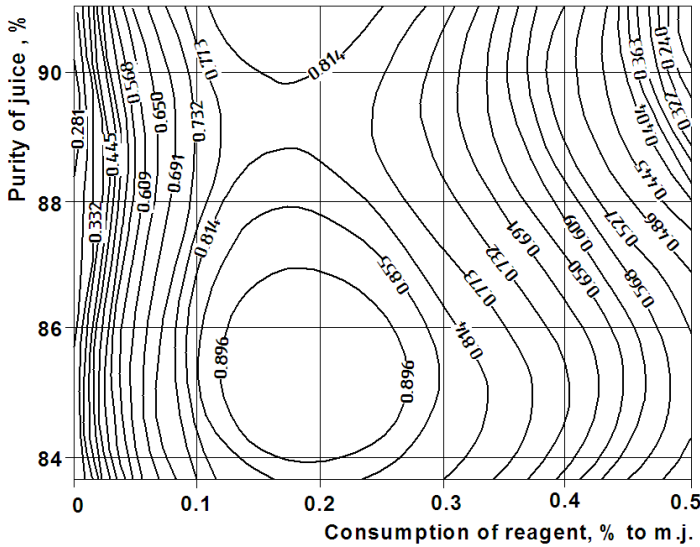
Fig. 2. Level lines of the generalized criterion of optimization in coordinates purity of filtered preliming juice - consumption of ammonium dihydrogen phosphate.

Using the massif of experimental obtained data aproksymated them in packet applied programmes, obtained the following equations of local optimality criterias (increase purity of juice, content of calcium salts, colour of juice from parameters of optimization):

• increase purity of juice 1st carbonatation from parameters of optimization:

$$\Delta P_{\text{juice 1}^{\text{st}}\text{ carbonatation}} = 1{,}96 \cdot 10^5 + 79{,}79 \cdot G - 6{,}51 \cdot 10^3 \cdot P + 8{,}85 \cdot 10^{-3} \cdot G \cdot P - 7{,}49 \cdot G^2 + 72{,}17 \cdot P^2$$
$$+ 0{,}228 \cdot G^3 - 0{,}27 \cdot P^3, \tag{1}$$

where G – pH_{20} of juice of 1st carbonatation after introduction of ammonium dihydrogen phosphate;
P – purity of juice 1st carbonatation, %.

• content of calcium salts of juice 1st carbonatation from parameters of optimization:

$$\text{Salts Ca}^{2+}_{\text{juice 1}^{\text{st}}\text{ carbonatation}} = - 6{,}31\ 10^4 - 1{,}20 \cdot G + 2{,}10 \cdot 10^3 \cdot P - 0{,}03 \cdot G \cdot P + 0{,}31 \cdot G^2 -$$
$$23{,}2 \cdot P^2 - 8{,}38 \cdot 10^{-3} \cdot G^3 + 0{,}09 \cdot P^3, \tag{2}$$

• colour of juice 1st carbonatation from parameters of optimization:

$$C_{\text{juice 1}^{\text{st}}\text{ carbonatation}} = - 5{,}31 \cdot 10^7 + 7{,}11 \cdot 10^3 \cdot G + 1{,}76 \cdot 10^6 \cdot P + 4{,}90 \cdot G \cdot P - 794{,}13 \cdot G^2 -$$
$$1{,}95 \cdot 10^4 \cdot P^2 + 27{,}68 \cdot G^3 + 72{,}06 \cdot P^3, \tag{3}$$
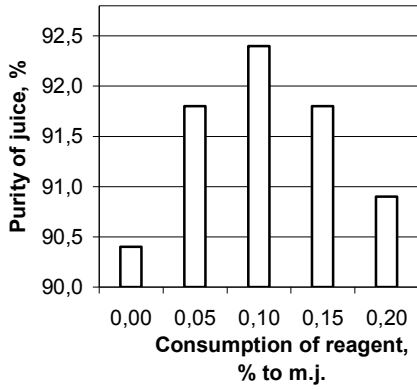
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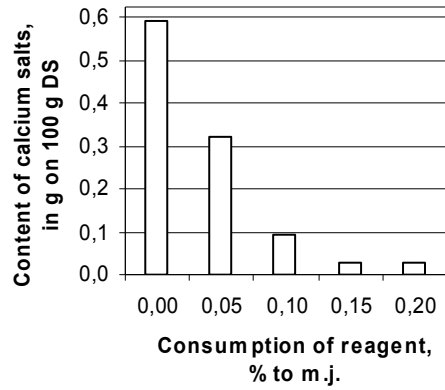
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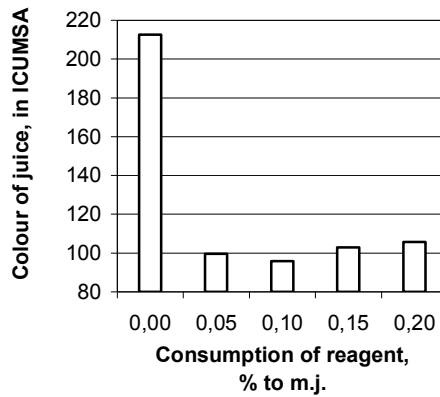
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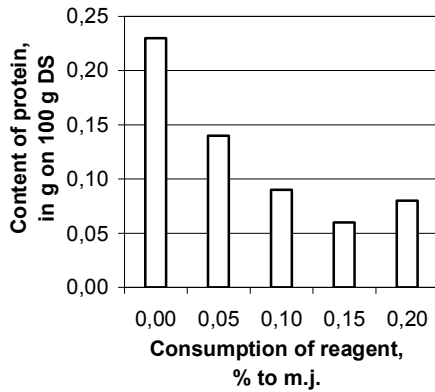
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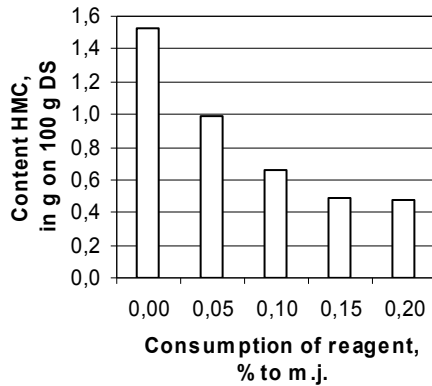
e

Fig 3. Dependence of the quality indicators of filtered juice of 1st carbonatation from consumption of ammonium dihydrogen phosphate:
a - purity of juice; b - content of calcium salts; c - colour of juice;
d - content of protein; e - content of HMC

To find the general criterions of optimization local criterions of optimalnost transferred into stretch form by means of method Harrington.

The optimal significance of parameters optimization – pH juice after introduction of $NH_4H_2PO_4$ and purity juice of 1st carbonatation find with the help of maximum significance of special function by using method nets.

The optimum pH of filtered juice of 1st carbonatation after introduction of ammonium dihydrogen phosphate varies depending on its purity. This dependence is presented on *Fig. 4*.
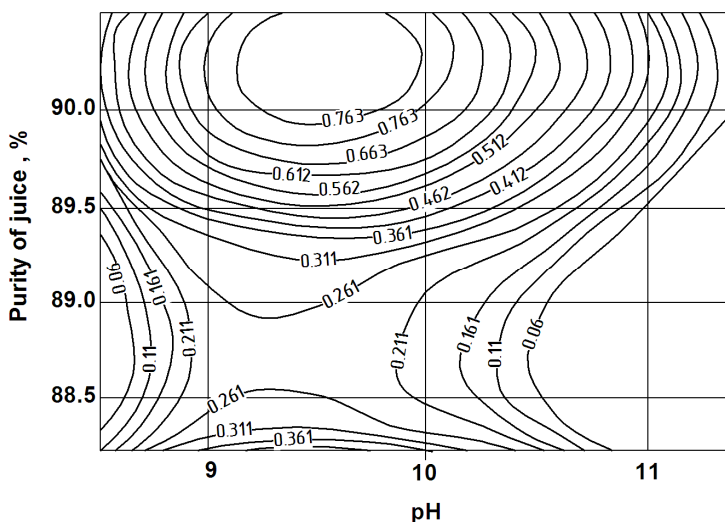
Fig. 4. Level lines of the generalized criterion of optimization in coordinates purity of filtered juice of 1st carbonatation - pH of juice of 1st carbonatation after introduction of ammonium dihydrogen phosphate

Obviously, that optimal significance of pH_{20} juice it is 9,2…9,5 (starting purities of juices were 88,4; 89,5; 90,6; 91,3; 91,5; 91,6%).

Thus, the use of ammonium dihydrogen phosphate in the first or final purification step of the raw juice helps to intensify the chemical and adsorption processes in consequence the formation of hydroxyapatite with a high specific surface area, to improve cleanliness and to reduce the viscosity of the purified juice and syrup, to increase the yield and quality white sugar.

Conclusions

1. Investigations showed considerable advancement in the efficiency of raw juice purification by means of using $NH_4H_2PO_4$ on the primary and on the final stage of purification.

2. It is ascertained that addition $NH_4H_2PO_4$ in alkaline medium at zone pH 11,5…9,5 at the high ionic correlation Ca/P as 1,67 generated hydroxyapatite with the big surface area.

3. The mechanism of formation hydroxyapatite by means of using $NH_4H_2PO_4$ is suggested.

4. The local criterions of optimization were selected and task of optimization the ammonium dihydrogen phosphate consumption to purification were solved.

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Effect of hydrocolloids on the stability of fruit fillings

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ABSTRACT

Introduction. For extend the assortment and improve the nutritional value of co-extrusion products, as filler was developed fruit stuffings.

Material and methods. Assessments of the stuffings were carried using the "polygon" method, by the following indexes: color, clarity, taste, smell, texture and behavior in the hull. For research of stuffing's properties and behavior, namely its water-retaining capacity, it has been determined the content of DM in the series of stuffings based on mixture of pectin and modified starch, during the storage.

Results and methods. Based on the received date, we should select a group of stuffings in which the range of moisture is only 4.5 - 5.6%. Better results showed stuffing with pectin and modified starch Emjel (№4) and stuffings based on apple juice and pectin. In other samples of stuffing the values are found in the range from 6,5 to 11,5% of dry matters during the storage.

Common quality of indicators, calculated as the area of the pentagram, made it possible to determine the optimal samples of stuffings. According to the results of all research of the series of stuffings, better results showed stuffing with pectin and modified starch Emjel and stuffings based on apple juice, for using in the co-extrusion product.

Introduction

Products of food concentrate industry occupy a significant place in the food market. Fast food and ready-to-eat foods are very popular. Because, time for preparation of these products is minimized or missing. It should be noted about the segment of products made by extrusion. It's universal, productive and cost-effective method of producing the finished product. Extrusion process allows using of a wide range of materials, and introduction of various additives and fillers (BAS, pastry fillings, etc.). Nowadays, almost all co-extrusion products contain fatty confectionery stuffing. Therefore, it is proposed to add as filler the fruit stuffing for the purpose expansion of assortment and improvement of the nutritional value of co-extrusion products [2].

Fruit and berries filler should have a high water-retaining capacity to prevent interaction with the hull of co-extrusion product. Most often, co-extrusion product contains the fatty stuffings, since they have necessary technological properties. In particular, low moisture content, at 4-6%. Upon cooling, fatty stuffing goes to the solid state, which makes it impossible for the migration of moisture from the stuffing to the hull of the product, under their contact. In the case with fruit filling situation is different, and it is connected with the use of raw materials from which it is prepared.

Since the content of dry matter (DM) of apple puree is only 10%, and which is often the basis for the stuffing [2]. The difference between moisture content of prepared stuffing and hull of co-extrusion product is large, within 17–25%. The result is the migration of moisture, leading to softening, loss of crunch, forms, and other negative changes. For "binding" free moisture and retaining it in this form for a long time, it was proposed to use in the recipe of fruit stuffing, stabilizing and water-retaining agents – highly-esterified pectin and modified starch [1, 6].

Material and methods

The object of research is the fruit filling based on compositions of pectin and modified starches for production of co-extrusion products. There were used the following hydrocolloids during the development of recipes of fruit stuffing:
1. Highly esterified apple pectin [1];
2. Modified starch [6]:
- Flogel-60 – acid-modifed and gelling starch;
- National Frigex nV – hydroxypropyl distarch phosphate from tapioca starch;
- Emjel EP-300 – pre-gelatinized acetylated distarch phosphate from potato starch;
- ULTRA-TEX –hyroxypropyl distarch phosphate from tapioca starch;
- THERMFLO – hydroxypropyl-distarch phosphate from waxy maize starch.

Determination of dry matter content in the samples of stuffing was carried by refractometric method, during 4 days.

To identify and clarify the causes of migration of free water and to study the properties and interactions between stuffing and extrudate has been prepared the control sample - fruit stuffing according to the recipe shown in (Table 1).

This staffing is often used in confectionery and bakery industries [2].

Table 1

Recipe of control sample of fruit stuffing based on apple puree (per 1,000 kg of finished product, mass fraction of DM 65%)

Ingredient	Weight, kg	Wet, %	Dry matters	
			%	kg
Sugar	433,42	0,15	99,85	432,77
Treacle	216,73	22	78	169,05
Apple puree	422	90	10	42,2
Citric acid	15,35	50	50	7,7
Water	100	–	–	–
Total	1187,5			651,72

Research of fruit stuffings was carried out with organoleptic evaluation.

Experimental samples were prepared with substitution of apple puree for pectin (in powder form), and water for juice in the recipe. Boiling lasted to the content of DM 71±2 % [3]. In order to investigate the behavior of stuffing was used extrudaty with moisture content of 4–6%.

For research of stuffing's properties and behavior, namely its water-retaining capacity, it has been determined the content of DM in the series of stuffings based on mixture of pectin and modified starch, during the storage. Determinations were conducted in the stuffing of the open storage and inside the extrudates.

Under determining of the best model among the prepared stuffings, their comparative organoleptic characteristics have been carried out. Assessment of the advantages and disadvantages of different stuffings were carried using the "polygon" method, by the following indexes: color, clarity, taste, smell, texture and behavior in the hull. Indexes were evaluated by a ten score scale.

Results and discussion

Parameters of the control sample don't meet the requirements that would allow the possibility to use it in co-extrusion products. The consistence of stuffing is pasty, thick and doesn't form a strong gelatinous structure. This is due to insufficient amount of pectin or low quality of apple puree. In addition, the stuffing is opaque, turbid and brown. DM content in the stuffing is much lower than that of recommended.

During the boiling to a higher content of DM the temperature increases (103-105°C), that leads to decrease of quality coefficient: filling gets dark, flavor of gets burnt sugar appears, taste is worse. The boiling process is complicated by the presence of dietary fiber and other coarse particles of the apple puree.

Recipes of the experimental samples of stuffings are presented in Table 2.

Table 2

Recipes of the experimental samples of stuffing

Sample	Ingredient							
	Sugar, g	Treacle, g	Apple pectin, g	Modified starch, g	Citric acid, g	Water, ml	Apple juice, ml	Glycerin, ml
1	100	20	2	–	1,5	100	–	–
2	65	30	1	8 *(Flogel)*	1	80	–	–
3	65	30	1	5 *(N.Frigex)*	1	80	–	–
4	65	30	1	5 *(Emjel)*	1	80	–	–
5	65	30	1	5 *(UltraTex)*	1	80	–	–
6	65	30	1	5 *(ThermFlo)*	1	80	–	–
7	65	30	1	–	1	–	80	–
8	65	–	1	–	1	–	80	–
9	65	–	1	3 *(Flogel)*	1	–	80	–
10	65	–	1	6 *(Flogel)*	1	–	80	–
11	65	–	1	–	1	–	80	3
12	65	–	1	3 *(Flogel)*	1	–	80	5

Investigation of the filling samples №1, №2 (Table 2).

The moisture is exuded by both samples of filling. When the filing is kept in the container, the sample with starch looses more moisture than another one [4]. The filling sample with pectin keeps the level of water content constant. When kept in corpus, both samples loose moisture almost with the same speed, though the loss in the filling with starch is a little bit more intensive.

Investigation of the filling samples №3, №4 (Table 2).

The analyses of these two fillings showed the reduction of moisture in both samples. When the filing is kept in the container, the sample with National Frigex starch loses moisture more intensively [4, 6]. When kept in corpuses, both samples lose moisture almost with the same speed, though the loss in the filling with National Frigex starch is a little bit more intensive.

Investigation of the filling samples №5, №6 (Table 2).

The moisture is lost by both filling samples. When the filing is kept in the container, the sample with THERMFLO starch loses moisture more intensively. That can be explained by the process of starch retrogradation and the instability of the formed structure. The same is true when the filling is put in corpus. The water content in the filling sample with Ultra-tex starch is reduced less intensively both in the container and in the corpuses [5].

Investigation of the filling samples №7, №8 (Table 2).

When kept in the container, the filling doesn't lose moisture. The changes were recorded in filling samples kept in copuses after drying and under ordinary conditions. When kept in corpuses, both samples loose moisture almost with the same speed. When dried, the moisture from corpus is taken away and it becomes fragile and crumbly. After drying, the intensity of moisture loss is lower than in the samples without drying. In the course of time the corpus becomes a bit more moistured and the sample is not fragile and crumbly any longer.

Investigation of the filling samples №9, №10 (Table 2).

The next samples both contained the mixture of pectin and Flogel-60 starch, but in different proportions. When investigating the moisture loss, it was discovered that the amplification of the starch amount doesn't affect largely the speed of water loss. Both samples show stability when stored in containers and undergo some changes when kept in corpuses after drying.

Investigation of the filling samples №11, №12 (Table 2).

The filling also contains free moisture, so it was suggested using glycerin alcohol as an additional water-retaining agent. It was noticed that glycerin slowed down the speed of moisture loss. When the whole corpuses were dried, the moisture almost didn't exude so that the corpus with filling remained crusty and crumby for a long period of time. It can be claimed that extra convective drying and an additional water-retaining agent glycerin make the water content of filling the most stable.

The amount of moisture that extracted from the experimental samples of inside extrudates stuffing, for 4 days are shown in Figure 1. The value of moisture that was extracted depends on the mount of free water which is absorbed by hull while in storage. Thus, the smaller amount of free water in the stuffing is the smaller value in the diagram and better are the results.

Based on the received date, we should select a group of stuffings (№ 4, 7, 8, 11, 12) in which the range of extracted moisture is only 4.5 - 5.6%.
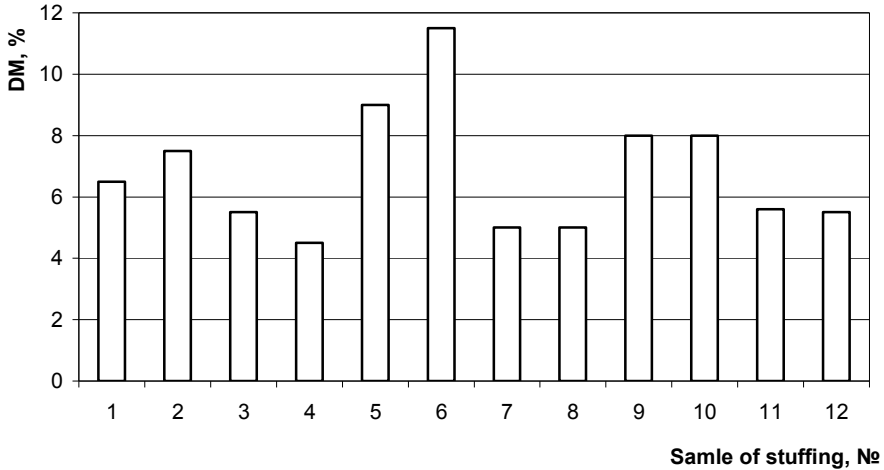
Fig. 1. The amount of moisture that extracted from the experimental samples of inside extrudate stuffings for 4 days.

Better results showed stuffing with pectin and modified starch Emjel (№4) and stuffings based on apple juice and pectin (№ 7, 8).

In other samples of stuffing the values are found in the range from 6,5 to 11,5% (№ 7, 8).

The total value of quality indicators is calculated as the area of the polygon (pentagram), the results are presented by the diagram (Fig. 2).
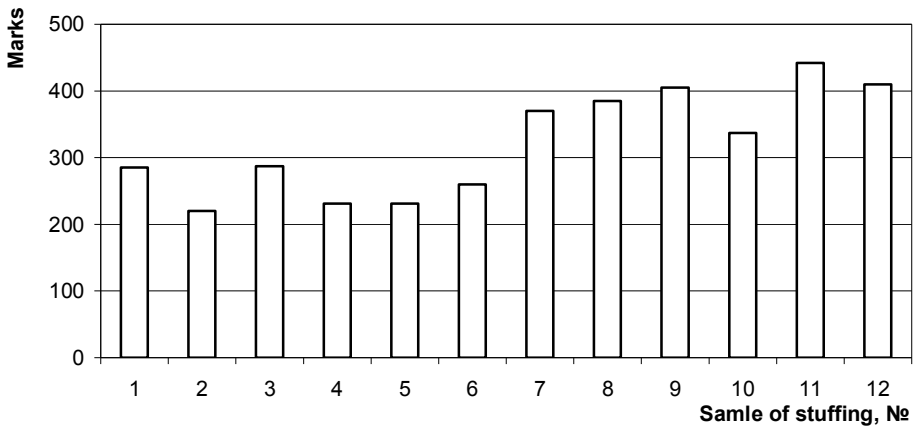
Fig. 2. Complex assessment of quality fruit stuffings quality based on the mixture of pectin and modified starch.

Conclusion

There have been identified and studied the causes of moisture migration (in co-extrusion products) from fruit stuffing into the hull. To create a stabilization system hydrocolloids and water-retaining agents - apple pectin and various types of modified starch have been selected.

The recipes of fruit stuffings containing stabilizing components in different proportions have been made. Experimental samples of fillings have been cooked according to the recipes and the impact of stabilization system on moisture-retaining ability has been analyzed.

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Methods of recovering schungite's adsorptive properties after processing red beet juice

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ABSTRACT

Introduction. Shungite investigated regeneration techniques for reuse in the production technology of red beet juice.

Material and methods. Using shungita (carbon adsorbent nature), chosen due to the peculiarities of its structure. Comparison of the adsorption properties of the regenerated different methods shungita conducted using the cleaning effect of the juice of red beet pectins.

Results and discssion. An important component is the presence shungite he fullerene carbon nanotubes, which is formed by the surface of active carbon rings. Shungit has free pore space represented by a three-dimensional maze of interconnected expansion and contraction of various sizes and shapes, including micro - meso - macropores. Exhaust shungit dried in muffle furnace at different temperatures and durations. The second method - the use of superheated steam to restore the adsorption properties shungite. The expediency of using the method of regeneration shungita superheated steam at a temperature t=170° within 30 min. Reach the maximum effect of red beet juice purification of pectins regenerated steam shungita 34%.

Introduction

In technology of producing red beet juice and its food dye it is feasible to use natural mineral shungite for adsorptive purification of juice from unwanted impurities [2-6].

Shungite is the only known mineral, which contains fullerenes (recently discovered new globular form of carbon existence). Feature of fullerenes structure is that atoms of carbon in molecules are located at peaks of regular hexagons and pentagons that cover the surface of the sphere and form closed polyhedrons created by even number of coordinated carbon atoms.

Difference between fullerenes and particles which have metallic properties lies in surface location of electron cloud and possibility of carbon structure to change the form. Electromagnetic waves dispersion is determined by fluctuations of electrons, which are divided by and modes. During adsorption on electrically neutral surface the modes of

fullerenes are localized, and a particle losses its metallic properties, resulting in creation of connected electron-positron pair in upper state. Thus, mineral shows bipolar properties.

Important feature of shungite is fullerene carbon nanotubes which have cylindrical pores with diameter of 1-6 nm, length – up to several microns. Cylindrical surface of tubes is created by rings of active carbon and also has empty pores.

The basis of shungite structure is globule which consists of graphite-like nets, formed in packages. A package has 6 graphite-like flat nets with quantity of carbon atoms attaining 300-600 and a curved net, consisting of 400 carbon atoms.

The sorbent has a structure where ordered zones of carbon rings – hexagons interchange with disordered zones. Contrary to graphite shungite has free porous space, which is represented as three-dimensional labyrinth of interconnected widenings and narrowings of different size and form. In this respect, there are micropores of up to 2 nm, mesopores and macropores.

Material and methods

Shungite regeneration was conducted in experimental laboratory installation, scheme of which is presented in fig.1.
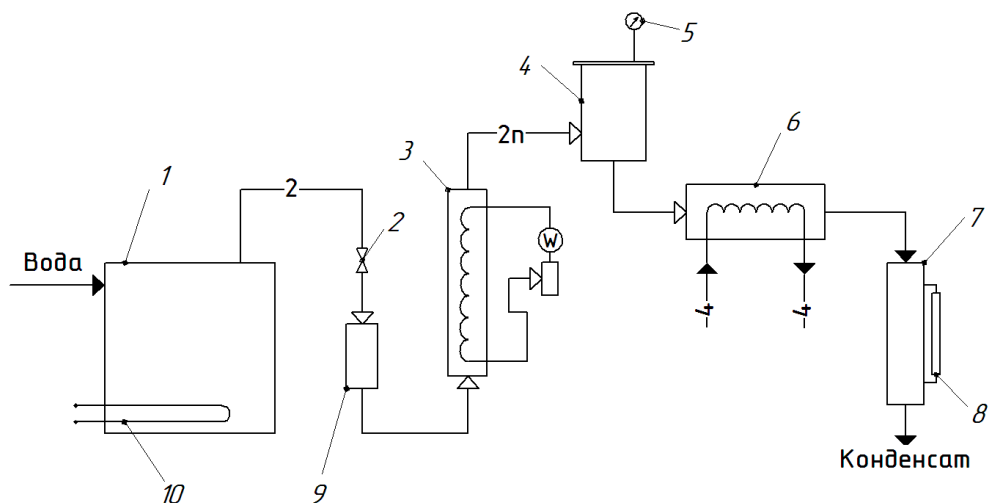
Fig. 1. Scheme of research installation for shungite regeneration
1 – steam boiler; 2 – valve; 3 – steam superheater; 4 – research unit; 5 – manometer; 6 – condenser; 7 – collecting tank; 8 – gage glass; 9 – separator; 10 – electrical tubular heater.

It operates in the following way: spent adsorbent is regenerated by superheated water steam, created in steam boiler 1 electrical tubular heater 10 and its passing through separator 9 and superheater 3. Test sample of adsorbent (10 g) was placed in research unit 4, pressure in which was measured by manometer 5. Spent steam proceeded to condenser 6, condensed steam accumulated in collecting tank 7. Level of condensed steam was measured with the help of gage glass 8.

Red beet juice purification effect was calculated pursuant to formula:

$$\mathring{A} = \frac{100 \cdot (\hat{E}_1 - \hat{E}_2)}{\hat{E}_1}$$

whereas K_1 and K_2 – quantity of target component in juice processed and juice not processed by shungite.

Results and discussions

During adsorption purification of red beet juice shungite surface and pores were filled with adsorbed impurities and as the result mineral's capacity to adsorb impurities gradually decreases. To recover adsorptive capacity of shungite it was necessary to find effective method for adsorbent regeneration. Economic feasibility, availability of water steam as well as appropriate equipment of canning plants were the leading criteria in search [7].

Attention was focused on the method of low temperature thermal regeneration of shungite which includes processing sorbent at 100-400°C. Such regeneration is mostly used to recover sorption capacities of carbon-bearing porous sorbents which have accumulated non-volatile and temperature-sensitive components of sorbate, which are dissolved and brought out by steam. In many cases such regeneration of adsorbent capacities is done directly in adsorption tanks, which saves production floor space and cuts down expenses of the plant. This method is save and available for all production conditions.

Efficiency of the chosen method was verified by comparing the results of purifying red beet juice from pectin substances before and after shungite regeneration [8].

To study the influence of temperature and duration on the process of desorbing pectin substances samples of spent sorbent were placed in muffle kiln and held at 140°, 200° and 300°C during 10-120 min. Cooled adsorbent was used to process red beet juice at previously selected optimal parameters for pectin substances adsorption and then purification effect was measured.

Average data is presented in fig. 2.

The highest markers of purifying red beet juice from pectin substances, shown in fig. 2, are within the range of 24-32% at 300°C, with duration of 30-120 min and 18-26% at 200°C, duration of 30-120 min. It is not feasible to regenerate shungite at 140°C, because maximum effect of purification achieved in this case does not exceed 10%. Regeneration duration of 10 min is not effective, so it is not applied thereafter.

Analysis of the obtained results shows that effect of purifying red beet juice from pectin substances by shungite regenerated at 300°C is the best one.

Taking into account that regeneration of shungite in muffle kilns is complicated and expensive process, which entails large wastes of energy resources, it was decided to recover adsorption capacities of shungite with the help of superheated steam.

The next round of experiments was dedicated to determining efficient technological parameters for regenerating shungite with the help of superheated water steam.

Superheated water steam of 140…180°C was used, 10°C apart, with pressure of 0.3 MPa at each of the chosen temperatures. Regenerated shungite was used to purify red beet juice from pectin substances, and purification effect was assessed. Experiments lasted within 10-30 min with mass rate of steam being $2.305 \cdot 10^{-3}$ kg/ sec.

The obtained results are shown in fig.3.

As it is showed in fig.3, after 10 minutes of regenerating shungite with superheated water steam the purification effect increases from 9 to 20%. By increasing the duration of regeneration up to 20 min, the purification effect significantly goes up. For instance, with

steam of 140ºC it constitutes 17% and grows to 32%. Maximum purification effect of 34% is achieved at regeneration temperature of 170º during 30 min.

The obtained data became a basis to optimize the process of regenerating shungite with superheated water steam.
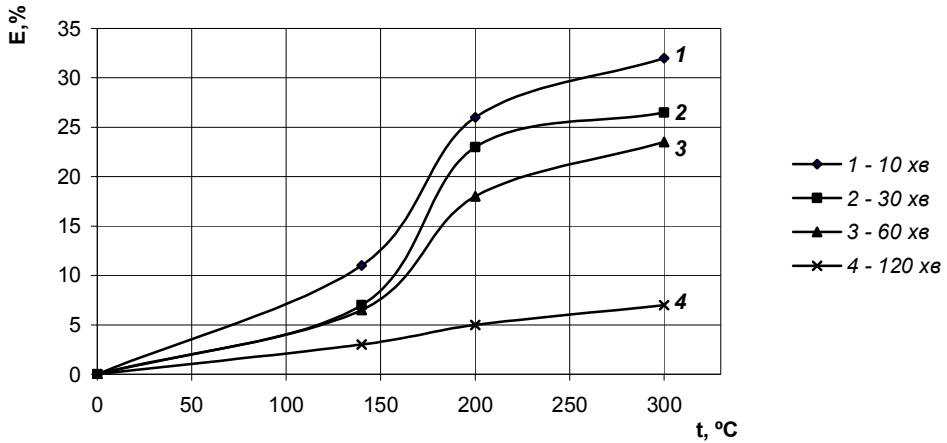
Fig. 2. Dependence of purification effect of red beet juice processed with thermally regenerated shungite on temperature and duration of shungite regeneration (E,% of original shungite constitutes 32%)
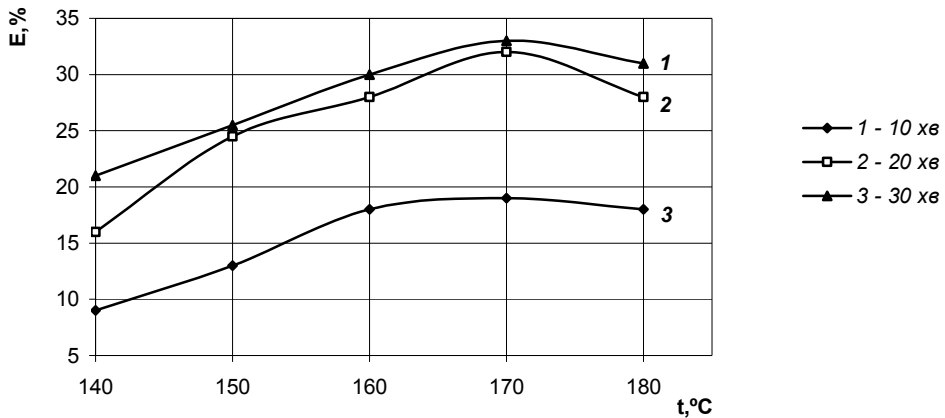
Fig. 3. Dependence of purification effect of red beet juice processed with shungite, regenerated with the help of superheated water steam, on temperature and regeneration duration

Conclusions

Investigated two methods of restoring shungita adsorption properties for reuse in cleaning juice from beet pectins: thermal activation method schungite in muffle furnaces and adsorbent treatment with superheated steam.

Proven benefits of regeneration shungita superheated steam. Established rational technological parameters regeneration shungita superheated steam temperature - duration - 30 minutes. When this high cleaning effect is achieved in 34 %.

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Research consistency of disperse systems by gravitational penetration method

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ABSTRACT

Introduction. Methods for determining the consistency of food need to be improved, simplified experimental equipment, the development of a single indicator measurements.

Materials and methods. Experimental researches performed on a gravitational penetrometer. Mathematical modeling is made from the analysis of motion of the gravitational force penetrometer.

Results and discussion. On the basis of a theoretical research relating to the instrument design a simple method of determining the consistency of concentrated fluid food disperse systems has been developed. The mathematical model of calculating the resistance of a free-fall penetrometer immersion as the product consistency characteristics has been drawn and explained on a theoretical basis. The model of a free-fall penetrometer motion through a layer of the product, which is based on a second-order differential equation, has been set. The solution has been obtained by the boundary conditions. To simplify the research its differentiation has been completed and the penetrometer immersion speed has been determined.

Conclusions. The results of the research are recommended to be used for various consistency properties of food dispersed systems.

Introduction

The assessment of the consistency is conducted according to organoleptic and physical methods that need improvement. The technological term "consistency" means structural and mechanical properties of the product with the exception of its surface properties: surface rubbing and adhesion.

To control the consistency of food viscometers, consistometers, penetrometers and other devices are commonly used. They are different in design and form the basis of test systems. Efficient functioning of the latter is achieved by the use of modern sensors and measuring devices, mathematical models that describe the process of deformation, piercing,

cutting of a product and modern computer technology for processing results. This allows to process the results quickly and efficiently and to determine their authenticity.

In the process of conducting the research the measured parameters are usually reduced to a common characteristic, which can be a marginal shear pressure (static and dynamic), efficient, plastic, dynamic viscosity, elastic modulus, relaxation time and in some cases other parameters. Determining the consistency of food disperse systems empiric dependences are the most common. They have limited possibilities of practical use.

Food products form mostly liquid (coagulation) structures, which have the ability to flow with the destruction of links between the parts creating the frame, and their subsequent restoration, and solid (condensation and crystallization) structures characterized by a relatively strong and resilient frame, which has inherent visco-elastic-plastic properties. It limits the system's ability to flow and renew the form in the event of destruction of the structure. Between liquid and solid products a food group can be identified that form the poorly flowing concentrated disperse systems the deformation. flow and destruction of which begins only after reaching the marginal shear pressure. In this case there is a nonlinear dependency between shear pressure and velocity gradient, and the system usually goes to the flow of destruction and partial structure upgrades. By increasing the speed of deformation zones are formed where the structure is almost completely destroyed and has no time to be updated. These products primarily include disperse systems with weak cohesive links.

The study of deformation and flow of food products based on their structural features is carried primarily on three types of devices. Properties of liquid products are studied by exploring of their ability to flow in the capillary and rotational viscometers, concentrated weak flowing products – in rotational viscometer and penetrometer and solid products – on the load devices by studying the behavior of the product under its tension and compression and needle free-fall penetrometers.

Analytical research shows that a large amount of conflicting data on the structural and mechanical properties of the same product can be found in the literature. They vary greatly especially if during the measurements different instruments and methods are used. It is not connected only with a large variety of materials and a wide range of products, but also with the following reasons.

Firstly, the properties of food raw materials and finished products change over time and depend on technological factors, first of all - temperature, humidity, shelf life, a way of receiving, transportation conditions, duration and type of mechanical stress, etc.

Second, the inadequacies of existing research methods, especially taking into account the complexity of factors related to the nature of the interaction product of work by instrumentation, as well as the environment.

Third, the different behavior of the product, due to the uneven level of destruction of its structure in different ways deformation: three-dimensional, linear, radial, and others, as well as different modes of application of voltage: pulse, fast, slow, etc.

Therefore, in case of the same disperse systems studying applying different methods on different instruments by design, we have to deal with the variety of research results.

So, if in the course of experimental studies the same or similar conditions of deformation can't be created, it is necessary to specify the method, mode and devices the results were received.

The description of fluid food products' consistency includes shear properties. They appear under the influence of external forces on the processed product and characterize the behavior of the sample under the action of tangential pressure if it is between two plates that are moving at different speeds. To study the shear properties of fluid food products

capillary and rotational viscometers are used. The typical feature of the first one is the movement of the product within the capillary along its walls, and the typical feature of the latter – in coaxial gap between the cylinder and the working part, which is usually also the cylinder but corrugated. At the same time, especially by a small gap between the cylinders, the fluidity of the material close to the shear can be traced.

On capillary and rotational viscometers a fundamentally different types of flows are experimentally implemented. In capillary viscometers measurements are carried out in a non-uniform field of shear and pressure velocity, and the period of the material staying in the capillary is limited. In rotary devices, however, the flow is in the pressure field of a high degree of homogeneity. The significant difference is the fact that a product that got into the capillary is continuously exposed to shear, and thus generates heat that is removed from the material, while in the rotational viscometer's functioning zone the same material is tested throughout the experiment. It heats up which affects the measurement results.

The theory of rotational and capillary rheometry is based on the same assumptions and constraints:

- hypothesis of entirety and continuity of the investigated mass;
- non-slip motion at the wall of the capillary or immovable cylinder;
- the assumption that the investigational product is isotropic;
- the assumption that the movement of the product is stable and the shear regime in coaxial gap is laminar.

The effective viscosity for the temperature regime under examination is given by the formula:

$$\eta_{ef} = \frac{\tau}{w}, \ Pa \cdot s$$

where w – average shear strain rate, s^{-1}; τ – shear stress in the capillary or rotational zone, Pa.

Materials and methods

Conducting the research on the experimental setup (Figure 1), the sequence of investigations is the following.
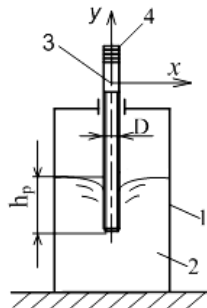
Figure 1. The experimental setup scheme of researching the consistency of concentrated fluid disperse systems

The sample 2 is placed into the cylinder 1. The penetrometer 3 is placed through a hole in the lid so that it touched the surface of the sample. Then the penetrometer is set free and the length t and depth y(t) of immersion can be recorded. There are two ways to conduct the

research. According to the first – the penetrometer immerses without stopping, according to the second –it stops after a while.

Depending on this for calculation different computational mathematical models are used. By varying the cargo 4 (the penetrometer's weight) it is possible to change the speed of its immersion into the sample and reach the first or the second method of investigation.

The depth of penetrometer's immersion should not exceed the length of the zone of deposition a special coating on the surface of the penetrometer required for the adhesion of the product to the surface and not slipping. Otherwise, the penetrometer surface can slip through the layer of the material and, consequently, false results of the research will be obtained.

By the slow motion of the penetrometer its velocity determination does not require the use of special devices for simultaneous fixation of depth and duration of immersion, which greatly simplifies the research.

Results and discussion

When plastic and viscous materials with intact structure are studied the method of penetration is widely used. When a conical indenter is used the marginal shear pressure is calculated:

$$\tau = K_1 K_2 K_3 K_4 \frac{m}{h^2} \ , \ Pa$$

where K, K_1, K_2, K_3 – are coefficients that take into account the various amendments to the research conditions; m – is weight of the cone with the exception of the friction force and spring resistance, if it is provided by its design, kg; h – depth of cone immersion, m.

Research result analysis of structural and mechanical properties of the different texture of food disperse systems using penetration has shown that the calculation mathematical models represented in the literature are empirical. Almost all properties of the product consistency are given by an approximation equation or regression function, which include factors that characterize the links of marginal shear pressure to many structural and technological factors in equipment and production process. These functional dependencies can be used for specific products under given conditions of research. These results depend on a number of subjective and objective reasons that are not included in the research. They have poor reproducibility even when similar devices are used, for example, the design provides a constant or variable load on the penetrometer. The above failures occur primarily due to the lack of reasonable theory that models the process of penetration – immersion of the indenter into the product. Based on the need of theoretical explanation of the penetration mechanism, the authors proposed to build a mathematical model of the penetration of the indenter into its investigational product based on second order differential equations, further solving boundary problems.

When the indenter has the shape of a needle in the moment of contact of the sample in general terms the differential equation of its motion (immersion) into the product will be the following:

$$m\frac{d^2}{dt^2}y(t) + F_{fr} + F_{res} = Đ_i \tag{1}$$

where m – mass of the indenter, *kg;* y – immersion of the indenter into the product; F_{fr}- the resistance that occurs as a result of friction and adhesion, *N;* F_{res} – the force that prevents penetration of the indenter into the product, *N,* P_H – weight of the indenter, *N.*

At work [2], [3] the analysis and solution of equations (1) with initial conditions:

$$t = 0 \rightarrow y(0) = 0, \ \frac{dy}{dt} = 0 \text{ та } t = 0 \rightarrow y(0) = 0, \ \frac{dy}{dt} = 0 :$$

$$x = f(t, m, y(t), D, F_{res}), \tag{2}$$

where D – is the diameter of the needle; t – dive duration; y – submersion.

From the equation the resistance is given F_{res}, knowing the characteristics of the penetrometer, having measured the depth y and duration of immersion t. It will describe the product consistency.

The disadvantage of the above model for consistency measuring is the necessity of measuring the length and depth of penetrometer immersion. Taking into account the high initial velocity of its motion ($V = \sqrt{2gh}$), it requires the use of special equipment for video fixation of the process.

In order to eliminate these defects and to develop a simple universal method of investigation, which will allow determining the consistency of the fluid disperse systems of different concentrations, the following model of a free-fall penetrometer motion with a weight m through a layer of the investigated product is proposed.

$$m\left(\frac{d^2}{dt^2}y(t)\right) + \pi D\mu\left(\frac{d}{dt}y(t)\right) - mg = 0, \tag{3}$$

where m – is a weight of a penetrometer; t – is the depth and time of penetrometer's immersion; D – is the diameter of the penetrometer; μ – typical viscosity, *Pa·s;* $g = 9,8$ *m/s².*

Taking into account that the penetrometer is immersed partially, the pushing force (lifting force) is neglected.

The equation solution in general form:

$$y(t) = \frac{mgt}{\pi D\mu} - \frac{me^{\left(-\frac{\pi D\mu t}{m}\right)}C_1}{\pi D\mu} + C_2 \tag{4}$$

Find constants of differentiation C_1 and C_2 by the initial conditions t = 0, y(0) = 0; y(t₁) = h₁ (boundary problem). Finally, we get:

$$y(t) = \frac{e^{\left(-\frac{\pi D\mu t}{m}\right)}(h_1\pi D\mu - mgt_1)}{\pi D\mu\left(-1 + e^{\left(-\frac{\pi D\mu t_1}{m}\right)}\right)} + \frac{mgt}{\pi D\mu} - \frac{h_1\pi D\mu - mgt_1}{\pi D\mu\left(-1 + e^{\left(-\frac{\pi D\mu t_1}{m}\right)}\right)} \tag{5}$$

Defining y(t) and t for a particular fluid disperse system with fixed values m, D, t we calculate μ from the equation (5).

Completing the derivation of the equation (5), we get the speed of a penetrometer immersion:

$$\frac{d}{dt}y(t) = \frac{mgt}{\pi D\mu} - \frac{e^{\left(-\frac{\pi D\mu t}{m}\right)}(h_1\pi D\mu - mgt_1)}{\pi D\mu\left(-1 + e^{\left(-\frac{\pi D\mu t_1}{m}\right)}\right)}$$

(6)

The equation (3) solution is obtained using the system of a computer symbolic mathematics "Maple".

In case the penetrometer stops *dy(t)/dt=0* it is better to use the equation (6). Then measuring the duration t_1 to its stop, the feature of consistency is defined – the viscosity μ.

Given that in food technology the variety of structural and mechanical properties of the fluid disperse systems are used, the choice between equations (5) or (6) depends on each case.

Using a mathematical model (6) we define the characteristic viscosity μ Pa·s of the dispersed food systems, provided *dy(t)/dt=0 t = 10s; m = 0,05 кг; D = 0,005 м; h_p = 0,1 м.*

As an example of the practical use of the developed models we defined the viscosity of fondant sugar masses. The fondant was received by sugar syrup boiling followed by whipping and adding flavorings. The samples were studied at a temperature T 45, 55, 65°C.

Substituting in equation (6) experimental data for T = 65 °C, we get:

$$0 = \frac{31,21}{\mu} - \frac{20,00e^{(-3,77\mu)}(0,0016\mu - 4,9)}{e^{(-3,14\mu)}}$$

(7)

From equation (7) we find μ:
At a temperature of 45 and 55°C consequently $\mu_{45} = 6103,5$; $\mu_{55} = 4405,3$ *Pa·s*.

Conclusions

The usage of a free-fall penetration will expand opportunities and will facilitate the study of food disperse systems different by consistency.

The setup to conduct a research is simple in design. Models are based on second order differential equations, which allow you to perform calculations, taking into account the initial conditions at various intervals of experimental research.

The expediency of a mathematical model of a free-fall penetrometer motion through a layer of the product in the study of its consistency has been explained on a theoretical basis and proved by the experiments. Diagram of the device has been given. As an example the viscosity of the disperse system at different temperatures has been determined.

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Calculation of geometrical parameters of the cossettes scalder

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ABSTRACT

Introduction. The process of cossettes scalding are examined. The exploration objective is the development of calculation methods for the parameters of the countercurrent cossettes scalders.

Materials and methods. The research techniques are based on physicochemical laws of constitutional changes and on industrial data processing.

Results and discussions. The basic stages of cossettes scalding are: preliminary heating of cossette, final heating of cossette, separation of blood and scalder mixture and foam, defoaming. The formulas for calculation of scalder diameter, the length of countercurrent and mixing parts, as well as the diameter of defoamer are proposed reasoning from optimum hydrodynamic conditions in a scalder.The basic dimensions for the scalders of different productivity are adduced. The obtained results can be used for designing the scalders for diffusion plants of columnar, rotating and twin screw type.

Introduction

At present, the overwhelming majority of extraction plants in beet sugar industry worldwide is armed by horizontal tandem countercurrent cossettes scalders with the system of forced defoaming. Those scalders were developed for fitting-out the diffusion towers produced by BMA and Buckau-Wolf [1], but then they came into in use for fitting-out the rotary and inclined double-screw plants.

There are the following technological and thermotechnical requirements for a process of scadling in sugar industry:

- cell membranes denaturation by thermal action (~70 ° C) during the period of about 10 minutes;

- heat recovery of diffusion juice by counterflow heat exchange with the beet cossettes coming in the cossettes scadler;

- defoaming in blood and scalder mixture;

- preparation of homogeneous blood and scalder mixture for its swap by centrifugal pumps;

- minimization of mechanic damages of beet cossettes.

The processes of different nature (mechanical, hydrodynamic, thermal, biochemical, diffusion, etc) occur during the work of a scalder. They are interrelated and therefore all factors, character and force of their influence should be taken into account during their projection.

Different aspects of scalders operation have been studied by native explorers. Lysianskyi V.M. elaborated the theory of heat and mass exchange processes calculation. However, the methods of the geometrical parameters calculation of scalders, taking into account hydrodynamic processes and processes of formation of foam during scalding, have not been sufficiently developed.

The available scalders have no system of forced defoaming. This drawback should be eliminated while the development of new scalders. The crucial task is an elaboration of modern scalders producing 4 – 6 thousands tons of beets in a day.

Goal of research: development of methods of geometrical dimension calculation of counter-flow scalder for the extraction plants of different types.

Materials and methods

The research techniques are based on physicochemical laws of constitutional changes and on industrial data processing.

Mathematic simulation based on physico-chemical laws of phase changes.

Processing of information concerning structure and behavior of the equivalent equipment produced by leading companies.

Results and discussions

The process of scalding in a counterflow scalder has the following stages:

1. The preliminary heating of cossettes to ~60°C at the counterflow area of a scalder. At such temperature, the gas emission is insufficient. On this area, the essential foaming can happen when failed to confirm with the standard operating procedure. That is, having low juice level, unripe beet processing, intense microbiologic activity, pump aeration, etc. In such cases, the antiseptic and defoaming agents are used and the process conditions are being corrected.

2. The final heating of cossettes to 70…75°C at the area of mixing. Here, the foam formation is a regular process caused by gas bubbles leaving the beet cossettes. The resulting foam is removed from the scalder, as well as the defoamant circulation circuit.

3. Defoaming takes place in the anti-foam vessel. Defoamed juice is returned to the scalder.

During the design calculation of a scalder it is necessary to determine the frame diameter, the counterflow part and the mixture part length. The base for calculation is the regularity of main processes.

The frame diameter of a scalder has an influence on the speed of diffusion juice flow in the intercossette space. It has an optimal meaning determined by interaction of both factors:

- heat transfer from juice to cossettes surface;
- compression of the cossettes layer caused by hydrodynamic friction.

4. When the speed slows down, the flow turbulence intensity descends and the heat irradiation goes down, therefore a big working volume of the counterflow part is necessary for the process. The increase in speed stimulates pressure and compacting of the cossettes layers right up to values when the selection of the adjusted juice quantity from the scalder becomes impossible.
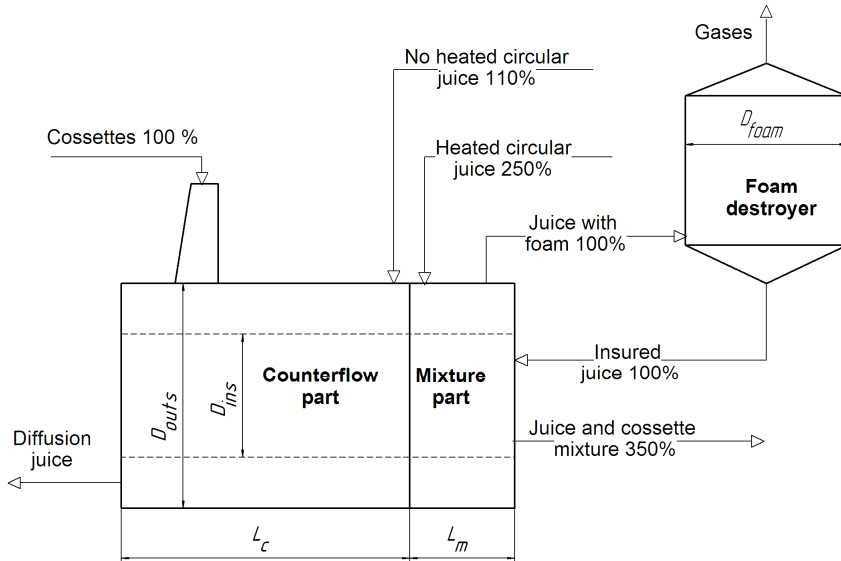
Fig. 1. Scheme of a counterflow scalder

Grebeniuk S.M. determined the value of this critical speed for cossettes obtained from the beets of different quality: 0.027 m/s for fresh beets, 0.021 m/s for frost-bitten and 0,016 for frozen ones. In the counterflow part of scalder the cossette is subjected to supplementary pressing between screw and counter-blades of transporting and mixing system. Considerable part of the scalder cross-section is surpassed by transporting paddles and screw belts. The design speed of the juice flow in space among cossettes equals 0.008 m/s.

The diffusion juice flow rate taken from the scalder is determined from the formula, m^3/s:

$$q = \frac{A}{24 \times 3600} \times \frac{\alpha}{100} \times \frac{1000}{\rho}, \tag{1}$$

where A – design capacity of scalred, t/day; α – diffusion juice extraction, % to beet weight; ρ – diffusion juice density, kg/m^3.

The computed value of total cross-section area between cossettes is determined from the formula, m^2:

$$F = \frac{\pi}{4} \times \left(D_{ins}^2 - D_{outs}^2 \right) \times \frac{\left(1000 - \gamma_c \right)}{1000}, \tag{2}$$

where D_{ins} – bore diameter of scalder frame, m; D_{outs} – full diameter, m; γ_c – specific loading of working place of counterflow part by cossettes, kg/m^3.

The juice flow speed in the space among cossettes equals, m/s:

$$v_{fl} = \frac{q}{F} \qquad (3)$$

There are other values for design calculation of a scalder: $v_{fl} = 0.008$ m/s; $\alpha = 110$ % to beet weight; $\rho = 1060$ kg/m^3; $D_{outs} = 0.385 \, D_{ins}$; $\gamma_c = 500$ kg/m^3. Substituting those values in formulas (1), (2) and (3), we have obtained the relation for the value of the inside diameter of the case, m:

$$D_{ins} = 0,0671 \cdot \sqrt{A}. \qquad (4)$$

The heat transfer duration is determined by the counterflow part length. Its increase provides better thermotechnical index. However, an area, where the temperature of juice cossettes mixture is 35-36°C, extends, and sugar actively decomposes on ferments and microorganisms. The exploitation of scalders of different types has shown that good thermotechnical results under acceptable values of sugar loss from decomposition are obtained when the counterflow heat transfer continues 600-900 s.

The counterflow heat transfer duration is determined from the formula, s:

$$\tau_c = \frac{\pi \left(D_{ins}^2 - D_{outs}^2 \right) L_c}{4} \times \frac{\gamma_c}{1000} \times \frac{24 \times 3600}{A} \times \frac{\rho}{1000} \qquad (5)$$

where L_C – scalder counterflow part length, m.

$$L_c = 0,00725 \tau_c \qquad (6)$$

For design calculation of scalder $\tau_c = 720$ s, accordingly $L_c = 5.22$ m.

Air is the source of gas bubbles in the intercellular spaces and pores of the beet tissue, as well as gases exhaling from the enchylema by virtue of diminution of their solubility during the heating. Mechanical stimulation of cossettes speeds up the air outlet.

The process of gas outlet is caused by gas expansion and compression of beet tissue during scalding. The experimental evidence shows that during the beet cossettes heating to 70 °C, it strongly expanses during 2-3 minutes. This is the time of gas outlet. The bubbles of different diameter are formed in the process of gas outlet from the beet tissue capillaries. The time of the bubble gas dilution in the diffusion juice is determined from the formula:

$$\tau_{dil} = \frac{r^2}{2 D_{gas} \left(C_S - C \right)} \qquad (7)$$

where r – bubble radius, m; D_{gas} – gas diffusion coefficient in solution, m^2/s; C_s – gas dilution in solution, m^3/m^3; C – gas content in solution, m^3/m^3.

The speed of gas bubble floating-up is determined from the formula, s:

$$v_{fl} = \frac{2 \cdot \rho \cdot g \cdot r^2}{9 \mu} \qquad (8)$$

where μ – liquid viscosity, Pa·s, g – gravitational acceleration, m/s^2.

The time of gas bubble floating-up from the scalder bottom is determined from the formula:

$$\tau_{fl} = \frac{9 \cdot \mu \cdot D_{ins}}{2 \cdot \rho \cdot g \cdot r^2} \quad (9)$$

At the area of mixing the juice cossettes misture usually has the temperature of 70 °C. The condenseds are used as extragents. The diffusion juice in the column diffusion tower does not contact with an air, thereupon, the diffusion juice has little air incorporation.

There are another values for design calculation of a scalder: $D_{gas} = 2.9 \cdot 10^{-9}$ m^2/s; $C_s = 0.0116$ m^3/m^3; $C = 0.00116$ m^3/m^3; $\mu = 0.859 \times 10^{-3}$ Pa·s, $g = 9.81$ m/s^2.

Plugging (4) in (9) and setting to (9), we value of some characteristic bubble radius r_{char} is determined, (image 2):

$$r_{char} = 68,8 \cdot \sqrt[4]{A} \quad (10)$$

The rise rate V_{char} corresponds to bubble radius r_{char} according to the formula (8) and the ascent time τ_{char} according to the formula (9). In period τ_{char} all bubbles, for which $r < r_{char}$, dissolve, and bubbles, for which $r > r_{char}$, reach the sieve and output from the scalder. For design calculation of a scalder, the hold-up time for the juice cossettes mixture should be no less than $1.25\tau_{char}$. The length of the mixing part of a scalder is determined from the formula (4) and (5) and the value of the specific inflation of mixing part is $\gamma_m = 286$ kg/m^3:

$$L_m = 0,0159\tau_{char} \quad (11)$$

The cross-section area of foam destroyer should have such value that the speed of descending current of juice should be less than $0.5V_{char}$
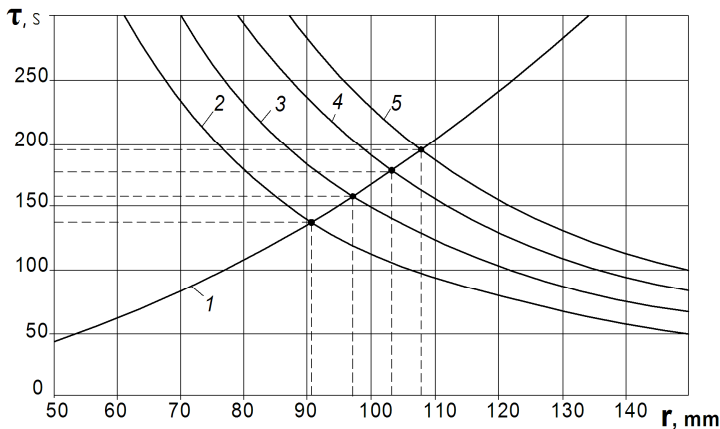
Fig. 2. The dependence of bubble dilution time value (curve 1) on bubble radius and on time of bubble floating-up for the scalders having
D_{ins} is 3; 4; 5; 6 m (curves 2; 3; 4; 5 respectively)

The diameter of foam destroyer is determined from the formula:

$$D_{f.d} = \sqrt{\frac{A}{24 \cdot 3600} \times \frac{1000}{\rho} \times \frac{4}{0,5 \cdot \pi \cdot V_{char}}}, \quad (12)$$

The results of calculation of main parameters for the scalders of different standard sizes are represented in a table.

The main parameters of counterflow scalders of beet cossettes

Parameter	Parameter value						
A, tpd	2000	3000	4000	5000	6000	7000	8000
D_{ins}, m	3.00	3.68	4.24	4.74	5.20	5.61	6.00
D_{outs}, m	1.16	1.41	1.63	1.83	2.00	2.16	2.31
L_c, m	5.22	5.22	5.22	5.22	5.22	5.22	5.22
r_{char}, µm	90.6	95.3	98.7	101.5	103.9	105.9	107.7
V_{char}, m/s	0.022	0.024	0.026	0.028	0.029	0.030	0.031
τ_{char}, s	136	151	162	171	179	186	192
L_m, m	2.16	2.39	2.57	2.71	2.84	2.95	3.05
$D_{f.d}$, m	1.59	1.85	2.06	2.24	2.40	2.54	2.67

The formulas for the calculation of beet cossettes scalders are proposed, their use secures the optimum hydrodynamic conditions for juice and cossette countercurrent movement and heat transfer.

Conclusions

The methods of main geometric parameters calculation of the countercurrent cossettes scalders are elaborated. The calculation formulas are based on the empirical evidence of processes in diffusion plants, namely in hydrodynamic, heat-exchange and diffusion ones. The results of the optimal sizes calculation for scalders of different productivity are given. The obtained results can be used for designing the scalders for diffusion plants of columnar, rotating and twin screw type.

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Hydrodynamics and mass transfer in gas-liquid media for wastewater treatment of food businesses

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ABSTRACT

Introduction. The purpose of of research is intensification of hydrodynamics and mass transfer processes in gas-liquid media for wastewater treatment of food businesses.

Materials and methods. For comparison aeration systems were evaluated ability of environment to keep gas and the dynamics of dissolution of oxygen. Experimental studies performed at the installation with a variety of designs of diffusers.

Results and discussion. The basic directions of intensification mass transfer processes identified as generating variable pressure through the creation of local areas of potential fields inertia forces, the concentration of energy flows in areas generating interfacial surface aerators, and use of dispersants. It is shown that the use of kinetic energy circulating fluid flows in the direction of synthesis of force is the direction, which features than other interventions are rated much higher.

Conclusions. The use of corrugated diffuser aerator provides substantial improvements on gas-retaining capacity of the environment and increases by about 35% the rate of dissolution of oxygen.

Introduction

The process of aeration of wastewater with the task of delivering them in the form of dissolved oxygen gas. At the same time it is logical to impose upon them the task of homogenization medium as in terms of the concentration of the substrate, and for even distribution of activated sludge. The consequence of this will accelerate the process of homogenization dissolved oxygen and process wastewater.

There are used method of surface aeration and input gas phase in the bulk liquid media. Last assessed as having held significantly more load than surface aerators [1-5]. Deep aeration followed by compression of the gas phase (air) to the values of hydrostatic pressure, which can reach several meters of water column. This implies the need to consider the laws of thermodynamics, focusing on what compression in gas blower machines are close to adiabatic processes. In this regard, the physical basis for this level are

the laws of conservation of matter and energy, first and second laws of thermodynamics, kinetic theory of gases.

Materials and method

In the comparative evaluation of aeration systems use two approaches. The first concerns the assessment retention capacity in a gas phase, and the second - directly dissolved oxygen dynamics. Both the levels achieved in experimental studies, which compared the system with diffusers divers. As the vertical notch aeration tank capacity used, which included a glass tube with a diameter of 200 mm and sealed tray (Fig. 1). Height of the cylindrical tube was equal to 1.8 m in the study used two types of diffusers. The first, with an inner diameter of 150 mm, made in the form of a cylindrical tube, and the other is made of radial groove with diameters of 160 × 140 mm. Height diffusers in both cases was the same and was 1.2 m.
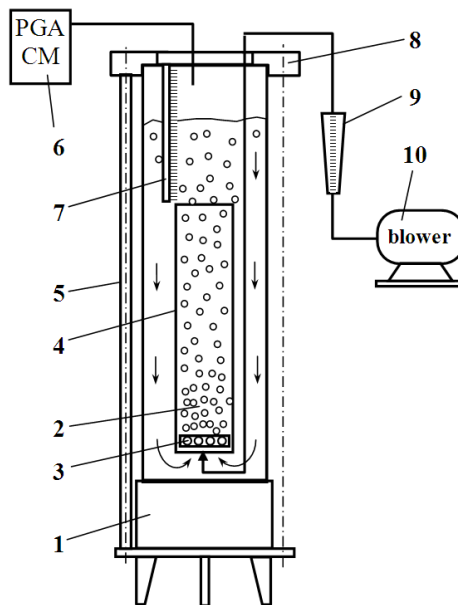
Fig. 1. Scheme of the laboratory stand:
1 – tray; 2 – glass pipe-column; 3 – item-bubbling aerator; 4 – diffuser; 5 – ties;
6 – paramagnetic oxygen analyzer; 7 – measuring range; 8 – flange;
9 – rotameter; 10 – blower machine

When doing research diffusers mounted on the same level. To ensure sealing of pipes, columns and tray unit is equipped with flanges fitted with a coupler and blower machine, flowmeter RS-5 and paramagnetic analyzer PGA-CM.

Results and discussion

The first part of the experiments connected with determining environment retention capacity in the gas phase. This work was performed at the facility as follows.

At the level of nominal pipe 2-column filled with water. Compressed air in the blower machine 10 through rotameter 9 rubber hose to put under bubbling element-aerator 3. Founded by bubbling gas phase floated, forming a pressure difference inside and outside the cone 4, occurred in the form of rising circulation flow in the diffuser and external to it standpipe flow. The presence of gas phase in a liquid medium leads to swelling of the gas-liquid layer. Height determines the amount of swelling retention capacity:

$$U = F_k \, \Delta h, \qquad (1)$$

where F_k - cross sectional area of the pipe-column, Δh - the value of the swelling layer.

Air consumption for aeration varied in the range from 3 to 11 m³/h.

Determine the design parameters of the system:

– Cross sectional area of the pipe-column

$$F_k = \frac{\pi D^2}{4} = \frac{3,14 \cdot 0,2^2}{4} = 0,0314 \ m^2 \qquad (2)$$

– Cross sectional area of the diffuser

$$F_{dif.} = \frac{\pi D_{dif}^2}{4} = \frac{3,14 \cdot 0,15^2}{4} = 0,0177 \ m^2 . \qquad (3)$$

The value of reduced velocity of the gas phase (velocity referred to the cross-sectional area of the column and cone) are presented in table 1.

Table 1

The value of reduced velocity of the gas phase

Airflow, *m³/h*	3	5	7	9	11
Present rate of the gas phase (referred to the area of the column), *m/s*	0,0265	0,044	0,0619	0,0796	0,0973
Present rate (attributed to the cross-sectional area of the diffuser), *m/s*	0,047	0,0785	0,1099	0,141	0,173

In Table. 2 shows the average level measurement data for gas-liquid swelling medium cases and corrugated cylindrical diffusers.

Table 2

Average statistical data on levels of gas-liquid swelling medium

Volume and air flow, m³/h	3	5	7	9	11
The level of swelling (cylindrical diffuser), m	0,14	0,168	0,187	0,199	0,21
The level of swelling (corrugated cone), m	0,161	0,186	0,206	0,202	0,232

The dependence of $\Delta h = \Delta h \, (V_p)$ as shown in the graph (fig. 2).

Because it shows increased swelling gas-liquid environment for the use of corrugated diffuser. The above value indicates the reliability of theoretical assumptions, which predicted precisely this outcome.

The results on the level of swelling enable you to figure out the value of retention capacity.
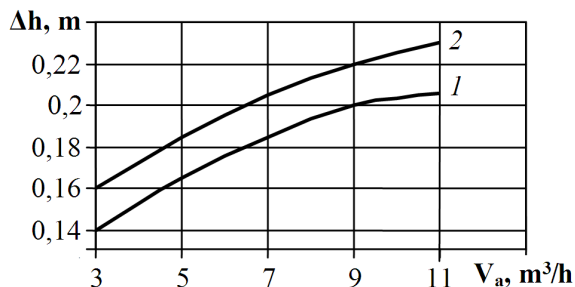
**Fig. 2. The relationship between the level of swelling layer
and gas-liquid volumetric flow rate of air for aeration:**
1 - cylindrical diffuser case; 2 - the case of corrugated cone

Results of calculations for determining retention capacity by gas-fired phase are shown in table 3. A value retention capacity and volume of air flow is determined residence time of bubbles in gas-liquid mixture

$$t_{(f)} = \frac{u}{V_a} \tag{4}$$

With the known time $t_{(k)}$ and the level of swelling layer is determined by the absolute velocity of the gas phase

$$w_a = w_r + w_l = \frac{1,5 + \Delta h}{t_{(ê)}} \tag{5}$$

where w_r - relative velocity of the gas phase; w_l - speed liquid phase in an upward path; 1,5 - nominal level of the liquid phase. The value of the absolute velocity of the gas phase are also given in tab. 3 for the two cases studies with different diffusers. Comparative analysis of these results shows that in the case of corrugated cone has been an increase retention capacity and thus reduce the absolute velocity of the gas phase. The latter indicates that the velocity decreases liquid phase in the circulation circuit.

Table 3

Volumetric air flow, m^3/h	3	5	7	9	11
Retention capacity (cylindrical diffuser), m^3	0,0044	0,0053	0,00587	0,00625	0,0066
Retention capacity (corrugated cone), m^3	0,00506	0,0058	0,0065	0,0069	0,00728
The absolute velocity of the gas phase (cylindrical diffuser), m/s	0,31	0,432	0,559	0,68	0,78
The absolute velocity of the gas phase (corrugated cone), m/s	0,27	0,404	0,51	0,623	0,728

Increased ability of kept diffuser means growth surface mass transmit but depending $\Delta h = \Delta h\ (V_p)$ are linear, due to increasing absolute velocity of the gas phase due to the speed of circulation of liquid medium. In fig. 3. shows a graph of the $w_a = w_a\ (V_p)$.
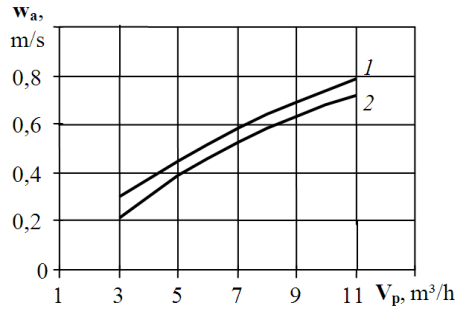
Fig. 3. Graph $w_a = w_a(V_p)$: 1 – cylindrical diffuser; 2 – corrugated cone

From this it is clear that for corrugated diffuser is a further inhibition of gas-liquid mixtures which are the basis for two factors namely extra friction on the surface and the increased pulsations of pressure due to inertial forces that arise due to changes in the speed of execution of the law of continuity flow. For comparative evaluation of mass transfer technique was used, based on the integration of sulfite and balance methods. This column is filled with a solution of sodium sulfite in the presence of copper ions. Oxygen passes into the mode of aeration in the medium reacts with sulfite according to the equation:

$$O_2 + 2Na_2SO_3 \rightarrow 2\ Na_2SO_4$$
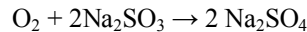
Thus the high velocity fluid flow latter reaction, the oxygen concentration is close to zero. This in turn means that it is an element of the driving factors in the process of mass transfer is not affected. Balancing method is based on indicators of volume (mass) of the gas phase flow applied to aeration and oxygen concentrations in the air before and after the aerator. Scale instrument PGA-KM built a percentage point to within 0.1%. The rate of dissolution of oxygen is determined by the dependence

$$\frac{dM_{O_2}}{dt} = M_f\left(\hat{E}_1 - \hat{E}_2\right),$$

where M_f - mass air flow, kg/s; K_1 - mass concentration (relative) oxygen inlet aerator (in the air); K_2 - mass concentration (relative) of oxygen at the outlet of the pipe-column.

All other things being equal, most dissolution rate of oxygen acts as a mass transmit characteristics of the whole system. Of course, the liquid medium in the presence of other physical and chemical parameters of the rate of dissolution rate of O_2 is slightly different, but comparable characteristics aerators will be quite useful. Statistically processed results of the research are presented in the tab. 4. and in fig. 4.

The value of K_2 and $\dfrac{dM_{O_2}}{d\tau}$ in the table recorded in the form of a fraction. Data relating to the numerator in this case a cylindrical diffuser and denominator - the case of corrugated diffuser. Comparison of the results shows that the rate of dissolution of oxygen under similar conditions and using corrugated cone increases by an average of 35%. The results indicate promising better understanding of the hydrodynamic modes and mass transfer in artificially creating uneven in terms of the speed of gas-liquid flows. This is even more rightly, that in a floating bubble an array due to their expansion under constant hydrostatic pressure does not occur as follows. At the same time there are opportunities quite reliable operation and process control due to the geometry diffusers.

Statistically processed results of experimental investigation of mass transmit

The mass flow of air, kg/s	0,00108	0,00179	0,00251	0,003225	0,00395
K_1	0,21	0,21	0,21	0,21	0,21
K_2	$\dfrac{0,18}{0,17}$	$\dfrac{0,175}{0,16}$	$\dfrac{0,179}{0,168}$	$\dfrac{0,189}{0,179}$	$\dfrac{0,186}{0,178}$
Dissolution rate of oxygen $dM_{O_2}/d\tau$, kg/s	$\dfrac{3,24\cdot10^{-5}}{4,34\cdot10^{-5}}$	$\dfrac{6,2\cdot10^{-5}}{8,65\cdot10^{-5}}$	$\dfrac{7,82\cdot10^{-5}}{10,62\cdot10^{-5}}$	$\dfrac{8,75\cdot10^{-5}}{11,95\cdot10^{-5}}$	$\dfrac{9,396\cdot10^{-5}}{12,78\cdot10^{-5}}$
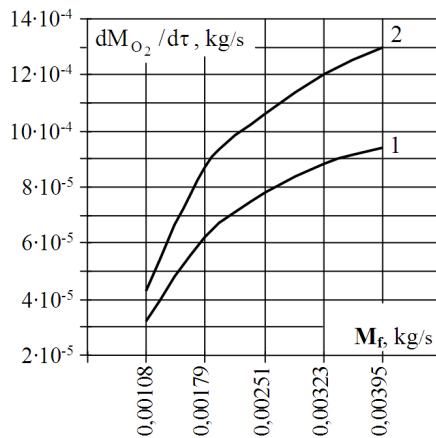
Fig. 4. Schedule to determine the dissolution rate of oxygen depending on the size of the mass airflow:
1 - for cylindrical diffuser, 2 - for corrugated cone

Thus, based on the selection of design features in the design of aeration systems achieved effects on kinematic parameters environments are transformed into power at impact forces of inertia. The latter is the main result, since the intensification of mass transfer (and heat) due to hydrodynamics necessarily achieved through coercion. This situation is evidenced, for example, the ratio of power factor in the criteria Reynolds, Froude, Euler and others.

Interaction flow in gas-liquid systems based on the use of potential field force of gravity and the result of this interaction is to generate forces of inertia and friction forces. Using kinetic energy circulation fluid flows in the direction of synthesis of force is a promising direction potential is compared with other interventions evaluated in excess of the order.

However, at the creation of remote aeration systems are possible intensification mass transmit processes by the superposition of the system. This analysis of such impacts based on comparing the potential and the gravitational forces perturbing vibrational processes. Shown that the research is quite oscillation modes that bring high impact on the hydrodynamics and mass transfer.

Conclusions

1. Assessments of achievement levels of dispersion of gas phase in the liquid proposed to use the concept of surface energy in the formation of interfacial surface.

2. Done experimental determination of hydrodynamic parameters of bubbling through the swelling in the aeration gas-liquid medium. It is shown that the use of corrugated diffuser aerator produces noticeable improvements on the ability of kept environment in a gas phase.

3. It is shown that the transition to corrugated cone increases by about 35% the rate of dissolution of oxygen.

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Concentration of fusel oil in alcohol column

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ABSTRACT

Introduction. To improve the process of removal of fusel oils in food distillation of ethyl alcohol is advisable to identify the areas of concentration in the system ethanol-water-izoamilol that at rectification form condensates heterogeneous type, and identify some of their technological characteristics.

Materials and methods. Materials research - ethanol-water-izoamilol and fusel oils. Experimental studies of phase equilibrium liquid - liquid-vapor in the system ethanol-water-izoamilol studied the instrument circulation type. Model mixtures were prepared gravimetrically.

Results and discussion. Defined area of concentration of fusel oil in alcohol column based on a heterogeneous formation of steam condensate in the system ethanol-water-izoamilol. Zone heterogeneous solutions in an ethanol-water system, a node is limited izoamilol with an ethanol content of 8.5...11.4 % by mass, which forms a heterogeneous distillates at 20 ºC. Technologically ethanol concentration greater than 10 wt%, izoamilol - 10 wt% enables to obtain a solution at a temperature of 91,1 ºC heterogeneous distillate. At low 3...5 % by mass concentration of alcohol in solution izoamilol rectification ratio is limited to 1.

Appropriate to apply the results of research in improving the processes of rectification of ethanol distillation column design, contact devices, determine their number, the development of technology selection fraction of fusel oils.

Introduction

The conditions of fusel oil removing in food rectification of ethanol is fairly well studied [1]. However, some technological features should be analyzed. The behavior of the rectification components in the of ethanol concentration related to both the construction of the column, contact devices, their quantity and technology of fusel oil fraction.

In alcohol-column the key components besides water and ethanol are alcohols fusel oils and their most significant representative – izoamilol. So we have selected mixture of these key components of ethanol-water-izoamilol for our research, moreover the behavior of ethanol and izoamilol alcohols in a wide concentration range, are closed to practice. In

this research the concentrations area,attracts our attention, when liquid mixtures with atmospheric pressure are heterogeneous, i.e. have a line of separation. The purpose of this research: to reveal areas of concentration in the ethanol-water-izoamilol system that would formed heterogeneous condensates by rectification, and define some of their technological characteristics.

Materials and methods

Experimental researches of phase balance liquid-liquid-vapor in the system of ethanol-water-izoamilol have studied on the base of circulating on type.

The design of a device is simple. It was made of heat-resistant glass, is heated by electricity through the autotransformer 1, flasks to the investigated mixture 2, volume of about 70 ml. The device has steck for thermometer 3, for receptacle canal 4, fridge 7.

Stirring of liquid in the flask is reached by circulation, which is performed kettle 1. In circulation device, to reduce volume fluid retention, is soldered the capillary the tube 6 from acceptor to the flask. Volume delays of the steam phase is close to 0. The device is insulated by asbestoscord and fiberglass. To monitor the intensity of boiling and the surface of section phases in isolation at the appropriate places was made "window". Modeling mixtures were prepared by the gravimetric method. The phase equilibrium was achieved in a isobaric conditions during the 1.5-2. A sample of vapor (volume = 1 ml) was taken into the pipette 5 by tap. The pipette was cooled by water. Methods of determining the quality of condensate is next.

A sample in the pipette was kept at +20 º C during the 6-18 h to fully of section phase. Were fixed volumes of layers to within 0.01 ml. Then was determined the refractive index n_3^{20} for each layer on the refractometer. By dint of index of refraction (separate study) was determined the composition of alcoholic and aqueous layer on the line of solubility. The composition of the initial condensate steam was found on the composition and material ratio layers, using the lever rule.
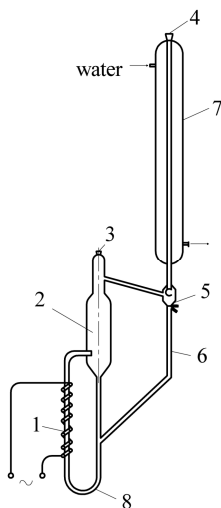
Fig. 1 Circulation device:
1 – heater; 2 – flask; 3 - place for thermometer; 4 - place for the receptacle canal;
5 - three-way valve; 6 - capillary canal; 7 – fridge; 8 - sampling valve

Results and discussion

In this work were used data of solubility in the system of ethanol-water-izoamilol at +20 ° C and at boiling temperature. Ethanol is easily dissolved in water and in izoamilol, the water at +20 ° C in izoamilol is dissolved only 2.83 wt%, at boiling point - to 3.07 wt% [2]. Izoamilol is dissolved in water at +20 ° C at 9.75 wt% at boiling point - 13.93% by weight. In the triple system observed two binary azeotrope: ethanol-water that consists of 95.57 wt% ethanol with boiling point 78,15 ° C and izoamilol-water - 50.4% by weight, with boiling point - 95,2 ºpp.

The line that is connecting the azeotrope components on concentration triangle (fig. 2) is intransitive line, that contains distillate components m_1m_2 [1]. The area of a triangle is limited by the solubility line at a certain temperature - the zone of heterogeneous solutions, which increases with decreasing of temperature, at that in the system ethanol-water-isobutanol zone heterogeneous solutions lower at the same temperature.
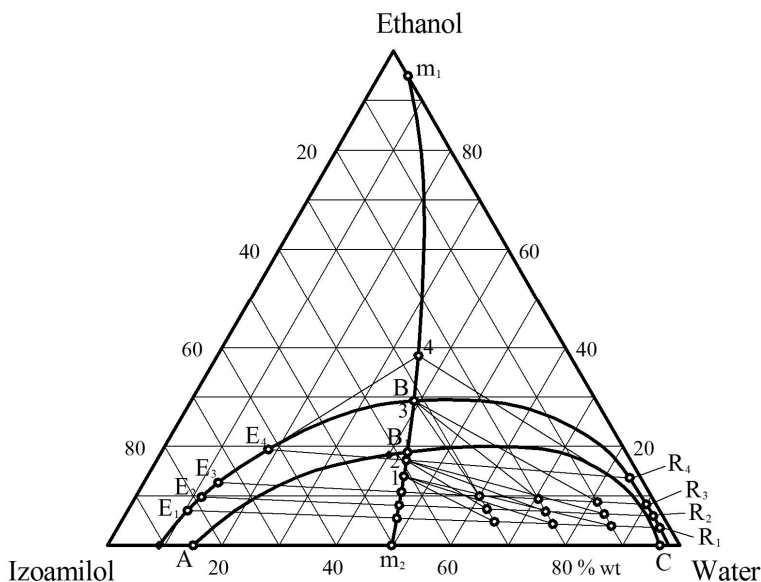
**Fig. 2. The equilibrium composition of the liquid and vapor
in the ethanol-water-izoamilol system:**
m_1m_2 – no transition line;
$R_1E_1, R_2E_2, R_3E_3, R_4E_4$ – node heterogeneous region;
E_1BR_1 – solubility line at +20 °C;
AB_1C – line solubility at the boiling point

Within the solubility curve components of the liquids placed on nodia - solubility curve. Components of a node within the curve of solubility are equilibrium with the same distillate at the temperature of boiling, because it is known that the composition of the distillate does not depend on the layers boiling heterogeneous mixture.

With increasing ethanol of content, its concentration in the liquid in the steam increases and components of the balance distillates are moving along of intransitive line to homogeneous components.

Distillates marginal mixtures do not separate into layers of hydrogen and alcohol when its cooling to 20C, have a boiling temperature 91,1C and ,according to the experiment data, containing not more than 11,41% of ethanol. Balance steam comforms to point B on the Solubility line at boiling temperature 20C. So, the zone of solutions, of which distillation provide heterogeneous distillates, are limited of node E_3R_3,content of ethanol – 8,5-11,41%.

During distillation mash, that containing little ethanol and higher alcohols, higher alcohols have greater volatility, than ethanol, and fusel oil is completely removed and the loss of his from barda – unlikely.

The lower plates of the column have little alcohol also and they vigorously transformed into steam phase.

It can be predicted that after one or two plates steam will match to points on the impassable line when the content in the liquid izoamilona 3 %wt. Chance maximum concentration izoamilol in steam not exceeding 50% by weight. The maximum concentration izoamilol if ethanol in the liquid up to 10 wt% (real terms) does not exceed 10% by weight.

Table 1

Node	Composition of the liquid						Boiling temperature, ℃	Composition of the steam						K
	Ethanol		Water		Izoamilol			Ethanol		Water		Izoamilol		
	wt%	mol%	wt%	mol%	wt%	mol%		wt%	mol%	wt%	mol%	wt%	mol%	
R_1E_1	Heterogeneous liquid							Heterogeneous condensate of steam						
	3,9	1,6	91,1	97,3	5,0	1,1	93,8	14,0	9,4	44,6	76,2	41,4	14,4	2,23
	4,0	1,7	86,0	96,0	10,0	2,3	93,8	14,0	9,4	44,6	76,2	41,4	14,4	1,13
	4,2	2,0	75,8	93,0	20,0	5,0	93,8	14,0	9,4	44,6	76,2	41,4	14,4	0,60
	4,5	2,4	65,5	89,2	30,0	8,4	93,8	14,0	9,4	44,6	76,2	41,4	14,4	0,44
	4,7	2,8	55,3	84,7	40,0	12,5	93,8	14,0	9,4	44,6	76,2	41,4	14,4	0,35
R_2E_2														
	5,5	2,3	89,5	96,6	5,0	1,1	93,0	19,0	12,7	43,2	74,0	37,8	13,3	2,20
	5,7	2,5	84,3	95,2	10,0	2,3	93,0	19,0	12,7	43,2	74,0	37,8	13,3	1,13
	6,0	2,9	74,0	92,0	20,0	5,1	93,0	19,0	12,7	43,2	74,0	37,8	13,3	0,59
	6,3	3,4	63,7	88,1	30,0	8,5	93,0	19,0	12,7	43,2	74,0	37,8	13,3	0,42
	6,6	4,0	54,3	83,5	40,0	12,5	93,0	19,0	12,7	43,2	74,0	37,8	13,3	0,30
R_3E_3														
	8,5	3,7	86,5	95,2	5,0	1,1	91,1	28,2	19,2	40,0	69,5	31,8	11,3	1,90
	8,8	3,9	81,2	93,7	10,0	2,4	91,1	28,2	19,2	40,0	69,5	31,8	11,3	0,90
	9,5	4,8	70,5	90,0	20,0	5,2	91,1	28,2	19,2	40,0	69,5	31,8	11,3	0,54
	10,0	5,6	60,0	85,7	30,0	8,8	91,1	28,2	19,2	40,0	69,5	31,8	11,3	0,31
	10,5	6,7	40,5	80,1	40,0	13,2	91,1	28,2	19,2	40,0	69,5	31,8	11,3	0,30
R_4E	Heterogeneous liquid							Heterogeneous condensate of steam						
	15,5	7,3	74,5	90,2	10,0	2,5	88,8	39,5	27,6	35,2	63,1	25,3	9,3	0,90
	16,2	8,6	63,8	85,9	20,0	5,5	88,8	39,5	27,6	35,2	63,1	25,3	9,3	0,47
	17,0	10,1	53,0	80,6	30,0	9,3	88,8	39,5	27,6	35,2	63,1	25,3	9,3	0,38
	17,4	11,1	47,6	77,3	35,0	11,6	88,8	39,5	27,6	35,2	63,1	25,3	9,3	0,32

K - Volatility of izoamilol comparatively ethanol (coefficient of rectification)

On the base on data from Table 1 and Figure 1 zone selection fusel oil in alcohol column should be chosen with plates where in the fluid ethanol is less than 10% by weight, and izoamilol at its regular selection, not more than 10% by weight. This condensate of steam are heterogeneous, therein ethanol was less than 28% by weight. Boiling temperature of solution at atmospheric pressure is 91,1 ° C, but with the working pressure at the bottom of column 2 m w.c:

$$t_{boil}+2,5 \cdot Pp=91,1+2,5 \cdot 2,0=96,1 \; ^{\circ}C$$

According to the research it is clear fusel oil appearance in rectified alcohol, when the quantity are accumulated in the column, when insufficient selection, when there is insufficient filing it epyurats and associated with this reduced selection of rectified alcohol. In these cases, rectification shifted to the intransitive line or coincides with it.

Conclusions

Was found the zone of heterogeneous in the system of ethanol-water-izoamilol, that is limited by node, containing ethanol 8,5-11,4% wt, that forms heterogeneous distillates at temperature 20 ℃

Technologically, from solution which consists of 10% of athanol and the same number of izoamilol can be obtained the heterogeneous distillate at the temperature of 91,1 ℃

We confirmed that at lower 3-5%wt concentrations of alcohols in solution coefficient of rectificatoin izoamilol is limited by 1.

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Effects of work-related stress on workers' health

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ABSTRACT

Introduction. Many workers consider that their work affects on health. Stress is increasingly accepted as a phenomenon in the workplace, which negatively affects for many people. Identification of the conditions of stress in the workplace that affect the health of workers, there is an actual.

Materials and methods. Sociological survey on working conditions in the workplace employees of different age categories and professional in Bulgaria.

Result and discussion. The secondary analysis of the Bulgarian data set of the Fifth EWCS 2010 shows that work-related stress, discrimination, violence, bullying and harassment have a negative impact on Bulgarian workers' health similarly to the EU. It can be concluded that the investigated work-related stress factors, such as shortage of time to get a job done, lack of consultation with workers, conflicts between work tasks and personal values, frequent necessity to hide one's feelings, mistakes at work that can cause a physical injury or a financial loss, verbal abuse, threats and humiliating behaviour, also affect workers' health negatively. Therefore, creating legal conditions for a healthy and safe working environment has to be a constant concern of every government and employer. Special attention should be paid to the new and emerging psychosocial hazards and their associated risks. It is of prime importance that workers should be kept very well-informed about all health and safety risks at work. More detailed research concerning the work-related stress factors needs to be conducted in order to suggest adequate measures to be implemented by employers.

Introduction

Stress is a physical and emotional reaction to adverse factors of the environment. Permanent job stress leads to uncertainty, a change or a loss of objectivity, changing values and social expectations, conflicts at the workplace and many other concerns. These situations are considered leading to stress and stress-induced diseases [9, 12, 13].

Stress is being increasingly recognized as a workplace phenomenon negatively affecting a growing number of people across the world. Work-related stress is one of the

biggest health and safety challenges in Europe. It is the second most frequently reported work-related health problem affecting 22 % of EU27 workers (in 2005), and the number of people suffering from stress-related conditions caused or aggravated by work is likely to increase. Stress is a factor on 50 % to 60 % of all working days. In 2005, the highest stress level was reported in Greece (55 %), and the lowest levels were observed in the UK (12 %), Bulgaria (18 %) and Germany (16 %). Quantitative job demands, low job control, harassment, violence and unwanted sexual attention are some of the main sources of work-related stress. The lowest levels of harassment have been reported in Italy and Bulgaria (2 %), and the highest in Finland (17 %). The Fourth European Working Conditions Survey found that one in 20 workers (5 %) had been personally subjected to violence. With regard to age, the highest stress level was observed among middle-aged workers. The prevalence of stress among men and women was reported as similar. It was established that stress was especially prevalent in education and health sectors, and in agriculture, hunting, forestry and fishing. With regard to the employment status, the well-being scores for self-employed workers were lower than those for employed workers [7, 8].

Hoel et al. reported that in a survey conducted by the Families and Work Institute in the USA, 26 % of the workers stated they were often or very often burned out or stressed by their work. Similarly, a study by Yale University reported that 29 % of employees perceived themselves to be quite a bit or extremely stressed at work [6].

The results of the Labour Force Survey 2007 demonstrated that 27 % of EU workers, i.e. 56 million people, were exposed to factors that could adversely affect mental well-being. Exposure to time pressure and overload at work was most often selected as the main factor. Stress, depression or anxiety were reported by 14 %. These occurred more frequently among employed women (17 %) than men (13 %). The proportion of workers that identified stress, depression or anxiety as their main work-related health problem was the highest in the age group of 25 ÷ 44 years [11, 15].

According to the European Survey of Enterprises on New and Emerging Risks (ESENER) carried out in 2009, accidents were reported as the main concern for European managers (80 % showed a major concern or some concern), followed by work-related stress (79 %) and musculoskeletal disorders (78 %). Violence or threat of violence as well as bullying and harassment were reported by almost 40 % of the responders as a major concern or some concern. Regarding the factors contributing to psychosocial risks, managers' principal concerns were "time pressure" (52 %) and "having to deal with difficult customers" (50 %) [5].

According to the analysis of EU-OSHA, about 14 % of the Europeans with a work-related health problem experienced stress, depression or anxiety as the main health problem. Therefore, psychosocial hazards and their associated risks are a key challenge for policymakers in Europe [14].

According to the European Opinion Poll on Occupational Safety and Health carried out in 2013, four in 10 workers (42 %) think that older workers tend to suffer more from work-related stress than other workers. When asked to choose from a list of six possible causes of work-related stress, 7 in 10 EU workers (72 %) and 6 in 10 Bulgarian workers (57 %) select job reorganisation or job insecurity. Hours worked and workload are selected by two-thirds (66 %) of EU workers and by 43 % of Bulgarian workers. Half of the workers in Europe (51 %) believe that cases of work-related stress are common at their workplace, and another 40 % say that such cases exist although they are rare. The situation in Bulgaria is similar [4].

Several overview models have been offered as summaries of the stress process [1, 2, 10]. Cooper's model turns out to be the most useful one because it focuses on the nature and details of work-related stress.

Several taxonomies of stressors have been introduced. Stressors can be divided into two groups: "content of work" and "context to work". The first group refers to the following stressors: work-environment and work equipment; task design, workload and work schedule. The second group consists of stressors such as organisational culture and function; role in organisations, career development, decision latitude and control, home/work interface and interpersonal relationships at work, including violence, harassment and bullying [6, 9].

It has been recognized that exposure to any form of violence at work has negative implications for individuals, organisations and society as a whole. This represents a huge cost in terms of both human distress and impaired economic performance [6, 8].

The aim of this research was to identify the factors of work-related stress that have a strong impact on Bulgarian workers' health.

Table 1

Interviewees' profiles

	Men (53 %)	Women (47 %)	Total (1014)
Age			
under 30	9 %	7 %	**16 %**
30 – 49	29 %	26 %	**55 %**
over 50	15 %	14 %	**29 %**
Length of service in the same company			
under 5 years	24 %	20 %	**44 %**
5 – 10 years	11 %	10 %	**21 %**
10 – 20 years	11 %	10 %	**21 %**
over 20 years	7 %	7 %	**14 %**
Level of education			
primary	0.5 %	0.4 %	**1 %**
lower secondary	6.3 %	4.3 %	**11 %**
upper secondary	36.0 %	27.6 %	**63 %**
semi-higher	1.0 %	2.2 %	**3 %**
higher	9.5 %	12.3 %	**22 %**

Materials and methods

The initial data originated from the Fifth European Working Conditions Survey (EWCS) carried out in 2010 by the European Foundation for the Improvement of Living and Working Conditions [3]. This survey has been conducted every five years since 1991. The questionnaire covers a broad range of working conditions, work characteristics and workers' sense of satisfaction and perception of different aspects of their jobs.

In the 5th EWCS, 1014 participants from Bulgaria were interviewed. The interviewees' profiles are presented in table 1. The most important survey question for our investigation was Q67, "Does your work affect your health, or not?".

A stratified sample was used and a post-stratification weighting was carried out. Throughout this paper, percentages are weighted after the W4 variable in the data set.

Disclaimer: The European Foundation for the Improvement of Living and Working Conditions and the UK Data Archive bear no responsibility for our further analysis and interpretation.

Results and discussion

Four of the 1014 Bulgarian participants in the survey refused to answer the main question (Q67), "Does your work affect your health, or not?", and

58 participants had no opinion. The rest 952 interviewees answered as follows: 5 % — "Yes, mainly positively", 34 % — "Yes, mainly negatively", 61 % — "No". Answers by gender are presented in fig. 1.
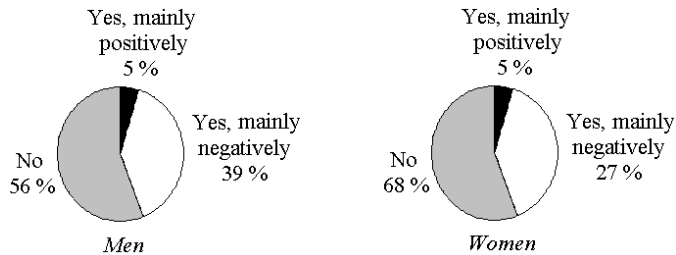
Figure 1. Answers given by the Bulgarian participants to the question, "Does your work affect your health, or not?"

The p-value returned by the χ^2- test is 0.0006, which means that the difference between the two distributions is unlikely to have occurred by chance. A strong correlation exists between the gender of an interviewee and his or her answer to Q67. Men's health is negatively affected by work more frequently than women's.

There is a very strong correlation (p = 0.008) between the interviewees' age and their answers to Q67. Young people's health is the least frequently affected by work. The positive influence of work over health is common for interviewees aged 30 – 49 years. In the age group of 50+ years, the negative influence of work increases. This is in accordance with results obtained from other studies [4, 7, 15].

A strong correlation (p = 0.003) exists between the level of education and Q67. However, this correlation is controversial. While higher levels of education correspond to positive influence of work over health, negative influence cannot be excluded either. Different kinds of education are best suited to different kinds of work with different risks (i.e. many other factors interfere and make it difficult to deduce a simple rule).

The length of service is another significant factor (p = 0.01). Its impact on health increases after 10 or more years.

Generally, health is negatively affected by manual work occupations more often than by clerical occupations (p = 0.00002).

The activity of the organisation where an interviewee works (industry or services) is not very strongly correlated (p = 0.13) with Q67. Nevertheless, industrial workers' health is negatively affected by their work a little more often.

The results show that there is a strong correlation between the factor "Enough time to get the job done" and the work impact on workers' health (p = 0.02). Shortage of time to perform tasks increases first the negative and then the positive impact. Perhaps greater demands are a source of stress for some workers, but a source of tone for others.

Involving workers in improving the work organisation or work processes in their department or organisation influences their health positively (p = 0.04), probably due to the beneficial psychological effect. However, overburdening with such demanding tasks reduces the positive effect.

Work affects health positively when workers are consulted always or most of the time before targets for their work have been set. Work affects health negatively when workers are consulted rarely or never (p = 0.02). The feeling of work well done has a positive

impact on workers' health (p = 0.02). It is interesting to note that the rare feeling of a job well done is related to the lack of influence of work on health whereas the inconstant feeling of a job well done (not very rare and not very frequent) affects health negatively. Perhaps uncertainty (successes replaced by failures) affects workers' health worse than monotony.

The study shows that frequent conflicts between work tasks and workers' personal values have a negative effect on their health; however, if rare, such conflicts can have a positive effect on health (p = 0.0007). Absence of conflicts of this kind does not affect health. Generally, workers who are emotionally involved in their work more frequently have their health affected by their work (p = 0.00002). This influence can be either positive or negative.

Table 2 presents data about the impact of work-related stress on workers' health. Our analysis shows that stress at work has a strong impact on health (p = 1.7×10^{-18}). Frequent stress had a negative impact on the health of 53.4 % of the interviewees. This is in accordance with the results obtained from other studies [5, 6, 7, 11, 15].

Table 2.

Effects of work-related stress on workers' health

Work-related stress	"Does your work affect your health, or not?"			
	Yes, mainly positively, %	Yes, mainly negatively, %	No, %	Total number
Often or always	10.8	53.4	35.8	**162**
Sometimes	5.0	42.3	52.6	**244**
Rarely or never	2.6	24.3	73.1	**528**
Total	**4.7**	**34.1**	**61.1**	**934**

There is a significant correlation (p = 0.00004) between workers' health and the requirement to hide their feelings. About 41.0 % of the interviewees who had been frequently subjected to such a requirement reported a negative effect on their health.

If mistakes at work can cause a physical injury to other people (p = 7.8×10^{-13}) or a financial loss to the company (p = 0.0005), then work affects health frequently. Negative influence of work on health was reported by 52.0 %, resp. 38.2 %, of the interviewees whose job involved such factors at their highest intensity.

On the other hand, the following factors have little or no influence on workers' health (p > 0.05): clear requirements, the feeling of doing useful work, the ability to apply their own ideas to their work or influence important decisions, help and support from colleagues and managers, having a say in the choice of working partners. In fact, these factors have some positive influence on workers' health but this influence is very weak.

Generally, work affects health most when working hours do not fit in with family or social commitments outside work (p = 0.0000001) and arranging to take an hour or two off during working hours to take care of personal or family matters is difficult (p = 0.00001). If workers can take a break when they wish, then work affects health positively. However, if the regime is too flexible or too strict, the negative effect of work on health increases (p = 0.052). Obviously, the moderate flexibility of the working time reduces stress and affects health positively.

Workers whose household is able to make ends meet easily most often report lack of influence of work on their health (p = 0.03). A positive impact of work on health is most frequent among those workers who have some difficulty in providing for their household;

most probably, this is due to the positive effect on health that a moderate working regime usually has. A negative influence of work on health is most frequent among those workers whose household was able to make ends meet with great difficulty; obviously, this situation is a source of great stress.

Being the person who contributes the most to the household income is another source of stress; this factor is also correlated with the negative influence of work on health although this correlation is not as strong as the previous one (now p = 0.08).

Sport is well-known for its ability to neutralize stress. It is impossible to go into details here (this question may itself be the subject of another investigation) but it is worth pointing out that regular sport minimizes the negative influence of work on health (p = 0.01): only 27 % of the workers involved in sporting, cultural or leisure activity outside their home feel some negative influence of work on their health (compared to the average level of 34 %); almost 10 % of those who are involved in sporting every day or every second day find that work affects their health positively (which is twice as many as the average level of 5 %).

Other factors related to stress are discrimination, violence, bullying and harassment. Figure 2 presents the results from the survey concerning workers in Bulgaria and EU27 subjected to these factors [3].
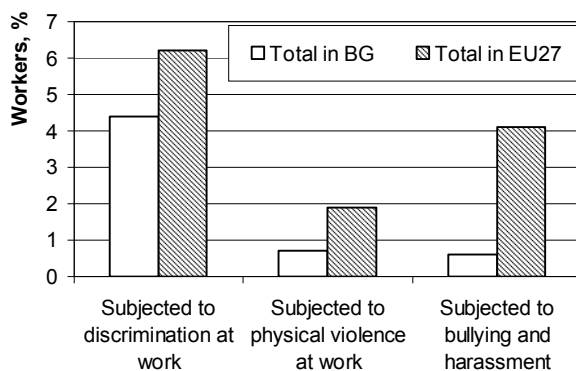
Figure 2. Total percentages of workers subjected to discrimination, violence, bullying and harassment in Bulgaria and EU27

The percentage of workers subjected to these work-related stress factors in Bulgaria is lower than in the EU (fig. 2). This is consistent with other studies [4, 7]. Concerning Bulgarian workers subjected to discrimination, the dispersion for men and women is 5.9 % and 2.7 % respectively. Concerning physical violence, this dispersion is 0.6 % and 0.7 % respectively. For bullying and harassment it is 0.7 % and 0.5 % respectively. It is interesting to mention that 4.8 % of Bulgarian workers subjected to discrimination at work are between 30 and 49 years old, 1.7 % of those subjected to physical violence are under 30 years old and 1.2 % of workers subjected to bullying and harassment are above 50 years old.Table 3 presents results about the impact of the type of discrimination at work on discriminated workers' health.

Age discrimination, discrimination linked to race, ethnic background or colour, and discrimination on the basis of sex: these are the only kinds of discrimination that have a significant correlation with the influence of work on health (i.e. $p < 0.05$). However, for most kinds of discrimination, the results of the χ^2- test are very uncertain because of the

small numbers involved. Therefore, only the first two kinds in table 3 are worth a detailed analysis.

Table 3

Effects of discrimination type on discriminated workers' health

Type of discrimination	"Does your work affect your health, or not?"			
	Yes, mainly positively, %	Yes, mainly negatively, %	No, %	Total number
Age discrimination (p = 0.000003)	25.4	39.2	35.4	21
Discrimination linked to race, ethnic background or colour (p = 0.04)	3.0	63.0	34.1	19
Discrimination linked to nationality (p = 0.15)	0.0	82.7	17.3	5
Discrimination on the basis of sex (p = 0.002)	32.9	22.4	44.7	6
Discrimination linked to religion (p = 0.48)	0.0	66.8	33.2	5
Discrimination linked to disability (p = 0.68)	0.0	56.8	43.2	3
Discrimination linked to sexual orientation (p = 0.19)	26.3	53.7	20.0	3

Age discrimination correlates with the negative influence of work on health (39.2 % is significantly higher than the average 34 %) because old workers are often denied long-term positions suitable for them and they are compelled to get engaged in jobs detrimental to their health. Surprisingly enough, age discrimination is also correlated with the positive influence of work on health (25.4 % is much higher than the average 5 %); this is most probably due to the percentage of young workers who usually have no difficulty in finding a job that has a positive effect on their health but are often discriminated with respect to their wages.

Discrimination linked to race, ethnic background or colour corresponds with the negative influence of work on health (63.0 %). This fact hardly needs an explanation because this kind of discrimination usually takes the form of narrowing the set of jobs available to workers, thus compelling them to get engaged in the hardest jobs which are often detrimental to their health.

Almost all kinds of discrimination tend to correlate with the negative influence of work over health. Although we lack enough data to get to certain conclusions, the tendency can be easily seen from the results presented in table 3.

There is a strong correlation between the influence of work on workers' health and depression or anxiety ($p = 4.3 \times 10^{-9}$). Depression is combined with the negative impact of work on health. The same holds for overall fatigue ($p = 3.6 \times 10^{-16}$) and insomnia or general sleep difficulties ($p = 2.4 \times 10^{-8}$). All these are connected with stress. Tiring or painful positions and handling angry clients or patients are frequent sources of work-related stress.

About 10 % of Bulgarian workers have been subjected to verbal abuse at work; 53.9 % of them think that their work has a negative influence on their health. This percentage is significantly greater than the average 34 % ($p = 0.000008$). Unwanted sexual attention increases the frequency of negative influence and reduces the positive impact of work on

workers' health (p = 0.04). Threats and humiliating behaviour at work also affect workers' health negatively (p = 0.00005); a negative impact is experienced by 64.9 % of workers who are subjected to this factor.

Physical violence, bullying / harassment and sexual harassment are correlated with the negative influence of work on health. These correlations are weak (p > 0.05). However, no certain conclusions can be drawn here (even about the strength of the correlation) because of the insufficient data: only few interviewees reported that they had been subjected to such treatment.

Conclusions

The secondary analysis of the Bulgarian data set of the Fifth EWCS 2010 shows that work-related stress, discrimination, violence, bullying and harassment have a negative impact on Bulgarian workers' health similarly to the EU. It can be concluded that the investigated work-related stress factors, such as shortage of time to get a job done, lack of consultation with workers, conflicts between work tasks and personal values, frequent necessity to hide one's feelings, mistakes at work that can cause a physical injury or a financial loss, verbal abuse, threats and humiliating behaviour, also affect workers' health negatively. Therefore, creating legal conditions for a healthy and safe working environment has to be a constant concern of every government and employer. Special attention should be paid to the new and emerging psychosocial hazards and their associated risks. It is of prime importance that workers should be kept very well-informed about all health and safety risks at work. More detailed research concerning the work-related stress factors needs to be conducted in order to suggest adequate measures to be implemented by employers.

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Causal relationship occupation injury in the food industries

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ABSTRACT

Introduction. Analyzing causes of injury in the food industries give an opportunity to create reasonable and effective ways of prevention and decreasing risks of workers injuries. The purpose of work is to research cause-and-effect relationships that lead to injury in the food industry. The object of research is occurrence of the occupational injuries at the food industry enterprises for the period 2003...2012.

Material and methods. Methods of statistical analysis were used. Analysis was done on the basis of statistics of occupational injuries on the causes of accidents and the types of events in the food industries.

Results and discussion. Obtained risk matrices of the injuries with death or deathless consequences for 15 types of accidents that were causing to accidents, and 16 reasons of traumatism during 2003–12 period. There are quantitative statistical evaluations for 240 types of risk reasons for binary groups "the reason of an accident – type of traumatic effect" in the matrices of risk. This approach allows for the analysis of direct causal relationships that occur during getting injury and identify both basic and hidden cause of occupational injuries, as well as types of events that lead to accidents on the basis of a form of mandatory annual reporting. It is the first time the regularity of the ranking of binary ratio "the reason of an accident – type of traumatic effect" is set for enterprises of the food industry. And its main clue is that approximately 20% of them causes 75% of the traumatism risk. Results of research can be used in improving management decisions projects that can provide safe working conditions in the food industries.

Introduction

For effective health and safety management, selection and use of reliable and affordable measures and means of prevention of accidents in the food industry need to know how to identify direct and hidden causes of occupational injuries.

Only with the knowledge of these causes we can confidently identify ways of neutralization or reducing their influence for risk.

To the level of occupational injuries in the food industry affects a large number of factors, which act in the mutual connection and conditionality, which leads to accidents with severe consequences for the staff [1-3]. The organization and execution of tasks on the reduction of injuries, accident prevention, development of scientific and practical recommendations for the creation of safe working conditions for the production staff in the food industries is important and priority area of development of safety management [4].

These circumstances require solving scientific problems: improving the method of analysis of the causes of accidents that have occurred at food industry enterprises. *The purpose* is to research cause-and-effect relationships that lead to injury in the food industry.

The object of research is occurrence of the occupational injuries at the food industry enterprises for the period 2003...2012.

The subject of research is dependence of the influence of cause-effect relationships that leading to injury at the food industry enterprises.

Material and methods

A promising research method of statistics of occupational injuries - is the method of causal relationships. This method allows you to combine disparate statistics on the causes of accidents and the types of events that result in injury into a single system of quantitative estimates of different risks for pairs "cause - the kind of traumatic event". It specifies causal relationships laid down in the official statistics on occupational injuries, and more clearly and unambiguously indicates the measures and means to effective prevention of risks.

The main sources of official estimates for generalized causes of occupational injuries in Ukraine are the forms of state statistical reporting (№ 7-THB) [5-6]. The above statistical reports allow you to select the 16 main causes of accidents and 15 types of traumatic events that traditionally analyze separately, independently one from the other. The causes of injury include: design flaws ($\ddot{I}_1$), imperfection of technological processes ($\ddot{I}_2$),unsatisfactory technical condition of production assets ($\ddot{I}_3$),other technical reasons ($\ddot{I}_4$), deficiencies in training ($\ddot{I}_5$), violation of work and rest ($\ddot{I}_6$), deficiencies of medical examination (professional selection) ($\ddot{I}_7$), the absence or non-use of personal protective equipment ($\ddot{I}_8$), breach of technological process ($\ddot{I}_9$), violations in the operation with industrial funds ($\ddot{I}_{10}$), traffic violations ($\ddot{I}_{11}$), violation of labor and production discipline ($\ddot{I}_{12}$), other organizational reasons ($\ddot{I}_{13}$), alcohol and drug intoxication ($\ddot{I}_{14}$), and other physiological reasons ($\ddot{I}_{15}$), other reasons ($\ddot{I}_{16}$).Statistical information about the types of events that led to the injury of the employee includes the following events: traffic accidents (B_1), falling down (without falling from a height) (B_2), falling down from a height (B_3), falling objects, materials, rocks, soil (B_4), the accident with moving, flying, rotating parts (B_5), electric shock (B_6), the action of harmful and toxic substances (B_7), the effect of ionizing radiation (B_8), neuro-psychological overload (B_9), contact with animals, insects, other (B_{10}), drowning (B_{11}) deliberate killing or intentional acts of another person, which led to injury (B_{12}), natural disaster (B_{13}), fire (B_{14}), and other events (B_{15}).

Results and discussions

Definition of matrix risks is proposed to perform by calculating the generalized statistics using the formula [7]:

$$\ddot{I}_i B_j = \frac{B_j^t \times \Pi_i^t}{\sum\limits_{i=1}^{n} \ddot{I}_i^t},$$

$\ddot{I}_i B_j$ - value (risk share), which characterizes the binary complex "principal cause of injury - type of traumatic event"; B_j^t - rate risk (proportion) of j-th type of traumatic event; $\ddot{I}_i^t$ - rate risk (proportion) of i-th cause injuries.

In Table. 1 there are results of the calculation of risk values for its 240 varieties based on injury statistics in nine years.

Each of these types corresponds to a combination of a cause of injury $\ddot{I}_i$ and a traumatic event B_j. That is in contrast to the vague and unspecific interpretation of the reasons $\ddot{I}_i$, kind of risk $\ddot{I}_i B_j$ is showing such cause, which allows determining the presence or absence of the possibility of a manifestation for such reason in the workplace. In addition, quantitative estimates of different types of risk allow you to rank and identify those of them that are requiring priority attention, and also to perform other actions due to current procedures of the risk assessment and planning of prevention of the occupational injuries.

For example, a combination of causes $\ddot{I}_1$, full title of which is design flaws, imperfection, insufficient reliability of machines, equipment and type of the traumatic event B_2 (falling of the victim) forms a kind of risk that can be interpreted as the risk of injury from falling of the victim due to the structural deficiencies of technology. Other words in contrast to the broad and largely undefined interpretation of causes $\ddot{I}_1$ (design flaws), a variety of risk $P_{\dot{I}_2}(B_2)$ essentially is describing the cause of risk, allowing more clearly and purposefully influence it. Moreover, quantitative estimates of the types of risk are listed in Table. 1, allow you to rank and to identify those of them which are requiring priority attention. You can perform other actions according to current procedures of risk assessment and also plan the prevention of occupational injuries.

Analysis of calculation of the different assessments of risk listed in Table 1-3, shows that technical reasons of injury $\ddot{I}_1, \ddot{I}_2, \ddot{I}_3, \ddot{I}_4$ causing the largest value of the risks in conjunction with the following types of traumatic events - $B_1, B_2, B_3, B_4, B_5, B_7, B_{15}$ for accidents with non-fatal consequences and B_1, B_2, B_3, B_4, B_5 as the risk of fatal injury. For the risks of injury with non-fatal consequence and fatal accidents the most dangerous types of risks are poor technical condition of assets Π_3 and weaknesses in the study Π_5, that can cause traffic accidents $B1$, falling the employee including falling from height of $B2$ and $B3$, damage from falling objects, materials, rocks, soil $B4$, damage from exposure to moving, flying, rotating parts $B5$. For the risk without a fatal injury is typical the action of harmful and toxic substances B7 and other events, the identification of which is not required by applicable classification $B15$.

**Matrix of risk of injury by kind of events that leads to the accident
and causes injury in the food industry, $\times 10^{-5}$**

	Π_1	Π_2	Π_3	Π_4	Π_5	Π_6	Π_7	Π_8	Π_9	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}	Π_{15}	Π_{16}
B_1	0,223	0,149	0,475	0,149	0,597	0,075	0,075	0,075	0,075	0,373	0,746	0,746	0,522	0,075	0,075	0,075
	2,405	1,430	5,394	2,600	4,484	0,390	0,325	0,975	0,780	18,458	7,994	5,199	7,864	2,600	1,625	3,184
B_2	0,106	0,071	0,212	0,071	0,283	0,035	0,035	0,008	0,035	0,177	0,353	0,353	0,247	0,035	0,036	0,036
	1,526	0,907	3,422	1,650	2,845	0,247	0,206	0,618	0,495	11,710	5,071	3,298	4,990	1,649	1,031	2,020
B_3	0,071	0,047	0,141	0,047	0,188	0,024	0,024	0,024	0,024	0,118	0,236	0,236	0,165	0,024	0,024	0,024
	0,888	0,528	1,991	0,960	1,655	0,144	0,120	0,360	0,288	6,814	2,951	1,919	2,903	0,960	0,600	1,176
B_4	0,071	0,047	0,141	0,047	0,188	0,024	0,024	0,024	0,024	0,118	0,236	0,236	0,165	0,024	0,024	0,024
	0,827	0,492	1,856	0,894	1,543	0,092	0,112	0,335	0,268	6,351	2,751	1,789	2,706	0,894	0,560	1,096
B_5	0,082	0,055	0,165	0,055	0,220	0,012	0,028	0,028	0,028	0,137	0,275	0,275	0,192	0,028	0,028	0,028
	0,922	0,548	2,069	0,997	1,720	0,150	0,049	0,374	0,300	7,079	3,066	1,994	3,016	0,997	0,623	1,221
B_6	0,035	0,008	0,071	0,024	0,094	0,004	0,012	0,012	0,012	0,059	0,118	0,118	0,082	0,012	0,012	0,012
	0,302	0,179	0,677	0,326	0,562	0,125	0,041	0,122	0,141	2,315	1,003	0,652	0,986	0,326	0,204	0,400
B_7	0,012	0,008	0,024	0,039	0,031	0,004	0,004	0,004	0,004	0,020	0,039	0,039	0,028	0,004	0,004	0,004
	0,560	0,333	1,257	0,606	1,045	0,091	0,076	0,227	0,182	4,300	1,862	1,211	1,832	0,606	0,380	0,742
B_8	0,012	0,008	0,024	0,008	0,031	0,004	0,004	0,004	0,004	0,020	0,008	0,039	0,028	0,004	0,004	0,004
	0,078	0,046	0,174	0,084	0,145	0,012	0,010	0,031	0,025	0,595	0,258	0,168	0,254	0,084	0,052	0,103
B_9	0,012	0,008	0,024	0,008	0,031	0,039	0,004	0,004	0,004	0,020	0,039	0,039	0,028	0,004	0,004	0,004
	0,216	0,128	0,483	0,233	0,402	0,035	0,030	0,087	0,070	1,654	0,716	0,466	0,705	0,233	0,145	0,285
B_{10}	0,012	0,008	0,024	0,008	0,031	0,004	0,004	0,004	0,004	0,020	0,004	0,039	0,028	0,004	0,004	0,004
	0,043	0,026	0,097	0,143	0,080	0,007	0,006	0,017	0,014	0,331	0,046	0,093	0,141	0,046	0,029	0,057
B_{11}	0,012	0,008	0,024	0,008	0,031	0,004	0,004	0,004	0,004	0,020	0,039	0,039	0,028	0,004	0,004	0,004
	0,043	0,026	0,097	0,046	0,080	0,007	0,006	0,017	0,014	0,331	0,143	0,093	0,141	0,046	0,029	0,057
B_{12}	0,012	0,008	0,024	0,008	0,031	0,004	0,004	0,004	0,004	0,020	0,039	0,039	0,028	0,004	0,004	0,004
	0,078	0,046	0,174	0,084	0,145	0,012	0,010	0,031	0,025	0,595	0,258	0,168	0,254	0,084	0,052	0,103
B_{13}	0,012	0,008	0,024	0,008	0,004	0,004	0,004	0,004	0,004	0,020	0,008	0,008	0,028	0,004	0,004	0,004
	0,043	0,026	0,097	0,046	0,080	0,007	0,006	0,017	0,014	0,035	0,128	0,093	0,141	0,046	0,029	0,057
B_{14}	0,012	0,035	0,024	0,039	0,031	0,004	0,004	0,004	0,004	0,020	0,039	0,039	0,028	0,004	0,004	0,031
	0,216	0,143	0,483	0,232	0,402	0,331	0,030	0,087	0,070	1,654	0,716	0,466	0,705	0,233	0,145	0,285
B_{15}	0,024	0,016	0,047	0,016	0,063	0,008	0,008	0,008	0,008	0,039	0,079	0,079	0,055	0,039	0,008	0,008
	0,569	0,338	1,276	0,615	1,061	0,134	0,077	0,231	0,184	4,366	1,891	1,230	1,860	0,615	0,384	0,753

For the accidents with fatal and non-fatal consequence the most dangerous is the organizational causes $\Pi_{10}, \Pi_{11}, \Pi_{12}, \Pi_{13},$ that can lead to the traffic accidents B1, as well as to the following types of traumatic events: *B2, B3, B4, B5, B6* (Table 2-3).

For types of risk from organizational reasons without fatal consequences the most dangerous injury is caused by exposure to harmful and toxic substances *B7*, damage from exposure to ionizing radiation *B8*, damage from exposure to fire *B14* and other events, the identification of which is not required by applicable classification *B15*. Psychophysiological Π_{14}, Π_{15} and other causes of injury, identification of which is not required by applicable classification Π_{16} for the accidents without fatalities predetermine the largest value of risks in conjunction with the following types of traumatic events – B_1, B_2, B_3, B_4, B_5 (Table 3).

These estimates of different risk injury due to technical, organizational and psychophysiological reasons for allowing more detail to take into account causal relationships that occur during injury in the food industry, providing a more targeted, and therefore effective preventive measures.

Thus, the analysis of matrices of risk for the food industry allowed to reveal a characteristic feature - the risks are distributed very unevenly among the 240 analyzed a variety of reasons.

Causes of the 50% and 75% of risks of fatal injury in the food industry, 2003–2012

	Π_1	Π_2	Π_3	Π_4	Π_5	Π_6	Π_7	Π_8	Π_9	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}	Π_{15}	Π_{16}
B_1	17	27	5	28	3	45	46	47	48	6	1	2	4	42	43	44
B_2	36	51	19	53	9					23	7	8	12			
B_3	49		29		21					32	15	13	24			
B_4	50		30		22					33	16	14	25			
B_5	38		26		18					31	11	10	20			
B_6			52		37						34	35	39			
B_7																
B_8																
B_9																
B_{10}																
B_{11}																
B_{12}																
B_{13}																
B_{14}																
B_{15}											40	41				

Causes of the 50% and 75% of risks of non-fatal injury in the food industry, 2003–2012

	Π_1	Π_2	Π_3	Π_4	Π_5	Π_6	Π_7	Π_8	Π_9	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}	Π_{15}	Π_{16}
B_1	27	49	8	25	12					1	3	9	4	26	46	17
B_2	48		15	44	22					2	10	16	11	45		30
B_3			32		41					6	20	33	21			
B_4			37		47					7	23	39	24			
B_5			29		40					5	18	31	19			
B_6										28						
B_7										13	35		38			
B_8																
B_9										42						
B_{10}																
B_{11}																
B_{12}																
B_{13}																
B_{14}										43						
B_{15}			50							14	34		36			

Analysis of the distribution of ranked values of different risks in food industries, results are presented in (Table 2-3), showed that 75% of the risk of fatal injuries and non-fatal corresponds to 20% allocated in the matrix of variety of risk. This is consistent with a wide regularity, called the principle of 20/80.

In contrast to the known results of the analysis of the causes of injury, obtained in work regularities and features of the distribution causes of injury by various of reasons substantially expand and elaborate knowledge of the immediate causes of injury and allow a clear choice and justify preventive measures.

We proposed an approach to the research of the main causes and types of events, which occur during getting injury in the food industries. This approach is in the matrix of risk of injury for 15 kinds of events, which led to accidents, and 16 causes of injuries, background information of which is shown in the official sources. The matrix of risk provides quantitative statistical assessment 240 different causes of risk for binary groups "cause of accident - kind of traumatic event". Presence in the matrix of risks quantitative values enables for ranking of different types of risk in view of their seriousness. In its turn it facilitates the choice of preventive measures and provides a more effective impact on total risk (because of targeting prevention on different kind with the largest values of risk indicators). The peculiarity of matrices of risks is that the comparison of two matrices The peculiarity of matrices of risks is that the comparison of two matrices (injury with fatalities and with no such effects) allows to get additional characterization of injury severity for the practice of risk analysis as the number of victims with no fatal consequences on one fatal.

For the first time was clarified the regularity of ranking of the binary interrelations "Reason of the injury - kind of the traumatic event" for the food industries, which is that only near 20% of them contribute 75% of the risk of injury.

Conclusions

Research of the causation of injury in the food industry based on calculating conditional probabilities brings together disparate statistics on the causes of accidents and the types of events that result in injury into a single system of quantitative estimates of different risks for pairs "cause - the kind of traumatic event". This method specifies causal relationships laid down in the official statistics on occupational injuries, and more clearly and unambiguously indicates the measures and means to effective prevention accidents at the food industry enterprises.

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The origin and essence of money. Modern point of view

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ABSTRACT

Introduction. Attempts to determine the origin, nature and role of money have a long history. In particular those questions were put back in the writings of classical political economy by Adam Smith and David Ricardo. We notice a lot of conflicting opinions analyzing the current theoretical research on the money essence and nature. So the article was to explore these issues more deeply and show the vision of the problem because we consider it relevant in modern economy which is constantly changing and transformating.

Materials and methods. Theoretical and methodological basis of research was the work of local and foreign scientists. Investigated and analyzed work of Adam Smith and David Ricardo, K.R.MacConnell, S.L. Brue, V. Usoskin, L. Krasavina, G. Kravtsova, M. Savluk, A. Moroz and others.

Results. We can note the diversity and complexity of monetary nature having examined the basic views on the essence of money. Money is in constant evolution, its development is not straightforward and has a recurring character. Attempts to transfer patterns of well-studied forms of money in their present understanding can not be very successful. Moving, dynamic nature, variability, transition from one dominant traits of money to another, do not give an opportunity to understand their essence in whole. From the first emergence of goods production and to the present time there were some significant changes. Loan nature of money replaced the commodity nature. Money took on features of the capital cost. However, there is an information component in the substance of money. In spite of the fact that the essence of money is a complex phenomenon, it is fully cognized.A universal definition of money, in our opinion,does not exist as well as an ideal form of money. In fact money is the basis of their ability to be a repository, concentration of value equivalent , an instrument of economic relations between people and a mirror that reflects all the contradictions of our society.

Introduction

Money is a kind of mystery, a phenomenon that always attracts philosophers and practical economists` attention . It can be considered one of the most important creations of human society. People work and suffer through money inventing different ways of getting and spending it. Money - is the only product that can not be used in a different way than spending it. It does not feed people or give shelter, it entertains as long as it is spent or invested. People do almost everything for money and money does almost everything for people.

Problem and analysis of recent research. Attempts to determine the origin, nature and role of money have a long history.In particular those questions were put back in the writings of classical political economy by Adam Smith and David Ricardo. Thereafter, they were generalized and worked up critically processing by other major theorists of the XIX-XX centuries**:** K. Marx, G.S. Mille, W. Jevons, L. Walras, A. Marshall. In the first half of XX century the theory of money was developed in the works of modern economics classics J. Hicks, P. Samuelson, J. Tobin, and F. Modigliani, D. Patinkin, M. Friedman. The scientists of our century K.R.MacConnell, S.L. Brue, V. Usoskin, L. Krasavina, G. Kravtsova, M. Savluk, A. Moroz, M. Puhovkina, A. Shchetinin, A. Demkivskyy continued the research. We notice a lot of conflicting opinions analyzing the current theoretical research on the money essence and nature.

Problem. So the article was to explore these issues more deeply and show the vision of the problem because we consider it relevant in modern economy which is constantly changing and transformating.

Materials and methods

Theoretical and methodological basis of research was the work of local and foreign scientists. Investigated and analyzed work of Adam Smith and David Ricardo, K.R.MacConnell, S.L. Brue, V. Usoskin, L. Krasavina, G. Kravtsova, M. Savluk, A. Moroz and others.

Results and discussion

What is a true meaning of the word "money"? This word is too old for any existing direct information. It is much older than current understanding. Etymology (from ancient Greek «τὸ ἔτυμον» - «true meaning» and from ancient Greek «ὁ λόγος» - «word») of the word "money" is difficult in any language.

Note that the English word «money» resonates with the Latin «moneta» - the so-called Roman goddess Juno (from Latin Juno Moneta), who warned the Romans of the earthquake oncoming (Latin «moneo» - heralds). There were workshops near the temple of Juno on the Capitol in Rome where metal money was minted. The common name of money in English could be due to this title.

Perhaps, «money» is derived from French. «Moneie» or «monere» means council within the meaning of " the goddess warning ".

A large number of scientific papers is devoted to problems of money and money circulation. Today the commonly accepted theory of money does not exist. There are significant differences in all the basic questions of monetary theory among economists, and in particular such as the causes of money laundering as the essence of economic phenomenon, structure and content of their functions [11].

Currently, rationalist and evolutionary conceptions of the money origin are the most conspicuous. Fundamentally different approaches to the interpretation of the origin of money are used in these conceptions.

Rationalist conception of the origin of money historically occurred first. It explains the origin of money as a result of agreement between people about special tools which are necessary for moving values in barter trade. Rationalist theory of the money origin appeared first in the work of Aristotle's "Nicomachean Ethics", indicating that there should be some unit of measure for the exchange of goods by agreement .

Although the rationalist conception occurred not on scientific basis, but it had a lot of supporters among economists. The German economist and statistician G. Knapp (1842-1926) in his book "Essays on the State theory of money" (Die staatliche Theorie des Geldes, 1905) calls money as "product order" or "product of the state." In his opinion, the nature of money has nothing to do with the material value.

The famous British economist L. Harris at his work "Monetary theory" teaches the essence of this concept and accepts the public nature of money analyzing its form [11].

The most influential economist of the second half of the XX century. P. Samuelson in the pages of his world famous work "Economy" noted that money is an artificial social convention [8].

So, the rationalist conception denies the commodity nature of money and its natural origin. This idea of the money origin was even enshrined in law in the legal system of ancient Rome, where one of the dogmas testified that "the emperor decrees value of money." This concept of money as a contract was the leading from the ancient society to the end of the XVIII century.

According to the second - the evolutionary concept, money came as a result of evolutionary process. The transition from subsistence to commercial farming leads to the possibility of creating an additional product as a result of increased productivity of social labour. A producer needed to exchange surpluses of his labour. Thus, beyond the will of the people, this process has led to the fact that a particular product stood out from the others and occupied a special place.

One of the founders of the modern economic theory, economist and philosopher Adam Smith created the first full work, which outlines a basic theory of production and distribution. In his book "Inquiry into the Nature and Causes of the nations Wealth " published in 1776, he speaks of the desire to share things as part of human nature, and that money appeared to make the exchange more efficient than barter [9].

The Adam Smith`s follower and opponent, British economist and political economy classic David Ricardo also considered money as a commodity that has value. He determined the value of money by cost of labour. Gold is the basis of the Ricardo`s monetary system. Like Smith, Ricardo rarely uses the concept of consumer value. In his opinion it was necessary only for barter value.

From a large number of scientists engaged in research of the money nature the German economist Karl Marx was the most scientific. In a critical review of common economic theory of that time he starts his research with the role of money and goods in the development of capitalism. Marx investigates the facts of simple commodity production, proves scientifically the existence of commodity production and trade in precapitalist times and argues historical causes of the capital origin [7].

Categories of goods and its value was sufficiently studied by representatives and followers of classical school, but only Marx gave a short and logical definition for the largest value of goods. According to Marx, money is also a product that serves a specific

form, but due to its participation in the process of exchange ,value takes the form of rates which can equal the cost and may differ from it.

Nowadays money market and its main element - money are important components of the world economy. It is not possible to construct a perfect economic model without deep theoretical knowledge, which influences on almost all the parts of society existence . The essence of money is important in studying it as an economic category.

Essence is a philosophical term that expresses the main, decisive features in the subject, which are caused by necessary internal connections and trends and known at the level of theoretical thinking. The essence always acts as inner meaning of phenomena hidden from direct perception. Theoretical determination of money hidden in their content and nature will help to understand the nature and role of money in general..

Money as public relations. Economists of Soviet times often determine the money through public relations [4].

According to L. Harris, the most fundamental feature of money is its social phenomenon [11].

It should be noted that money is an essential active element and integral part of economic activities, relations between various participants and links of the reproductive process. In this case, the essence of money is characterized by their participation in the implementation of various kinds of social relations, but the essence of money can not be the same, it should reflect the development of economic relations in society and money changes .

Modern economics mentions close relations between the state and the money because of extremely important economic and social role for society .We can`t deny the state's role in formation and evolution of money [1].

So, money is a tool of social economic relations and a means of material resources distribution. It is not possible to cancel or change money by agreement between people or a decision until the state can not use its social relations. And the introduction of money without such relationship is impossible.

Money as information. Money is information about some of the cost of certain carriers, adopted by the community to create absolute confidence. Informational essence of money began to appear when the gold coin after its first steps in circulation due to its abrasion have become less cost than its face value. Informational essence of money as abstract, countable, and ideal can not be extended over all the money. Checks, calculations in giro , credit cards, electronic money which are carriers of the information about cash flows, have informational nature while the money are monetary funds in the accounts of financial institutions and checks or electronic money are direct kinds of credit money.

Money is a function they perform. According to K.R.McConnell and S.L.Brue money is something they do and everything that serves as money is money [6]. Proponents of the economic concept determine the nature of money by their functions and its value by how well money performs its functions [3].

The functions of money are the specific manifestation of form and content of a universal equivalent, that is why the disclosure of categories of money through their functions,is incorrect in our opinion. You can not consider money only through the external features of its operation. The essence of phenomena only appears, but it is not formed by them, and therefore it can not be reduced to the sum of these phenomena.

Money as a commodity. This view of the nature of money is to place money in the commodity exchange. In this interpretation, despite the demonetization of gold, money is a specific product that has abilities to trade for any other goods acting as a universal equivalent.

Some product usually satisfies some of the human needs. Money also represents a specific product, serving as direct and total implementation of cost, that is why it has the ability of trading for all other commodities . Normal product acts only as a product of particular work (shoemaker, baker, scientist). Money is the only product that acts as a direct implementation of abstract labour without reference to professional affiliation.

Modern money, not as a sign of gold, acts only as the sign of value and therefore is ideal as a universal equivalent. In this case the definition of money as a specific product does not disclose the nature of modern money because money became more abstract independent category in the issue of transformation .Modern money is not marketable nature, although the fact of the money origin from goods is absolute. Money as capital. Determination of current money and all the money in general due to the capital cost category is rather good. Money is not capital inherently. They can manifest itself as capital when used not as simple intermediary exchange but as money for profit.

Lending money is not the only possible form of capital. But this form of credit money merged with other traffic of loan capital more closely and led to attempts of economists to give an interpretation of modern money through the category of capital and not through commercial value.

Features of current value of money, according to some scientists and economists, are more similar to the characteristics of the capital cost but not goods [2].

Although the current credit money is not essentially a commodity, it is a transformed form of capital, as well as complete money once - gold and other goods that performed monetary functions and have been the transformed form of the product. It can manifest itself as capital.

Financial money. As we have discussed above, the money can be a form of movement and display of capital. In fact money is relatively easy to pass on from money in the capital and back again. Therefore it seems that there is no difference between modern money and capital. In academic world there were some mentions of the so-called financial funds, which are essentially financial instruments. Financial instruments are financial assets / liabilities, and distribution and redistribution of created capital are implemented through intermediary of them . A financial instrument is a legal document that reflects some contractual relationship or provides certain rights, which include stocks, bonds, checks, bills, certificates of deposit, etc..

Thus, financial money can be called as securities of various kinds, a new class of money intended for maintenance of capital accumulation and redistribution of income in society.

The need for financial money is determined by the fact that lending money, even in its best form, the form of money deposit, can not provide enough opportunities in the accumulation of capital.

When lending money is spent on acquisition of financial assets, it delegates its responsibility to financial money to serve as a means of savings as far as financial money can do it more efficiently and diversely. The economy created a complex system of credit forms of payment. All financial and credit institutions are involved in this system. Instruments of payment are the obligations and requirements of these institutions, such as bills, commercial bills, checks, and perpetual term deposits, government securities, stocks and financial and non-financial corporations bonds, mortgage lists, insurance policies, pension funds securities, mutual insurance banks, credit unions, brokers, dealers and others.

Various attempts to understand the essence of money are not finished. It should be noted that there are other interesting scientific interpretations of this problem[5].

Conlusions

We can note the diversity and complexity of monetary nature having examined the basic views on the essence of money. Money is in constant evolution, its development is not straightforward and has a recurring character. Attempts to transfer patterns of well-studied forms of money in their present understanding can not be very successful. Moving, dynamic nature, variability, transition from one dominant traits of money to another, do not give an opportunity to understand their essence in whole. From the first emergence of goods production and to the present time there were some significant changes. Loan nature of money replaced the commodity nature. Money took on features of the capital cost. However, there is an information component in the substance of money .In spite of the fact that the essence of money is a complex phenomenon, it is fully cognized.A universal definition of money, in our opinion,does not exist as well as an ideal form of money. In fact money is the basis of their ability to be a repository, concentration of value equivalent , an instrument of economic relations between people and a mirror that reflects all the contradictions of our society.

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Abstracts in Ukrainian

Анотації

Харчові технології

Застосування кріотекстуратів крохмалю для інкапсулювання кверцетину

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Вступ. Зберігати та транспортувати біологічно активні речовини можна шляхом їх включення в структуру природних високомолекулярних сполук, що відіграють роль мікрокапсул. Шляхом інкапсулювання можна перевести деякі сполуки в розчинну форму, що підвищує їх засвоюваність. Матеріали для інкапсулювання - білки, полісахариди, зокрема крохмаль.

Матеріали і методи. Предмет досліджень - крохмаль, отриманий заморожуванням крохмальних клейстерів, і продукт його взаємодії з кверцетином. Отримані продукти досліджували за допомогою скануючого електронного мікроскопа LEO 1420 (Germany), рентгенофазовий аналіз проведено за допомогою рентгенівського дифрактометра HZG4A (Carl Zeiss, Jena, Germany), для вивчення складу був використаний метод УФ- видимої спектроскопії на приладі Thermo scientific Evolution 600, UV- VIS.

Результати. Виготовлено зразки кріотекстуратів крохмалю шляхом заморожування суспензії кукурудзяного крохмалю концентрацією 5 і 10 %, та використано їх для інкапсулювання кверцетину. Порівнюючи отримані спектри uv-vis крохмалю, кверцетину і продукту сорбції кверцетину на крохмалі, встановили наявність хімічної взаємодії між молекулами крохмалю і кверцетину. Рентгенофазовий аналіз (РФА) показав зміни в ступені кристалічності, що відбуваються при модифікації крохмалю заморожуванням. РФА продукту взаємодії кріотекстурату крохмалю з кверцетином показав, що кверцетин в ньому знаходиться в некристалічній формі при збереженні аморфно-кристалічної структури пористого крохмалю.

Висновки. Застосування розчинних комплексів дозволяє створити на їх основі харчові добавки оздоровчої дії.

Ключові слова: крохмаль, заморожування, кріотекстурат, кверцетин, інкапсулювання

Вплив розмірів частинок емульсій на якість та стабільність напоїв

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Вступ. Необхідно визначити вплив розмірів часток на стабільність емульсій в процесі їх зберігання і використання у виробництві напоїв.

Методи досліджень. Досліджувались зразки емульсій з різними стабілізаторами (гуміарабік, модифікований крохмаль), розмірами від 0,1-1,0 мкм та понад 1,0 мкм. При визначенні стабільності емульсії, діаметр частинок визначено методом лазерної гранулометрії та постановки на стійкість безалкогольного напою на 180 днів, в якому використовувалась емульсія.

Результати. Технології приготування емульсії з гуміарабіком та крохмалем відрізняються. Для отримання емульсій з часточками до 1 мкм важливо підібрати тиски гомогенізатора для певної водної та масляної фаз. В процесі зберігання продуктів з розміром частинок більше 1,0 мкм з'являлося «кремування», яке пов'язане з порушенням структури емульсії та перетворення масляних часток у більші і спливання їх на поверхню. У продуктах з розмірами частинок емульсії 0,1-1,0 мкм цих змін не спостерігалося. При виготовленні емульсійних продуктів, з метою збереження їх стабільності і якості, розмір часток емульсій не повинен перевищувати 1,0 мкм. Результати досліджень можна застосувати в виробництві емульсій для напоїв.

Ключові слова: емульсія, фаза, гомогенізатор, стабільність

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Технологія виробництва кумисного функціонального напою

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Башкирське регіональне відділення Міжнародної академії аграрної освіти

Вступ. Мета роботи - розробка технології виробництва та оцінка збагаченого йодом кумисної напою, продукту функціонального призначення.

Матеріали та методи. Досліджувалися матеріали: кобиляче молоко, кумис, кумисовий напій з коров'ячого молока, збагачений йодом та інуліном. Визначали вміст масової концентрації йоду, свинцю, міді, цинку, кадмію на вольтамперметричному аналізаторі Екотест - ВА. Антиоксидантні властивості інуліну та комплексу йод - інулін визначені методом хемілюмінесцентного аналізу.

Результати та обговорення. Запропоновано новий об'єктивний товарознавчий показник аналізу якості кумису і кумисних напоїв, заснований на вивченні інтенсивності процесів надслабкого світіння продукту. Розроблено модифікований метод хемілюмінесцентного аналізу з використанням $1 \cdot 10^{-1}$ М розчину азодіізобутиронітрила як ініціатора процесів вільнорадикального перекисного окислення ліпідів. Науково обгрунтований спосіб експрес-оцінки якісних характеристик кумису методом хемілюмінесцентного аналізу: визначають світлосуми і максимальну світність хемілюмінесценції кумису; при їх значенні в межах від $0,93 \pm 0,07$ у.о. до $2,17 \pm 0,26$ у.о. і від $0,57 \pm 0,05$ у.о. до $1,92 \pm 0,41$ у.о. відповідно продукт оцінюють як зберігший якість і біологічну цінність. Проведена лабораторна та промислова апробація розробленої технології напоїв кумисних, збагачених інуліном і йодом в промислових умовах. На моделях експериментального йодного дефіциту у щурів показано, що напій кумисний, збагачений йодом і інуліном, характеризується фізіологічною активністю. Доведено економічну

ефективність виробництва напою. Впровадження розробки на молочних підприємствах дозволить забезпечити населення здоровим функціональним харчуванням.

Ключові слова: молоко, кумис, йод, інулін.

Вивчення фазових переходів «вода – лід» у рослинній сировині

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Вступ. Для розроблення оптимальних параметрів заморожування необхідним є з'ясування температурних інтервалів кристалізації води, яка складає до 90% маси плодоовочевої сировини. Метою роботи є вивчення фазових переходів «вода – лід» у різних видах сировини при її заморожуванні і плавленні льоду.

Матеріали та методи. Предметом досліджень є дикорослі та культивовані ягоди, широко розповсюджені на території України, – смородина, чорниці, шипшина, журавлина, полуниці тощо. Дослідження проводили методом диференційної скануючої мікрокалориметрії, який дає значний обсяг інформації як щодо стану води у клітинах, так і про співвідношення вільної та зв'язаної води в досліджуваних матеріалах.

Результати та обговорення. Визначено температурні інтервали, при яких найбільш доцільно проводити заморожування різних видів сировини з точки зору максимального збереження усіх цінних біокомпонентів та цілісної структури плодів і ягід.

Ключові слова: низькі температури, вода, лід, плодоовочева сировина, біокомпоненти.

Застосування мінеральних добавок у виробництві м'ясних продуктів

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Вступ. В останні роки в групі харчових добавок, які регулюють консистенцію, велика увага приділяється стабілізаційним системам, які містять декілька компонентів.

Матеріали та методи. Визначали оптимальний склад композиційних сумішей за факторним експериментом, колір за шкалою «Тінторама», волого-зв'язуючу здатність та пластичність сумішей методом пресування, а також термостійкість розробленого нами бурякового барвника методом нагрівання при різних температурах, ξ-потенціал розчинів барвника з харчовими добавками.

Результати. Визначено раціональний склад структуро-моделюючих композиції на основі нанокомпозитів і розробленого червоного барвника з буряку. Підтверджена можливість стабілізації ξ-потенціалу бурякового соку буферним комплексом і мінеральною добавкою, перспективність використаня даних композитів у технології

виробництва м'ясних та м'ясомістких продуктів, що виробляються за технологіями виробництва варених ковбас і м'ясних хлібів.

Ключові слова: барвник, стабілізація, нанокомпозит, м'ясо.

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Установка для контролю температури продуктів під час холодильного оброблення

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Вступ. Визначення кріоскопічної температури – одне з головних завдань під час вироблення морозива. На даний момент немає даних про кріоскопічні температури нових сумішей для морозива. Стандартний метод визначення кріоскопічної температури має певні недоліки.

Матеріали і методи. Нові суміші для морозива і дистильована вода досліджувалися за допомогою установки, основою якої були термопари Т-типу, контролери ICP I-7014, перетворювачі сигналу ICP I-7520 і ПК із спеціальним програмним забезпеченням NDCONUTILv3 для реєстрації температури.

Результати. Побудовані криві заморожування для 20 нових сумішей для морозива на молочній та безмолочній основах. З кривих визначені кріоскопічні температури для цих сумішей. Використання дистильованої води протягом усього часу вимірювань дозволило збільшити їх точність. Одночасне вимірювання для 4-5 сумішей з використанням 2-3 термопар для кожної суміші дозволило збільшити точність вимірювань і скоротити їх тривалість. Вдосконалено спосіб визначення кріоскопічної температури за допомогою термопар. Спроектована та зібрана лабораторна установка для визначення кріоскопічної температури.

*Ключові слова***:** морозиво, заморожування, кріоскопія.

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Дослідження способів вилучення пектину з картоплі

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Вступ. Крім традиційних сировинних ресурсів для аиробництва пектину - яблучних та цитрусових вичавок, перспективною сировиною є картопляна мезга, яка утворюється внаслідок виробництва крохмалю з картоплі і містить близько 2…5,5 % пектину до маси сухих речовин.

Матеріали і методи. Матеріал досліджень – картопляна мезга. Шляхом статистичного оброблення попередніх експериментальних даних визначено оптимальні параметри процесу гідролізу-екстрагування картопляного пектину. Структуру одержаного картопляного пектину досліджено за допомогою ІЧ-спектроскопії.

Результати. Визначено оптимальні параметри процесу гідролізу-екстрагування картопляного пектину. Встановлено особливості структури одержаного пектину за допомогою методу ІЧ-спектроскопії. З'ясовано, що пектин, вилучений з картоплі

містить значну кількість баластних речовин і має низьку драглеутворювальну здатність. Отримані зразки пектину містять значну кількість крохмалю, що екстрагується разом із пектиновими речовинами і осаджується етанолом. Використання ферментів для гідролізу сировини підвищує чистоту пектину.

Висновки. Картопля - перспективна сировина для отримання пектину. Спектри картопляного пектину, зроблені у інфрачервоній області, підтверджують наявність функціональних (карбоксильних, гідроксильних та ефірнозв'язаних) груп у молекулі цього полісахариду. Зразки пектину, отримані при обробленні сировини ферментними препаратами, мають значно більшу кількість карбоксильних та карбонільних груп, що свідчить про частковий гідроліз полісахаридів крохмалю.

***Ключові слова*:** пектин, гідроліз, картопля, мезга, ІЧ, спектр.

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Використання рослинних олій в м′ясних паштетах

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Вступ. Згідно з основними постулатами сучасної науки про харчування функціональні продукти повинні володіти властивостями, необхідними для підтримки життєво важливих функцій організму. Органолептичні і фізико-хімічні властивості нових функціональних м′ясних продуктів є об'єктом інтенсивних досліджень.

Матеріали і методи. Органолептичні характеристики були визначені при опитуванні контрольної групи з 10 осіб. Фізико-хімічні властивості були визначені за стандартною методикою, склад олій – за допомогою газової хроматографії згідно стандарту EN ISO 5509-2002.

Результати і обговорення. Знайдено, що додавання рослинних олій в кількості 7-10% має позитивний ефект на органолептичні і фізико-хімічні характеристики виготовлених м′ясних паштетів. Консистенція їх стає більш м′якою, а структура більш гнучкою. Порівняльний аналіз складу жирних кислот рослинних олій підтверджує можливість їх використання в технологіях паштетів. Збагачення ними м′ясних продуктів дозволяє знизити в рецептурах паштетів вміст жирів тваринного походження на 7-10 %.

***Ключові слова*:** м′ясо, паштет, олія, рецептура

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Хімічні реагенти для інтенсифікації процесів очищення дифузійного соку

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Вступ. Подальше удосконалення технологічної схеми очищення дифузійного соку можливе за рахунок підвищення ефекту очищення безпосередньо в процесі екстракції, впровадження прогресивних технологій з відокремленням осаду до основного вапнування, інтенсифікація хімічних і адсорбційних процесів на різних

стадіях очищення, використання додаткових високоефективних коагулянтів, флокулянтів і дешевих природних сорбентів.

Матеріали і методи. Визначення технологічних показників соків та сиропів проведено за загальноприйнятими методиками відповідно до діючих стандартів.

Результати і обговорення. Встановлено, що за витрат дигідрофосфату амонію 0,20 % до маси декантату соку попереднього вапнування повнота осадження ВМС збільшується на 84,0 %, солей кальцію та аніонів кислот – на 93,0 %, барвних речовин – на 27,0 %. Чистота очищеного соку II карбонізації підвищується на 2,0 од. При введенні у фільтрований сік I карбонізації дигідрофосфату амонію в кількості 0,10…0,15 % до м.с. в зоні pH 11,5…9,5 ступінь осадження аніонів кислот та солей кальцію збільшується на 85,0 %, барвних речовин – на 55,0 %, ВМС – на 57,0 %, в тому числі білкових речовин і продуктів їх деструкції – на 70,0 %, що призводить до суттєвого підвищення чистоти соку II карбонізації – в середньому на 2,0 од. Запропоновано механізм утворення гідроксилапатиту при вапняно-вуглекислотному очищенні дифузійного соку з використанням дигідрофосфату амонію.

Висновки. Обгрунтована ефективність використання дигідрофосфату амонію на початковій та заключній стадіях очищення дифузійного соку, що дозволяє інтенсифікувати хімічні та адсорбційні процеси в результаті утворення гідроксилапатиту з великою питомою поверхнею, підвищити чистоту і знизити в'язкість очищеного соку та сиропу, збільшити вихід білого цукру і покращити його якість. Розроблені математичні моделі, обрані локальні критерії оптимальності та розв'язані задачі оптимізації витрат дигідрофосфату амонію для додаткового очищення декантату соку попереднього вапнування та фільтрованого соку I карбонізації.

*Ключові слова***:** фосфат, гідроксилапатит, очищення, дифузія, сік.

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Вплив гідроколоїдів на стійкість фруктових наповнювачів

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Вступ. Для розширення асортименту та покращення харчової цінності коекструзійних виробів, в якості наповнювача розроблені фруктові начинки.

Матеріали і методи. Серія начинок, на основі пектину та його суміші з крохмалем досліджена органолептично методом «багатокутника» по таким показникам: колір, прозорість, смак, запах, консистенція та поведінка в корпусі, для дослідження поведінки начинки при зберіганні, а саме вологоутримання. Вміст сухих речовин визначено рефрактометричним методом.

Результати. Базуючись на отриманих даних, зміни масової частки сухих речовин в процесі зберігання виробу, серед досліджуваних зразків виділяється група фруктових начинок в яких діапазон зміни вмісту сухих речовин становить лише 4,5 - 5,6 %. Кращими виявилися: начинка, зварена з внесенням пектину та мод. крохмалю Emjel та начинки на основі яблучного соку з внесенням пектину. В решти зразках начинки зміна становить від 6,5 до 11,5 % сухих речовин.

—— *Abstracts* ——

На основі загальної оцінки показників якості визначено оптимальні зразки начинки. Із серії зразків начинки, для використання в ко-екструзійних продуктах рекомендовані зразки, виготовлені з внесенням пектину та пектину в суміші з модифікованим крохмалем Flojel на основі яблучного соку.

Ключові слова: начинка, гідроколоїди, пектин, крохмаль.

Процеси та обладнання харчових виробництв

Методи відновлення адсорбційних властивостей шунгіта після оброблення соку столового буряка

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Вступ. Досліджено методи регенерації шунгіта для повторного використання в технології виробництва соку столового буряка.

Матеріали і методи. Використано шунгіт – адсорбент вуглецевої природи, завдяки особливостям його структури. Порівняння адсорбційних властивостей регенерованого різними методами шунгіту проведено за допомогою ефекта очищення соку столового буряка від пектинових речовин.

Результати. Важливою складовою шунгіта є наявність фулеренових вуглецевих нанотрубок, поверхня яких утворена кільцями активного вуглецю. Шунгіт має вільний пористий простір, представлений трьохвимірним лабіринтом взаємопов'язаних розширень та звужень різного розміру та форми, включаючи мікро-мезо-макропори. Відпрацьований шунгіт висушували в муфельних печах при різних температурах і тривалостях. Другий метод – використання перегрітої водяної пари для відновлення адсорбційних властивостей шунгіта. Встановлено доцільність використання методу регенерації шунгіта перегрітою водяною парою при температурі t=170º С протягом 30 хв. Досягнуто максимальний ефект очищення соку столового буряка від пектинових речовин регенерованим водяною парою шунгітом в 34%.

Ключові слова: *метод, регенерація, шунгіт, адсорбція, очищення, пара.*

Дослідження консистенції дисперсних систем методом гравітаційної пенетрації

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Вступ. Методи визначення консистенції харчових продуктів потребують вдосконалення, спрощення експериментального обладнання, розробки єдиного числового показника її вимірювань.

Abstracts

Матеріали і методи. Експериментальні дослідження виконані на гравітаційному пенетрометрі. Математичне моделювання виконано на основі силового аналізу руху гравітаційного пенетрометра.

Результати. На основі теоретичних досліджень розроблено простий в апаратурному оформленні спосіб визначення консистенції концентрованих текучих харчових дисперсних систем. Теоретично обґрунтовано і побудовано математичну модель розрахунку сили опору занурення гравітаційного пенетрометра, як характеристики консистенції продукту. Запропоновано модель руху гравітаційного пенетрометра крізь шар продукту, в основу якої покладено диференціальне рівняння другого порядку. Розв'язок отримано при крайових умовах. Для спрощення проведення досліджень виконано його диференціювання і визначено швидкість занурення пенетрометра.

Результати досліджень рекомендовано використовувати для характеристики різних за консистенцією харчових дисперсних систем.

Ключові слова: пенетрація, в'язкість, консистенція.

Розрахунок геометричних параметрів ошпарювача

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Вступ. Розглянуто процес ошпарювання бурякової стружки. Мета досліджень - вдосконалення методики розрахунку геометричних параметрів протитечійних ошпарювачів.

Матеріали та методи. Методи досліджень базуються на фізико - хімічних законах фазових перетворень і обробці виробничих випробувань.

Результати та обговорення. Виділено основні стадії процесу ошпарювання: попередній нагрів стружки, остаточний нагрів стружки, розділення соко - стружкової суміші і піни, руйнування піни. Виходячи з оптимальних гідродинамічних умов проведення процесів у ошпарювачі, запропоновані формули для розрахунку: діаметра ошпарювача, довжини проточної частини, довжини ділянки змішування, діаметра збірника - піногасника.

Наведено основні розміри для ошпарювачів різної продуктивності. Отримані результати слід враховувати при проектуванні ошпарювачів для дифузійних установок колонного, ротаційного і двухшнекове типів.

Ключові слова: ошпарювач, буряк, стружка, піна, газові, дифузія

Гідродинаміка і масообмін в газорідинних середовищах при очищенні стічних вод харчових підприємств

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Вступ. Мета досліджень - інтенсифікація гідродинамічних і масообмінних процесів в газорідинних середовищах при очищенні стічних вод харчових

підприємств.

Матеріали і методи. При порівнянні аераційних систем оцінювали газоутримувальну здатність середовища та динаміку розчинення кисню. Для експериментальних досліджень розроблено установку з різними конструкціями дифузорів.

Результати. Основні напрямки інтенсифікації масообмінних процесів визначені як генерування змінних тисків за рахунок створення в локальних зонах потенціальних полів сил інерції, концентрація енергетичних потоків в зонах генерування міжфазної поверхні та використання аераторів-диспергаторів. Доведено, що використання кінетичної енергії циркуляційних рідинних потоків у напрямку синтезу силових дій є напрямком, можливості якого порівняно з іншими втручаннями оцінюються на порядок вище.

Висновки. Використання аератора з гофрованим дифузором дає суттєві позитивні зміни щодо утримувальної здатності середовища по газовій фазі та підвищує приблизно на 35 % швидкість розчинення кисню.

Ключові слова: аерація, стік, вода, гомогенізація, газ.

Концентрування сивушного масла в спиртовій колоні

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Вступ. Для удосконалення процесу видалення сивушних олій при ректифікації харчового етилового спирту доцільно виявити зони концентрацій в системі етанол-вода-ізоамілол, які при ректифікації утворюють конденсати гетерогенного типу, та визначити деякі їх технологічні характеристики.

Матеріали та методи. Матеріали для досліджень - система етанол-вода-ізоамінол та сивушні олії. Експериментальні дослідження фазової рівноваги рідина-рідина-пара в системі етанол-вода-ізоамілол вивчалися на приладі циркуляційного типу. Модельні суміші готували ваговим методом.

Результати та обговорення. Визначено зону концентрування сивушного масла в спиртовій колоні на основі утворення гетерогенного конденсату пари в системі етанол-вода-ізоамінол. Зона гетерогенних розчинів в системі етанол-вода-ізоамілол обмежена нодою з вмістом етанолу 8,5…11,4% мас, яка утворює гетерогенні дистиляти при 20 ºС. Технологічно концентрація етанолу більше 10%мас, ізоамілолу – 10% мас у розчині дозволяє отримати при температурі 91,1 ºС гетерогенний дистилят. При низьких 3…5% мас концентраціях спиртів в розчині коефіцієнт ректифікації ізоамілолу обмежений 1.

Результати досліджень доцільно застосувати при удосконаленні процесів ректифікації етилового спирту, проектуванні ректифікаційної колони, контактних пристроїв, визначення їх кількості, розробці технології відбору фракції сивушних олій.

Ключові слова: спирт, сивушна олія, концентрування.

—— *Abstracts* ——

Безпека життєдіяльності

УДК 316.4: 614.8:364.29

Вплив професійного стресу на здоров'я працівників

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Вступ. Багато робочих вважають, що їх робота впливає на здоров'я. Стрес все більше приймається як явище на робочому місці, яке негативно позначається на все більшій кількості людей. Актуальним є ідентифікація умови стресу на робочому місці, які впливають на здоров'я робітників.

Матеріали і методи. Соціологічне опитування з питань умов праці на робочому місці працівників різних вікових категорій і професій в Болгарії.

Результати та обговорення. Вторинний аналіз болгарських даних згідно Fifth EWCS 2010 показує, що робочий стрес, дискримінація, насильство, залякування та переслідування мають негативну дію на здоров'я Болгарських робітників в ЄС. Можна констатувати, що такі фактори, як брак часу, щоб отримати роботу, відсутність консультацій з робітниками, конфлікти між робочими обов'язками та особистими цінностями, часта необхідність приховувати свої почуття, помилки на роботі, які можуть викликати фізичну травму або фінансові втрати, словесні образи, погрози і принизливе поводження також впливають на здоров'я працівників негативно. Тому, створення правових умов для здорового та безпечного робочого середовища повинно бути постійною турботою органів влади та роботодавця. Особливу увагу слід звернути на психологічні небезпеки і пов'язані з ними ризики. Це має першорядне значення, що працівники повинні бути добре інформовані про всіх ризики для здоров'я та безпеку на роботі. Більш детальне дослідження пов'язаних з роботою стресових факторів необхідно провести для того, щоб запропонувати адекватні заходи для роботодавців.

***Ключові* слова:** професія, стрес, персонал, здоров'я.

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Причинно-наслідкові зв'язки виробничого травматизму на харчових підприємствах

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Вступ. Метою роботи є дослідження причинно-наслідкових зв'язків, що призводять до травмування на підприємствах харчової промисловості. Об'єктом дослідження є явище виробничого травматизму на підприємствах харчової промисловості за період 2003...2012 роки.

Матеріали і методи. Застосовані методи статистичного аналізу. Аналіз проведено на основі статистичних даних щодо виробничого травматизму про причини нещасних випадків і видів подій в харчовій промисловості.

Результати. Отримані матриці ризику травмування зі смертельним та без смертельного наслідку для 15 видів подій, що приводили до нещасних випадків і 16 причин травматизму, за період з 2003 по 2012 роки. Розраховані значення ризику для його 240 різновидів. Запропонований підхід до аналізу ризиків травмування на підприємствах харчової промисловості з використанням умовної імовірності, який дозволяє об'єднати розрізнену статистичну інформацію про причини нещасних випадків та види подій, що призводять до травмування в єдину систему кількісних оцінок різновидів ризику для пари "причина – вид травматичної події". Це деталізує причинні зв'язки, закладені в офіційній статистичній інформації з питань виробничого травматизму, та більш чітко й однозначно вказує на заходи і засоби ефективної профілактики ризиків. Вперше встановлено закономірність ранжування бінарних співвідношень "причина травми – вид травматичної події" для підприємств харчової промисловості, яка полягає в тому, що лише близько 20% їх зумовлюють 75 % ризику травмування. Отримані результати можуть бути використані при вдосконаленні проектів управлінських рішень щодо забезпечення безпечних умов праці робітників підприємств харчової промисловості.

Ключові слова: *безпека, праця, травматизм, ризик.*

Економіка та управління

Походження та сутність грошей. Сучасний погляд

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Вступ. Сучасні теоретичні дослідження щодо сутності та природи грошей мають багато суперечливих поглядів. Мета дослідження - вивчити більш глибоко ці питання і показати своє бачення даної проблеми, оскільки вважаємо її актуальною і в сучасних умовах економіки, яка зазнає постійних змін і перетворень.

Матеріали і методи. Теоретичною та методологічною основою досліджень стали роботи вітчизняних і зарубіжних учених. Досліджено і проаналізовано роботи А. Сміта і Д. Рікардо, К.Р. Макконел та Л.С. Брю, Усоскіна В.М., Красавіної Л.Н., Кравцової Г.І., Савлука М.І., Мороза А.М. та ін.

Результати. Розглянувши основні погляди на визначення сутності грошей, можемо відмітити багатоаспектність і складність грошової природи. Гроші знаходяться в постійній еволюції, їх розвиток є непрямолінійним, і носить циклічний характер. Спроби перенести закономірності добре вивчених форм грошей на їх сучасне розуміння можуть бути не дуже успішними. Рухлива, динамічна природа, мінливість, перехід від однієї домінуючою, якщо так можна висловитися, риси характеру грошей, до іншої, не дають у цілому осягнути їхню сутність. Із часів виникнення товарного виробництва і до нинішнього часу відбулися значні зміни. Кредитна природа грошей прийшла на зміну товарній природі. Гроші набули рис капітальної вартості. Разом із тим у суті грошей була і залишається інформаційна складова. Не зважаючи на те, що сутність грошей складне явище, при цьому воно цілком збагненне. Універсального визначення грошей, на наш погляд, не може бути,

як і ідеальної форми грошей. У суті грошей основою є їх здатність бути вмістилищем, згустком вартості, еквівалентом, інструментом економічних відносин людей і дзеркалом, що відображає всі суперечності суспільства.

Ключові слова: *гроші, концепція, раціоналізм, еволюціонізм, фінанси.*

Abstracts in Russian

Аннотации

Пищевые технологити

УДК 664.292

Применение криотекстуратов крахмала для инкапсулирования кверцетина

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Вступление. Хранить и транспортировать биологически активные вещества можно путем их включения в структуру природных высокомолекулярных соединений, играющих роль микрокапсул. Путем инкапсулирования можно перевести некоторые соединения в растворимую форму, что повышает их усвояемость. Материалы для инкапсулирования - белки, полисахариды, в частности крахмал.

Материалы и методы. Предметом исследования - крахмал, полученный путем замораживания крахмальных клейстеров, и продукт его взаимодействия с кверцетином. Полученные продукты исследовали с помощью сканирующего электронного микроскопа LEO 1420 (Germany), рентгенофазовый анализ проведен с помощью рентгеновского дифрактометра HZG4A (Carl Zeiss, Jena, Germany), для изучения состава был использован метод УФ-видимой спектроскопии на приборе Thermo scientific Evolution 600, UV-VIS.

Результаты. Изготовлено образцы криотекстуратов крахмала путем замораживания суспензии кукурузного крахмала концентрацией 5 и 10 %, и использовано их для инкапсулирования кверцетина. Сравнивая полученные спектры uv-vis крахмала, кверцетина и продукта сорбции кверцетина на крахмале, установили наличие химического взаимодействия между молекулами крахмала и кверцетина. Рентгенофазовый анализ (РФА) показал изменения в степени кристалличности, происходящие при модификации крахмала замораживанием. РФА продукта взаимодействия криотекстурата крахмала с кверцетином показал, что кверцетин в нем находится в некристаллической форме при сохранении аморфно-кристаллической структуры пористого крахмала.

Выводы. Использование растворимых комплексов кверцетина с криотекстуратами кукурузного крахмала, что открывает перспективы создания на их основе пищевых добавок оздоровительного действия.

Ключевые слова: крахмал, замораживание, криотекстурат, кверцетин, инкапсулирование.

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Влияние размера частичок эмульсий на качество и стабильность напитков

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Введение. Необходимо определить влияние размеров частиц на стабильность эмульсий в процессе их хранения и использования в производстве напитков.

Методы исследований. Исследовались образцы эмульсий с различными стабилизаторами (гуммиарабик, модифицированный крахмал), размерами от 0,1-1,0 мкм и более 1,0 мкм. При определении стабильности эмульсии, диаметр частиц определено методом лазерной гранулометрии и постановки на устойчивость безалкогольного напитка на 180 дней, в котором использовался эмульсия.

Результаты. Технологии приготовления эмульсии с гуммиарабиком и крахмалом отличаются. Для получения эмульсий с частицами до 1 мкм важно подобрать давления гомогенизатора для определенной водной и масляной фаз. В процессе хранения продуктов с размером частиц более 1,0 мкм появлялось «кремование », которое связано с нарушением структуры эмульсии, преобразования масляных частиц в более крупные и всплытия их на поверхность. В продуктах с размерами частиц эмульсии 0,1-1,0 мкм этих изменений не наблюдалось. При изготовлении эмульсионных продуктов, с целью сохранения их стабильности и качества, размер частиц эмульсий не должен превышать 1,0 мкм. Результаты исследований можно применить в производстве эмульсий для напитков.

Ключевые слова: эмульсия, фаза, гомогенизатор, стабильность

Технология производства кумысного функционального напитка

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Введение. Цель работы - разработка технологии производства и товароведная оценка йодобогащённого кумысного напитка, продукта функционального назначения.

Материалы и методы. Исследовались материалы: кобылье молоко, кумыс, кумысный напиток из коровьего молока, обогащенный йодом и инулином. Определяли содержание массовой концентрации йода, свинца, меди, цинка, кадмия на вольтамперометрическом анализаторе Экотест-ВА. Антиоксидантные свойств инулина и комплекса йод-инулин определены методом хемилюминесцентного анализа.

Результаты и обсуждение. Предложен новый объективный товароведный показатель анализа качества кумыса и кумысных напитков, основанный на изучении интенсивности процессов сверхслабого свечения продукта. Разработан модифицированный метод хемилюминесцентного анализа с использованием $1 \cdot 10^{-1}$ М раствора азодиизобутиронитрила в качестве инициатора процессов свободнорадикального перекисного окисления липидов. Научно обоснован способ экспресс-оценки качественных характеристик кумыса методом хемилю-минесцентного анализа: определяют светосумму и максимальную светимость хемилюминесценции кумыса; при их значениях в пределах от $0,93 \pm 0,07$ у.е. до $2,17 \pm 0,26$ у.е. и от $0,57 \pm 0,05$ у.е. до $1,92 \pm 0,41$ у.е., соответственно, продукт оценивают как сохранивший качество и биологическую ценность. Проведена лабораторная и промышленная апробация разработанной технологии напитков кумысных,

обогащённых инулином и йодом в промышленных условиях. На моделях экспериментального йодного дефицита у крыс показано, что напиток кумысный, обогащённый йодом и инулином, характеризуется физиологической активностью. Доказано экономическую эффективность производства напитка. Внедрение разработки на молочных предприятиях позволит обеспечить население здоровым функциональным питанием.

Ключевые слова: молоко, кумыс, йод, инулин.

Изучение фазовых переходов «вода – лёд» в растительном сырье

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Введение. Для разработки оптимальных параметров замораживания необходимо установить температурные интервалы кристаллизации воды, составляющей до 90% массы плодоовощного сырья. Целью работы является изучение фазовых переходов «вода – лед» в разных видах сырья при его замораживании и плавлении льда.

Материалы и методы. Предметом исследований стали дикорастущие и культивированные ягоды, широко распространенные на территории Украины, – смородины, черники, шиповника, клюквы, клубники и т.д. Исследования проводили методом дифференциальной сканирующей микрокалориметрии, которая дает значительный объем информации как относительно состояния воды в клетках, так и о соотношении свободной и связанной воды в исследуемых материалах.

Результаты и обсуждения. Определено температурные интервалы, при которых наиболее целесообразно проводить замораживание различных видов сырья с точки зрения максимального сохранения всех ценных биокомпонентов сырья и целостности структуры плодов и ягод.

Ключевые слова: низкие температуры, вода, лед, плодоовощное сырье, биокомпоненты.

Использование минеральных добавок в производстве мясных продуктов

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Введение. В последние годы в группе пищевых добавок, регулирующих консистенцию, большое внимание уделяется стабилизационным системам, которые содержат несколько компонентов.

Материалы и методы. Определяли оптимальный состав композиционных смесей по факторному эксперименту, цвет по шкале «Тинторама», влаго-связывающую способность и пластичность смесей методом прессования, термостойкость разработанного нами свекольного красителя методом нагревания при разных температурах, ξ-потенциал растворов красителя с пищевыми добавками.

Результаты. Определен рациональный состав структуро-моделирующих композиций, на основе нанокомпозитов и разработанного красного красителя из свеклы. Подтверждена возможность стабилизации ξ-потенциала свекольного сока буферным комплексом и минеральной добавкой, перспективность использования данных композитов в технологии производства мясных и мясосодержащих продуктов, производимых по технологиям производства вареных колбас и мясных хлебов.

*Ключевые слова***:** краситель, стабилизация, нанокомпозит, мясо.

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Установка для контроля температуры продуктов во время холодильной обработки

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Введение. Определение криоскопической температуры – одна из важных задач при производстве мороженого. В настоящее время отсутствуют данные о криоскопических температурах новых смесей для мороженого. Стандартный метод определения криоскопической температуры имеет определенные недостатки.

Материалы и методы. Новые смеси для мороженого и дистиллированная вода исследовались при помощи установки, основой которой были термопары Т-типа, контроллеры ICP I - 7014, преобразователи сигнала ICP I - 7520 и ПК со специальным программным обеспечением NDCONUTILv3 для регистрации температуры.

Результаты. Построены кривые замораживания 20 новых смесей для мороженого на молочной и безмолочной основах. Из кривых определены криоскопические температуры для этих смесей. Использование дистиллированной воды в течение всего времени измерений позволило увеличить их точность. Одновременное измерение для 4-5 смесей с использованием 2-3 термопар для каждой смеси позволило увеличить точность измерений и сократить их продолжительность. Усовершенствован способ определения криоскопической температуры с помощью термопар. Спроектирована и собрана лабораторная установка для определения криоскопической температуры.

*Ключевые слова***:** мороженое, замораживание, криоскопия.

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Исследование способов извлечения пектина из картофеля

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Введение. Кроме традиционных сырьевых ресурсов для производств пектина - яблочных и цитрусовых выжимок, перспективным сырьем является картофельная мезга, которая образуется в результате производства крахмала из картофеля и содержит около 2…5,5 % пектина к массе сухих веществ.

Материалы и методы. Материал исследований - картофельная мезга. Путем статистической обработки предыдущих экспериментальных данных определены оптимальные параметры процесса гидролиза-экстрагирования картофельного пектина. Структура полученного картофельного пектина исследована при помощи ИК-спектроскопии.

Результаты. Путем планирования эксперимента и статистической обработки экспериментальных данных определены оптимальные параметры процесса гидролиза - экстрагирования картофельного пектина. Исследованы особенности структуры полученного пектина с помощью метода ИК - спектроскопии. Выяснено, что пектин, изъятый из картофеля, содержит значительное количество балластных веществ. С помощью микрофотографирования показано, что полученные образцы пектина содержат значительное количество крахмала, который экстрагируется вместе с пектиновыми веществами и осаждается этанолом. Использование ферментов для гидролиза сырья повышает чистоту пектина.

Выводы. Картофель – перспективное сырье для получения пектина. Спектры картофельного пектина, сделанные в инфракрасной области, подтверждают наличие функциональных (карбоксильных, гидроксильных и ефирносвязаных) групп в молекуле этого полисахарида. Образцы пектина, полученные при обработке сырья ферментными препаратами, имеют значительно большее количество карбоксильных и карбонильных групп, что свидетельствует о частичном гидролизе полисахаридов крахмала.

Ключевые слова: пектин, гидролиз, картофель, мезга, ИК, спектр.

Применение растительных масел в мясных паштетах

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Введение. Согласно основным постулатам современной науки о питании функциональные продукты должны обладать свойствами, необходимыми для поддержания жизненно важных функций организма. Органолептические и физико-химические свойства новых функциональных мясных продуктов являются объектом интенсивных исследований.

Материалы и методы. Органолептические характеристики были определены путем опрашивания в контрольной группе из 10 людей. Физико-химические свойства были определены по стандартной методике, состав масел – при помощи газовой хроматографии согласно стандарту EN ISO 5509-2002.

Результаты и обсуждение. Внесение растительных масел в количестве 7-10% позитивно влияет на органолептические и физико-химические характеристики изготовленных мясных паштетов. Консистенция их становится более мягкой, а структура более гибкой. Сравнительный анализ состава жирных кислот растительных масел подтверждает возможность их применения в технологиях паштетов. Обогащение ими мясных продуктов позволяет снизить в рецептурах паштетов содержание жиров животного происхождения на 7-10 %.

Ключевые слова: мясо, паштет, масло, рецептура.

Химические реагенты для интенсификации процессов очистки диффузионного сока

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Введение. Дальнейшее усовершенствование технологической схемы очистки диффузионного сока возможно за счет повышения эффекта очистки непосредственно в процессе экстракции, внедрения прогрессивных технологий с отделением осадка до основного известкования, интенсификации химических и адсорбционных процессов на разных стадиях очистки, использования дополнительных высокоэффективных коагулянтов, флокулянтов и природных сорбентов.

Материалы и методы. Определение технологических показателей соков и сиропов проведено по общепринятым методикам в соответствии с действующими стандартами.

Результаты и обсуждение. Установлено, что введение в декантат сока предварительного известкования 0,20 % до м. с. дигидрофосфата аммония позволяет увеличить полноту осаждения ВМС до 84,0 %, солей кальция и анионов кислот – до 93,0 % и красящих веществ – до 27,0 %. Это способствует повышению чистоты сока II карбонизации на 2 ед.

При введении в фильтрованный сок I карбонизации дигидрофосфата аммония в количестве 0,10…0,15 % к м. с. в зоне рН 11,5…9,5 степень осаждения анионов кислот и солей кальция увеличивается на 85,0 %, ВМС – на 57,0 %, в том числе белковых веществ – на 70 %, а цветность сока снижается более чем в два раза, что позволяет существенно повысить чистоту сока II карбонизации – в среднем на 2,0 ед.

Предложен механизм образования гидроксилапатита при известковой очистке диффузионного сока с использованием дигидрофосфата аммония.

Выводы. Обоснована эффективность использования дигидрофосфата аммония на начальной и завершающей стадиях очистки диффузионного сока, что позволяет интенсифицировать химические и адсорбционные процессы в результате образования гидроксилапатита с большой удельной поверхностью, повысить чистоту и снизить вязкость очищенного сока и сиропа, увеличить выход белого сахара и его качество.

Ключевые слова: фосфат, гидроксилапатит, очистка, диффузия, сок.

Влияние гидроколлоидов на стойкость плодовых наполнителей

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Введение. Для расширения ассортимента и улучшения пищевой ценности коекструзионных изделий, в качестве наполнителя разработаны фруктовые начинки.

Материалы и методы. Начинки на основе пектина и его смесей с крахмалом исследованы органолептическим методом «многоугольника» по следующим

показателям: цвет, прозрачность, вкус, запах, консистенция и поведение в корпусе. Для исследования влагоудеживания начинки при хранении определено сухие вещества рефрактометрическим методом.

Результаты. Основываясь на данных изменения массовой доли сухих веществ в процессе хранения изделий, среди исследуемых образцов выделяется группа фруктовых начинок, в которых диапазон разницы сухих веществ составляет 4,5-5,6 %. Лучший показатель имеет начинка, приготовленная внесением пектина и модифицированного крахмала Emjel и начинки на основе яблочного сока с внесением пектина. В остальных образцах начинки данный показатель составляет от 6,5 до 11,5 % сухих веществ.

Основываясь на общей оценке показателей качества, определены оптимальные образцы начинок. Для использования в ко-екструзионных продуктах рекомендованы образцы начинок, изготовленные внесением пектина в смеси с модифицированным крахмалом Flojel на базе яблочного сока.

Ключевые слова: начинка, гидроколлоиды, пектин, крахмал.

Процессы и оборудование пищевых производств

Методы восстановления адсорбционных свойств шунгита после обработки сока столовой свеклы

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Введение. Исследованы методы регенерации шунгита для повторного использования в технологии производства сока столовой свеклы.

Материалы и методы. Использован шунгит - адсорбент углеродистой природы благодаря особенностям его структуры. Сравнение адсорбционных свойств регенерированного различными методами шунгита проведено при помощи эффекта очистки сока столовой свеклы от пектиновых веществ.

Результаты. Важной составляющей шунгита является наличие фуллереновых углеродных нанотрубок, поверхность которых образована кольцами активного углерода. Шунгит имеет свободное пористое пространство, представленное трехмерным лабиринтом взаимосвязанных расширений и сужений различного размера и формы, включая микро-мезо-макропоры. Отработанный шунгит высушивали в муфельных печах при различных температурах и длительности. Второй метод – использование перегретого водяного пара для восстановления адсорбционных свойств шунгита. Установлена целесообразность использования метода регенерации шунгита перегретым водяным паром при температуре $t = 170\,°\text{С}$ в течение 30 мин. Достигнут максимальный эффект очистки сока столовой свеклы от пектиновых веществ регенерированным водяным паром шунгита в 34 %.

Ключевые слова: метод, регенерация, шунгит, адсорбция, очистка, пар.

—— *Abstracts* ——

УДК 664.404.8:664.64.016

Исследования консистенции дисперсных систем методом гравитационной пенетрации

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Введение. Методы определения консистенции пищевых продуктов требуют усовершенствования, упрощения экспериментального оборудования, разработки единого числового показателя ее измерений.

Материалы и методы. Экспериментальные исследования выполнены на гравитационном пенетрометре. Математическое моделирование выполнено на основе силового анализа движения гравитационного пенетрометра.

Результаты. На основе теоретических исследований разработана простая в аппаратурном оформлении способ определения консистенции концентрированных текучих пищевых дисперсных систем. Теоретически обоснована и предложена математическая модель расчета силы сопротивления погружения гравитационного пенетрометра, как характеристики консистенции продукта. Предложена модель движения гравитационного пенетрометра сквозь слой продукта, в основу которой положен дифференциальное уравнение второго порядка. Решение получено при краевых условиях. Для упрощения проведения исследований выполнено его дифференцирование и определена скорость погружения пенетрометра.

Результаты исследований рекомендуется использовать для характеристики различных по консистенции пищевых дисперсных систем.

Ключевые слова: пенетрация, вязкость, консистенция.

УДК 664.1.033

Расчёт геометрических параметров ошпаривателя

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Введение. Рассмотрен процесс ошпаривания свекловичной стружки. Цель исследований – совершенствование методики расчета геометрических параметров противоточных ошпаривателей.

Материалы и методы. Методы исследований базируются на физико-химических законах фазовых превращений и обработке производственных данных.

Результаты и обсуждение. Выделены основные стадии процесса ошпаривания: предварительный нагрев стружки, окончательный нагрев стружки, разделение соко-стружечной смеси и пены, разрушение пены. Исходя из оптимальных гидродинамических условий проведения процессов в ошпаривателе, предложены формулы для расчёта: диаметра ошпаривателя, длины противоточного участка, длины участка смешивания, диаметра сборника-пеногасителя. Приведены основные размеры для ошпаривателей различной производительности. Полученные результаты следует учитывать при проектировании ошпаривателей для диффузионных установок колонного, ротационного и двухшнекового типов.

Ключевые слова: ошпариватель, свекла, стружка, пена, диффузия.

УДК 663.62

Гидродинамика и массообмен в газожидкостных средах при очистке стоков пищевых предприятий

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Введение. Цель исследований – интенсификация гидродинамических и массообменных процессов в газожидкостных средах при очистке сточных вод пищевых предприятий.

Материалы и методы. При сравнении аэрационных систем оценивали газоудерживающую способность среды и динамику растворения кислорода. Для экспериментальных исследований разработана установка с различными конструкциями диффузоров.

Результаты. Основные направления интенсификации массообменных процессов определены как генерирование переменных давлений за счет создания в локальных зонах потенциальных полей сил инерции, концентрация энергетических потоков в зонах генерирования межфазной поверхности и использование аэраторов – диспергаторов. Использование кинетической энергии циркуляционных жидкостных потоков в направлении синтеза силовых действий является направлением, возможности которого, по сравнению с другими вмешательствами, оцениваются на порядок выше.

Выводы. Использование аэратора с гофрированным диффузором дает существенные позитивные изменения удерживающей способности среды по газовой фазе и повышает примерно на 35 % скорость растворения кислорода.

Ключевые слова: аэрация, сток, вода, гомогенизация, газ.

УДК 664

Концентрирование сивушного масла в спиртовой колонне

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Введение. Для усовершенствования процесса удаления сивушных масел при ректификации пищевого этилового спирта целесообразно выявить зоны концентрации в системе этанол-вода-изоамилол, которые при ректификации образуют конденсаты гетерогенного типа, и определить некоторые их технологические характеристики.

Материалы и методы. Материалы для исследований – система этанол-вода-изоамилол и сивушные масла. Экспериментальные исследования фазового равновесия жидкость-жидкость-пар в системе этанол-вода-изоамилол изучались на приборе циркуляционного типа. Модельные смеси готовили весовым методом.

Результаты и обсуждение. Определена зона концентрирования сивушного масла в спиртовой колонне на основе образования гетерогенного конденсата пара в системе этанол-вода-изоамилол. Зона гетерогенных растворов в системе этанол-вода-изоамилол ограничена нодой с содержанием этанола 8,5...11,4 % масс, которая образует гетерогенные дистилляты при 20 ºC. Технологически концентрация этанола

более 10 % масс, изоамилола - 10 % масс в растворе позволяет получить при температуре 91,1 ℃ гетерогенный дистиллят. При низких 3...5 % масс концентраций спиртов в растворе коэффициент ректификации изоамилола ограничен 1.

Результаты исследований целесообразно применить при совершенствовании процессов ректификации этилового спирта, проектировании ректификационной колонны, контактных устройств, определения их количества, разработке технологии отбора фракции сивушных масел.

Ключевые слова: спирт, сивушное масло, концентрирование.

Безопасность жизнедеятельности

УДК 316.4: 614.8:364.29

Влияние профессионального стресса на здоровье рабочих

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Введение. Много рабочих считают, что их работа влияет на здоровье. Стресс все больше воспринимается как явление на рабочем месте, которое отрицательно сказывается на все большем количестве людей. Актуальным является идентификация условий стресса на рабочем месте, которые влияют на здоровье рабочих.

Материалы и методы. Социологический опрос по вопросам условий труда на рабочем месте работников разных возрастных категорий и профессий в Болгарии.

Результаты и обсуждение. Вторичный анализ болгарских данных согласно Fifth EWCS 2010 показывает, что рабочий стресс, дискриминация, насилие, запугивание и преследование имеют негативное воздействие на здоровье болгарских рабочих в ЕС. Можно констатировать, что такие факторы, как нехватка времени, чтобы получить работу, отсутствие консультаций с рабочими, конфликты между рабочими обязанностями и личными ценностями, частая необходимость скрывать свои чувства, ошибки на работе, которые могут вызвать физическую травму или финансовые потери, словесные оскорбления, угрозы и унизительное обращение также влияют на здоровье работников отрицательно. Поэтому создание правовых условий для здоровой и безопасной рабочей среды должно быть постоянной заботой органов власти и работодателя. Особое внимание следует обратить на психологические опасности и связанные с ними риски. Первостепенное значение имеет хорошая осведомленность рабочих обо всех рисках для здоровья и безопасности на работе. Более детальное исследование связанных с работой стрессовых факторов необходимо провести для того, чтобы предложить адекватные меры для работодателей.

*Ключевые слова***:** профессия, стресс, персонал, здоровье.

УДК 331.46:614.82

Причинно-следственные связи производственного травматизма на пищевых предприятий

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Введение. Целью работы является исследование причинно-следственных связей по статистике производственного травматизма на предприятиях пищевой промышленности. Объектом исследования является явление производственного травматизма на предприятиях пищевой промышленности за период 2003...2012 годы.

Материалы и методы. Применены методы статистического анализа. Анализ проведен на основании статистических данных по производственному травматизму о причинах несчастных случаев и видов событий в пищевой промышленности.

Результаты. Полученные матрицы риска травматизма со смертельным и без смертельного последствия для 15 видов событий, которые привели к несчастным случаям, и 16 причин травматизма за период с 2003 по 2012 годы. Рассчитаны значения риска для его 240 разновидностей. Предложен подход к анализу рисков травматизма на предприятиях пищевой промышленности с использованием условной вероятности, который позволяет объединить разрозненную статистическую информацию о причинах несчастных случаев и видов событий, приводящих к травматизму в единую систему количественных оценок разновидностей риска для пары "причина – вид травматического события". Это детализирует причинные связи, заложенные в официальной статистической информации по вопросам производственного травматизма, и более четко и однозначно указывает на мероприятия и средства эффективной профилактики рисков. Впервые установлена закономерность ранжирование бинарных соотношений "причина травмы - вид травматического события" для предприятий пищевой промышленности, которая заключается в том, что лишь около 20 % предопределяют 75 % риска травматизма. Полученные результаты могут быть использованы при совершенствовании проектов управленческих решений по обеспечению безопасных условий труда работников предприятий пищевой промышленности.

Ключевые слова: безопасность, труд, травматизм, риск.

Экономика и управление

УДК 336.011

Происхождение и сущность денег. Современный взгляд

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Введение. Попытки выяснить возникновение, сущность и роль денег имеют многовековую историю, эти вопросы раскрываются в трудах классиков политэкономии А. Смита и Д. Рикардо. Современные теоретические исследования о сущности и природе денег имеют массу противоречивых взглядов. Поэтому целью

статьи было исследовать более глубоко эти вопросы и показать свое видение данной проблемы, поскольку она является актуальной и в современных условиях экономики.

Материалы и методы. Теоретической и методологической основой исследований стали работы отечественных и зарубежных ученых. Исследованы и проанализированы работы А. Смита и Д. Рикардо, К.Р. Макконела и Л. Брю, Усоскина В.М., Красавиной Л.Н., Кравцовой Г.И., Савлука М.И., Мороза А.М. и др.

Результаты. Рассмотрев основные взгляды на определение сущности денег, можем отметить многоаспектность и сложность денежной природы. Деньги находятся в постоянной эволюции, их развитие носит циклический характер. Попытки перенести закономерности хорошо изученных форм денег на их современное понимание могут быть не очень успешными. Подвижная, динамическая природа, изменчивость, переход от одной доминирующей черты характера денег, к другой, не позволяют в целом понять их сущность. Со времен возникновения товарного производства и до настоящего времени произошли значительные изменения. Кредитная природа денег пришла на смену товарной природе. Деньги приобрели черты капитальной стоимости. Вместе с тем сущностью денег была и остается информационная составляющая. Несмотря на то, что сущность денег сложное явление, при этом оно вполне постижимо. Универсального определения денег, на наш взгляд, не может быть, как и идеальной формы денег.

Ключевые слова: деньги, концепция, рационализм, эволюционизм, финансы.

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Всі наукові статті, представлені для публікації в «**Ukrainian Journal of Food Science**» проходять «Подвійне сліпе рецензування» (рецензент не знає, чию статтю рецензує, і, відповідно, автор не знає рецензента) принаймні двома вченими, призначених редакційною колегією: один є членом редколегії і один незалежний учений.

Авторське право

Автори статей гарантують, що робота не є порушенням будь-яких існуючих авторських прав, та відшкодовують видавцю порушення даної гарантії. Опубліковані матеріали є правовою власністю видавця «**Ukrainian Journal of Food Science**», якщо не узгоджено інше.

Політика академічної етики

Редакція «**Ukrainian Journal of Food Science**» користується правилами академічної етики, викладених в роботі Miguel Roig (2003, 2006) "Avoiding plagiarism, self-plagiarism, and other questionable writing practices. A guide to ethical writing"

[http:/Vfacpub.stjohns.edu/ roignvplagiarism ~ /].

Редакція пропонує потенційним учасникам журналу, рецензентам і читачам прямо слідувати цьому керівництву, щоб уникнути помилок в науковій літературі.

Шановні колеги!

Редакційна колегія наукового періодичного видання «**Ukrainian Journal of Food Science**» запрошує Вас до публікації результатів наукових досліджень.

Вимоги до оформлення статей

Мова статті – англійська.

Рекомендований обсяг статті – **8-15 сторінок** формату А4**.**

Стаття виконується в текстовому редакторі Microsoft Word 2003 (більш нові версії не допускаються).

Для всіх (!) елементів статті шрифт – **Times New Roman**, кегль – **14**, інтервал – 1, абзац – 1 см.

Всі поля сторінки – по 2 см.

Структура статті:

1. УДК**.**

2. **Назва статті.**

3. Автори статті (ім'я та прізвище повністю, приклад: Денис Озерянко).

4. *Установа, в якій виконана робота.*

5. Анотація. Рекомендований обсяг анотації – пів сторінки. Анотація повинна відповідати структурі статті та містити розділи Вступ, Матеріали і методи, Результати та обговорення, Висновки.

6. Ключові слова (3-5 слів, **але не** словосполучень (!)).

Пункти 2-6 виконати англійською, українською та російською мовами.

7. Основний текст статті. Має включати такі обов'язкові розділи:

- Вступ
- Матеріали та методи
- Результати та обговорення
- Висновки
- Література.

За необхідності можна додавати інші розділи та розбивати їх на підрозділи.

8. Авторська довідка (Прізвище, ім'я та по батькові, вчений ступінь та звання, місце роботи, електронна адреса або телефон).

9. Контактні дані автора, до якого за необхідності буде звертатись редакція журналу (телефон та електронна адреса).

Рисунки виконуються якісно. Розмір тексту на рисунках повинен бути **співрозмірним** (!) основному тексту статті.

Фон графіків, діаграм – лише білий (!). Колір елементів рисунку (лінії, сітка, текст) – чорний (не сірий).

Оригінали рисунків (файли графічних редакторів), а також файли формату EXCEL з графіками обовязково подаються в окремих файлах.

Фотографії та кольорові бажано не використовувати.
Скановані рисунки не приймаються.

Скорочені назви фізичних величин в тексті та на графіках позначаються латинськими літерами відповідно до системи СІ.

В списку літератури повинні переважати статті та монографії іноземних авторів, які опубліковані після 2000 року.

Стаття надсилається за електронною адресою:
ukrfoodscience@meta.ua

Просимо уважно слідкувати за виконанням всіх вимог до оформлення статті, жодну вимогу не ігноруючи.
Найпоширеніші помилки:
- Виконання статті в Word 2007
- Застосування шрифту з іншим кеглем (<u>для всіх елементів статті дозволяється лише 14</u>)
- Дрібний текст на рисунках
- Колір елементів графіків та рисунків – сірий або кольоровий (дозволяється лише чорний), фон графіків та рисунків – сірий (дозволяється лише білий)
- Переклад статті на англійську, і анотації на російську мову виконано неякісно (електронний перекладач перекладає неправильно).
- Не перекладено текст на графіках та рисунках
- Анотація та стаття не розбита на розділи Вступ, Матеріали та методи, Результати та обговорення, Висновки.
- В статті присутні скановані рисунки
- До статті не прикладені файли рисунків та діаграм

Оформлення списку літератури

Наукометричні бази України та світу визначають рейтинг як журналу, так і окремих авторів за кількістю посилань на статті. Електронні системи опрацьовують кожен елемент списку – авторів, назву статті та видання, номер, рік та інші елементи.

Українські стандарти передбачають складні вимоги до оформлення посилань на літературу. Такі посилання не можуть опрацьовуватись наукометричними базами (Scopus, Index Copernicus, EBSCO, Google Scholar, Web of Science та ін.). Ці бази сприймають просте оформлення списку, без косих ліній та зайвих елементів.

В світі відсутні єдині правила оформлення посилань. Наукові видання самі розробляють вимоги оформлення посилань, але зазвичай узгоджують їх із загальноприйнятими вимогами American Psychological Association, Council of Biology Editors, Citation-Sequence, Chicago 16th Edition, Harvard, Harvard - British Standard, NLM - National Library of Medicine та іншими.

Всі визнані світові стандарти передбачають оформлення списку літератури лише латинськими символами. При оформленні посилань на українські та російські джерела необхідно проводити транслітерацію. Користуючись програмами транслітерації, слід уважно вказувати, з якої мови проводиться транслітерація – української чи російської. За транслітерації з української використовуємо лише **Паспортний (КМУ 2010)** стандарт, в якому використовуються лише символи англійського алфавіту. За транслітерації з російської – лише стандарт «МВД».

Список літератури оформлюється згідно таких вимог.

Посилання на статтю.

Автори (рік видання), Назва статті, *Назва журналу (курсивом)*, том (номер), сторінки.
Всі елементи після року видання розділяються комами.

Приклади:

1. Yannick Fayolle, Sylvie Gillot, Arnaud Cockx, Laetitia Bensimhon, Michel Roustan, Alain Heduit (2010), In situ characterization of local hydrodynamic parameters in closed-loop aeration tanks, *Chemical Engineering Journal*, 158(2), pp. 207-212.
2. Carlo Tocchi, Ermanno Federici, Laura Fidati, Rodolfo Manzi, Vittorio Vincigurerra, Maurizio Petruccioli (2012), Aerobic treatment of dairy wastewater in an industrial three-reactor plant: Effect of aeration regime on performances and on protozoan and bacterial communities, *Water Research*, 46(10), pp. 3334-3344.

Приклад оформлення статті, оригінал якої українською мовою:

1. Pyroh T.P., Konon A.D., Skochko A.B. (2011), Vykorystannia mikrobnykh poverkhnevo-aktyvnykh rechovyn u biolohii ta medytsyni*, Biotekhnolohiia*, 4(2), pp. 24-38.

За бажання після транслітерованої назви статті або журналу в {фігурних дужках можна дати переклад англійською мовою}.

Посилання на книгу.

Автори (рік), *Назва книги (курсивом)***, Видавництво, Місто.**
Всі елементи після року видання розділяються комами.

Приклади:

1. Harris L. (1991), *Money theory*, McGraw-Hill Companies, Hardcover
2. Rob Steele (2004), *Understanding and measuring the shelf-life of food*, CRC Press.

Приклад оформлення статті, оригінал якої українською або російською мовою:

1. Donchenko L.V. (2000), Tekhnologiya pektina i pektinoproduktov, Deli, Moscow
2. Kirianova H.A. (2008), Udoskonalennia tekhnolohii termostabilnykh zheleinykh nachynok shliakhom ratsionalnoho vykorystannia hidrokoloidiv roslynnoho ta mikrobnoho pokhodzhennia: PhD tethis, NUHT, Kyiv.
3. Zalutskyi I.R., Tsymbaliuk V.M., Shevchenko C. H. (2009), Planuvannia i diahnostyka diialnosti pidpryiemstva, Novyi svit, Lviv.

За бажання після транслітерованої назви книги в {фігурних дужках можна дати переклад англійською мовою}.

Посилання на електронний ресурс.

Виконується аналогічно посиланню на книгу або статтю. Після оформлення даних про публікацію пишуться слова **available at:** та вказується електронна адреса.

Приклад посилання на статтю із електронного видання:

1. Barbara Chmielewska. (2012), Differentiation of the standard of living of families in countries of the European Union, *Ukrainian Food Journal*, 2(2), pp. 230-241, available at:
http://ufj.ho.ua/Archiv/UKRAINIAN%20FOOD%20JOURNAL%202013%20V.2%20Is.2.pdf
2. (2013), *Svitovi naukovometrychni bazy*, available at:
http://www1.nas.gov.ua/publications/q_a/Pages/scopus.aspx

Наукове видання

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