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Contents

Effect of raw materials nomenclature and their temperature upon safety and quality parameters of mechanically separated poultry meat

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Abstract

Introduction. The research was conducted to determine the influence of technological factors and basic properties of different types of raw materials on the determinants of quality and food safety of poultry meat mechanically separated.

Materials and methods. To fulfill the research most practical and widely spread raw materials for manufacturing mechanically separated poultry meat were used, namely these: whole carcasses of broilers and hens, hen necks and broiler backs. Temperature ranged from minus 4 °C to 6 °C. Research was fulfilled using screw type press-separator «Lima» and band type press-separator «Baader».

Results and discussion. A certain range of the most proper temperature parameters corresponds to each of the types of raw materials studied thus enabling producing mechanically separated poultry meat of the safe content of bone inclusions by significantly high output of end product. During the hard separation using screw separator machines the said range is from 0 °C to 2 °C for almost all the types of the raw materials processed. Decline in bone inclusions content is detected from the temperature threshold of minus 2 °C. In some way lower product output is offset with the quality of the staff obtained – namely the content of bone inclusions. The most proper range for broilers and hen necks is from 4 °C to 6 °C. Rather a similar effect is found for soft separation with the use of band machines. The surface-frozen raw materials are usually known not to be processed with separators of the said type – mainly, because of rapid wear of the pressing band of the separation unit and lower, comparing to screw separator machines, pressure effecting the raw materials. When raw materials are surface-frozen by minus 2 °C and are to be processed with the use of band separators, the said raw materials shall be preliminary ground with the use of meat grinders (meat wolves) equipped with the plates with big diameter orifices.

In average by 9–10% lower output of mechanically separated poultry meat is characteristic for soft separation comparing to hard separation, while the average content of bone inclusions in the case of hard separation is by 40% higher. The most proper, considering technology and food safety issues, temperature range of raw materials is from 2 °C to 6 °C. The use of raw materials their temperature being lower than minus 2 °C is not applicable. The said is especially true for hen necks, as with the decline in temperature the raise in bone inclusions content in end product is drastic.

Conclusion. The research making it possible to obtain mechanically separated poultry meat of minimal bone inclusions content while output values of end products being significant.

Introduction

A significant part of meat protein raw materials in the formulations of the said foods belongs to such poultry raw meats as ground meat after manual deboning and meat of mechanical deboning. More significant part of mechanically deboned meat is often considered to be a beneficial factor for enriching a product with fat, vitamins, mineral substances etc. [1]. It is proven [2], that the nutritional value of poultry meat (namely broiler chickens and turkeys meats) being mechanically deboned is almost equal to the values of the said parameters measured in canned sardines, anchovy and mackerel overwhelming the values measured in plant oils and beef products, while PER (Protein Efficiency Ratio) value in mechanically deboned poultry meat was greater than PER values measured in all the foods mentioned above. However the significant content of bone inclusions confines the use of mechanically deboned poultry meat these inclusions being difficult for detection and proper assessment [3, 4]. A number of studies have been held to determine content of this raw food, namely quality parameters, proteins, lipids and minerals content, bone rests together with stability of proteins and lipids, the presence of pathogen and other microorganisms. Mechanically deboned poultry meat has proven its nutritional and functional traits while being safe for human life and health. The mechanical deboning technology allows preserving useful minerals, lipids and proteins, so that the product obtained as a result of fulfillment of the said technological process can be used for formulating a range of meat foods [5, 6]. At the same time, the mechanical process of removing meat from the bone causes cell breakage, protein denaturation (with deterioration of mechanical properties) and an increase in lipids and free heme groups, which implies several disadvantages, such as color, flavor, palatability (attenuation of characteristic taste) and microbial load, making mechanically separated poultry meat a highly perishable raw material [7]. When the effect of adding chicken breast (5, 15 or 25%) or mechanically deboned chicken meat (5, 15, 25 or 35%) on quality characteristics of emulsion-type sausage was evaluated [8], it was determined that addition of chicken breast sausages caused increased moisture and protein content (%), but decreased fat content of the sausages. Addition of mechanically deboned chicken meat to sausages caused decrease in the moisture and protein content (%), but increase in the fat content (%) of the sausages. Addition of chicken breast to sausages caused raise in P, Na and Cu contents. Addition of mechanically deboned chicken meat sausages caused increase in Ca and Fe contents. The addition of chicken breast sausages increased the hardness, springiness, gumminess and chewiness values, but the addition of mechanically deboned chicken meat to sausages decreased the hardness, springiness, gumminess and chewiness values, so that addition of mechanically deboned chicken meat was the best choice concerning the quality of the sausages.

Materials and methods

To fulfill the research, the most practical and widely spread raw materials for manufacturing mechanically separated poultry meat were used, namely these: whole carcasses of broilers and hens, hen necks and broiler backs. Temperature ranged from minus 4 °C to 6 °C.

Research was fulfilled using screw type press-separator «Lima» and band type press-separator «Baader».

Temperature of the assayed ground meats was determined with the digital thermometer «Checktemp» HI 98509. Determination range is from -50 to 150 °C. Resolution is 0.1 °C. Accuracy is ± 0.3 °C (within temperature range from -20 to 90 °C).

Weight of samples was determined with the use of digital laboratory scale «OHAUS RU 313». Determination range is from 0 to 310 g. Accuracy of measurement ± 0.001 g.

Parameters of raw materials and mechanically separated poultry meat were determined with the use of following methods.

Content (by mass) of bone inclusions in mechanically separated poultry meat was determined with the use of the specially developed method, implying separation of the said particles from other components of the product. Muscle, connective and adipose tissues of a sample are removed by boiling in alkaline solution. Not dissolved particles of the probe are separated from bone inclusions by means of concentrated solution of zinc chloride.

Measurement of weight of bone inclusions is done after removing the excess zinc chloride solution and drying in air oven.

Content of bone inclusion (by mass) is calculated with taking probe weight into account. The range of bone inclusion (by mass) content by gravimetric method is from 0.05% to 1.5%.

The procedure of bone inclusion (by mass) content determination is following.

Potassium hydroxide solution (mass fraction 2%) shall be prepared by dissolving a (20.0 ± 0.5) g probe of potassium hydroxide in 980 cm^3 of distilled water.

Concentrated solution of zinc chloride shall be prepared. For the purpose saturated solution of zinc chloride shall preliminary be prepared – a probe of zinc chloride of weight of (280–300) g shall be dissolved in 100 cm^3 of distilled water. For a probe of a sample analyzed about 70 $см^3$ of concentrated solution of density from 1.65 g/cm^3 to 1.8 g/cm^3 is necessary. Incinerated calcium chloride is placed at the bottom of clean and dry desiccators. A sample of mechanically separated poultry meat shall be comminuted to pasty body and refrigerated by temperature not exceeding 4 °C.

A (50.00±0.05) g probe of sample is weighed in a 250 cm^3 beaker, then 100 cm^3 of water solution of potassium hydroxide of mass fraction 2% shall be added and mixed thoroughly. The beaker with the sample probe shall be placed on water-bath its temperature not being less than 80 °C. The content of beaker shall be stirred occasionally from 1 h to 1.5 h to dissolve fragments of muscle tissue till a layer of not dissolved connective and adipose tissues is formed at the surface of the solution.

The sample shall be removed from water-bath and let settle for about 2 min. The upper layer of solution with the fragments of not dissolved connective and melted adipose tissues shall be decanted with care. After decanting the side walls of the beakers shall be wiped with a cotton or gauze wad rinsed with hot water in the case when the rests of adipose have adhered to. The wad shall be discharged. A portion of 2% potassium hydroxide solution shall be added to the rest of the sample in such a way that the level of solution in beaker was about the same as the solution level before decanting, the solution shall be placed on water-bath again. Adding of potassium hydroxide solution, heating, retention and decanting shall be fulfilled repeatedly before the full dissolving of muscle tissue and removing of adipose and connective tissues. Bone inclusions and other not dissolved particles, separated from the sample, settle at the bottom of the beaker.

The potassium hydroxide solution with settled bone inclusions and other not dissolved particles is decanted with care to prevent from their settling at the walls of the beaker. Then bone inclusions and other not dissolved particles shall be washed in beaker with distilled water 3–4 times by portions of 100–150 cm^3.

After washing bone inclusions and other not dissolved particles shall be carried to dried and weighed to constant mass beakers by rinsing with distilled water, the result of weight measurement shall be recorded with the accuracy of 0.001 g. Then bone inclusions and other not dissolved particles shall be separated with the use of concentrated zinc chloride solution, for the purpose the precipitate with bone inclusions and other not dissolved particles is carried to the beaker by rinsing. The rest of the precipitate is diluted with concentrated zinc chloride solution to fill about 3/4 of the beaker volume. The content of the beaker is mixed by a glass stick and let settle for 1–2 min. Not dissolved particles float at the surface of concentrated zinc chloride solution, as the density of the said solution is higher than the density of not dissolved particles but lower than the density of bone inclusions. The concentrated zinc chloride solution together with not dissolved particles shall be decanted through a strainer to a separate glass in such a way that bone inclusions are still at the bottom of the beaker. When some of not dissolved and not yet separated from the bone inclusions particles are still in the precipitate, the separation process fulfill repeatedly with the use of concentrated zinc chloride solution of higher density before the full separation of bone inclusions from other not dissolved particles. Thus separated bone inclusions are washed by distilled water to remove zinc chloride solution completely. During the washing a cloudy solution of light gray color and heterogeneous density is formed, the sludge gradually precipitates at the bottom of the beaker and gets white. The most light-weighted bone inclusions retain in the solution so they can be decanted with the solution when washed without care. To prevent this, the content of the beaker shall be mixed with a glass stick to let the bone inclusions precipitate, then the upper transparent layer of the solution shall be decanted with care. By gradual adding and decanting distilled water, complete washing out of zinc chloride shall be achieved. The washing process with distilled water is considered to be complete when the liquid above the bone inclusions becomes transparent.

Beakers with completely separated, washed bone inclusions shall be dried by the temperature (103±2) °C during 1 h, inserted from the air oven, sealed and placed to desiccator completely filled with the incinerated calcium chloride and cool to the ambient temperature. The duplicate sample shall be prepared in similar way.

After cooling to ambient temperature in desiccator the beakers shall be weighed on the balance. Results shall be recorded with the accuracy of 0.001 g. The beakers shall be placed into drying oven again, allowed to stay for 30 min, cooled and weighed again. When decrease of weight from the first to the second weighing does not exceed 0.005 g, drying shall be finished, but when decrease of weight exceeds 0.005 g, the beakers shall be placed into drying oven again. Drying periods of 30 min shall be successively repeated till difference of weight between successive dryings does not exceed 0.005 g. The results of weighing shall be recorded to three decimal places.

Results of determination of bone inclusions content (by mass) in mechanically separated poultry meat ω,%, in *i* parallel is calculated by formula:

$$\omega_i = \frac{(m_{i1} - m_{i2})}{m_i} \times 100, \qquad (1)$$

where m_{i1} – weight of a beaker with bone inclusions, g; m_{i2} – weight of a beaker, g; m_i – weight of test portion, g; i – number of a parallel sample (i = 1, 2).

Arithmetic mean of the results of two parallel determinations is recorded as the end result of measurements of bone inclusions content in mechanically separated poultry meat when the results of repeatability control are positive.

Outcome of mechanically separated poultry meat is determined as the relation of the mass of meat processed with the use of an appliance to the mass of the raw materials used for processing,%.

$$X = 100\frac{(m_1 - m_2)}{m}, \quad (2)$$

where A – mass of meat processed with the use of an appliance, g; C – the mass of the raw materials used for processing, g;

Statistical analysis of the results obtained was fulfilled on the base of calculation of arithmetic mean values and quadratic mean. All the experimental data are the results of 5 parallel determinations.

Results and discussion

Important parameters of mechanically separated poultry meat are the linear dimensions of its particles and fractional content of bone inclusions. The said parameters are influenced by machinery design and wear degree of working surfaces of separating units [9]. The fractional content of bone inclusions and their linear dimensions are sufficiently influenced by the diameter of filter orifices of a separating unit. With the decrease of orifices the dimensions of bone inclusions also decrease and the part of fine fraction increases. By the equal perforation dimensions, product safety level is sufficiently influenced by pressure determining the output of the product. Thus, very fine bone inclusions are characteristic for the perforation of 0.8 mm orifices, moreover, with the decrease of output the part of fine inclusions increases. With the decrease of output, part of fine fraction decreases and part of big fraction increases. Taк, when output exceeds 68.7% rather big bone inclusions of 526.4 μm dimensions can be observed in the staff processed, however the part of the said inclusions is not sufficient counting up to 0.27%. When a separating cylinder of 1.0 mm orifices is used, the part of fine fraction with dimensions up to 300 μm decreases, but the quantity of bone fragments with bigger dimensions increases. Such pattern is also true for perforation orifices with 1.1 mm diameter, but the part of 300.1 to 500 μm fraction increases from 0.3 to 5.75%. When 1.2 mm perforation is used, the part of the fraction with bone fragments dimensions from 300.1 to 500 μm decreases 3.8 times, but bone inclusions of 576.9 μm dimension can already be observed in the quantity of 1.5%. When a cylinder of 1.4 mm separation orifices is used, the part of 300.1 to 500 μm bone inclusion increases from 0.99 to 2.63% with simultaneous increase of particles dimensions within the fraction from 350.9 to 401.4 μm. To this, bone inclusions can be detected in mechanically separated poultry meat: those of 621 μm in the quantity of 2.64%, and those of the dimensions from 954.1 to 1053.0 μm in the quantity from 0.5 to 2.26% [10].

The manufacturing process of mechanically separated poultry meat can be fulfilled with the use of high pressure. Such technological solution is simpler when its technical performance is considered, but the structure of the staff obtained is destroyed its slime profile being not proper from the technologists' point of view. However, low pressure allows obtaining the profile characteristic for the ground meats of manual deboning, but high output of the produce cannot be achieved. More valuable parts of carcasses, namely filets, legs and drumsticks are used in great amounts, correspondingly the amounts of the raw materials available for manufacturing mechanically separated poultry meat also rise, its range of possible use in meat industry becoming wider [11]. However, the terminology used to determine objects and processes connected with mechanical deboning of poultry carcasses and their pats cannot be considered to have become of common use. According to [12], the term «mechanically separated meat» is used, this defining the product, obtained by removing meat from bones or poultry carcasses with the use of mechanical tools, when muscle fibers are destroyed or modified in some other way. The authors of [12] classify mechanically separated meat obtained with low pressure (type I), and with high pressure thus causing loss or modification of muscle fibers (type II). In the first case meat staff is obtained with the use of the methods not leading the modification of the raw materials used. Mechanically separated meat obtained in any other way than that specified for type I pertains to type II. Other authors [13–16] noticing significant dependence of quality parameters of mechanically separated poultry meat upon the separation method applied use the term «hard separation» for the separation process with high pressure and the term «soft separation» for the separation process with low pressure. Processing with the latter method not modifying the structure of raw materials can be fulfilled, for example, by the separators of «Baader» company [13–16]. According to [17], up to 77% of all mechanically separated poultry meats produced in EU are separated with high pressure. Market costs of such staff are from 0.3 до 0.6 Euro/kg, however the meat staffs of the soft separation are from 0.6 to 1.5 Euro/kg. Mechanically separated poultry meat obtained with low pressure not only possesses such trait as not destroyed structure, it also contains less calcium and phosphorus, its characteristic microbial contamination is also lower. That is why possibility and necessity of introducing a new term for such raw materials is considered, this differing from «mechanically deboned poultry meat» [13–15, 17].

To carry out the technological process of mechanical separation of poultry meat piston, screw and band methods are the most practical to remove muscle tissue from bones. The diversity of the technical solutions is certain not to be confined neither with three above mentioned technological schemes nor with some wider nomenclature presented at Figure 1. Screw presses are very practical the principle of their action basing at the pressing of raw materials with high pressure in the orifices of perforation. In the working areas of these machines muscle tissue is separated with the flights of working screw and edges of orifices thus enabling separation of raw material into fluid fraction (muscle tissue) and hard fraction (bone rests). From the other side, the action of the mechanical appliances of the said type causes excessive heating of the staff processed, this, in its turn, being the reason for the significant worsening of its technological properties. Sensorial properties are not proper either as the staff obtained has the smack of burnt bones. According to the second, of the three mentioned, technological scheme piston separators work, these belonging to batch action machines and equipped with powerful hydraulic drive. Meat and bone raw materials are loaded into the hopper and pressed with the use of piston, the pieces of muscle tissue being forced through the orifices of perforated cylinder and hard fraction being compressed and removed when a cycle is finished. Force intensive action of piston type appliances may cause smashing the muscle tissue and modifying of its structure, thus being the reason of undesirable paste like profile of the staff obtained. A gentler mode, considering meat structure, is the mode of the operation of the band separating machines, this mode is often called soft as the muscle tissue being processed with the use of the said appliances undergoes short time depression only thus promoting production of ground meat like staff without excessive heating. Band separation after the first manufacturer of such equipment is often called «baadering». The principal structural member of the machines of the said type is endless band made of nonmetal material. The surface of the band has adhesive properties promoting soft removing of meat from bones, meat staff being led out of working area of machine through perforated drum. For band separators uniform content of bone inclusions is characteristic, the most part of them, about 85% of overall number, pertaining fine fraction – up to 500 μm and middle size fraction – from 500 μm to 750 μm, these distributed almost in equal parts – by 40 – 45% each. The rest (about 15 – 20%) is the fraction of big bone inclusions with the dimensions exceeding 750 μm. [18–20].

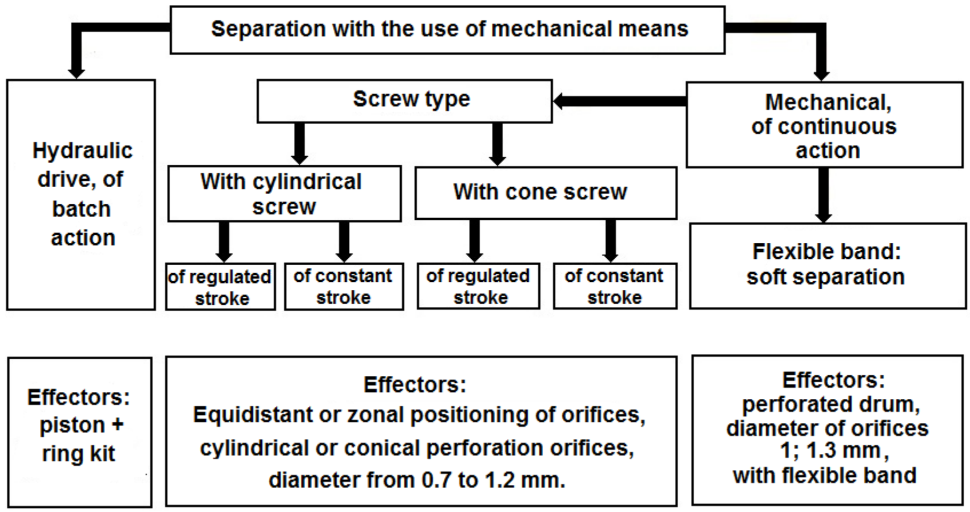

Figure 1. Principal design schemes to separate poultry meat from bones with the use of mechanical means

Therefore, current equipment for «soft» separating of meat and bone staff allows obtaining of high quality mechanically separated poultry meat with necessity to apply labor-intensive manual operations, foremost desinewing – separating of connective tissue, tendons, skin, small bones etc. An important raw material resource to produce mechanically separated poultry meat is also a number of low value muscle cuts. «Soft» separation equipment allows processing of meat and bone raw materials with the output of meat staff from 85 to 95%, enhancing of processing quality and obtaining, as a result, granular ground meat its destruction rate and waterholding capacity being optimal to manufacture high grade pâté products. The separated hard particles can be used to manufacture pâté products of lower price level thus providing their availability to the consumers of low income.

Raw materials to produce mechanically separated poultry meat shall have certain technological requirements, these guaranteeing economically viable outputs of high quality product and its successive storing. The principal technological parameter in the production of mechanically separated poultry meat is the temperature of raw materials to be processed. In the process of mechanical separation of whole poultry carcasses, halves together with parts of carcasses abounding with soft tissues (both muscle and adipose) a separation appliance operates in a normal regime when the temperature of raw materials to be processed is from minus 2 °C to minus 4 °C. By lower temperature values the load upon grinder (bone crusher) and deboning machine increases, the wear intensifies, the quality of separation of meat and bone fractions worsens, thus making the output of muscle fraction lower. When the temperature o raw materials is higher than minus 2 °C, especially when the temperature is no less than 0 °C, by complete defrosting of meat technical and economical parameters of the deboning process sufficiently decrease. However the most part of the machines used for mechanical separation of poultry meat are intended to process the chilled raw materials but not the frozen ones. There is information yet, that modified separators are being developed these also allowing processing frozen meats and thus obtaining the product of perfect texture, longer shelf life and lower bacterial contamination [21].

Results of the research of the effect of raw materials nomenclature and their temperature upon the output of the poultry meat obtained by hard and soft separation and bone inclusions content of the said meat are shown in Table 1.

Table 1

Effect of raw materials nomenclature and their temperature upon the output of the poultry meat obtained by hard and soft separation and bone inclusions content

Raw material used	Temperature, °C	Separation mode			
		Hard (screw separator)		Soft (band separator)	
		Output,%	Bone inclusions content,%	Output,%	Bone inclusions content,%
Carcasses of broiler chickens	−4	80.1	0.36		
	−3	78.4	0.33		
	−2	75.3	0.22	64.1	0.18
	from 0 to 2	75.7	0.09	73.4	0.08
	from 3 to 4	80.3	0.25	57.2	0.03
	4	76.2	0.28	72.2	0.10
	6	75.3	0.29	74.7	0.14
Backs of broiler chickens	−4	69.3	0.30		
	−3	65.9	0.20		
	−2	64.4	0.15	59.8	0.15
	from 0 to 2	60.2	0.08	60.2	0.10
	from 3 to 4	69.1	0.13	60.1	0.14
	4	69.5	0.25	59.5	0.16
	6	68.6	0.30	60.6	0.16
Carcasses of hens	−4	77.2	0.35		
	−3	76.9	0.34		
	−2	76.4	0.21	68.4	0.15
	from 0 to 2	74.7	0.10	65.7	0.09
	from 3 to 4	76,3	0.11	66.3	0.10
	4	75.2	0.23	68.2	0.13
	6	72.4	0.26	68.3	0.15
Necks of hens	−4	67.7	0.34		
	−3	68.3	0.31		
	−2	71.4	0.12	60.4	0.36
	from 0 to 2	70.2	0.10	60.2	0.22
	from 3 to 4	71.0	0.20	58.3	0.17
	4	71.4	0.23	61.4	0.18
	6	73.8	0.22	61.8	0.19

Analyzing of the table data allows drawing the conclusion, that a certain range of the most proper temperature parameters corresponds to each of the types of raw materials studied thus enabling to produce mechanically separated poultry meat of the safe content of bone inclusions by significantly high output of end product. During the hard separation using screw separator machines, the said range is from 0 °C to 2 °C for almost all the types of the raw materials processed. Decline in bone inclusions content is detected from the temperature threshold of minus 2 °C. In some way lower product output is offset with the quality of the staff obtained – namely by its content of bone inclusions. The most proper range for broiler and hen necks is from 4 °C to 6 °C. Rather a similar effect is found for soft separation with the use of band machines. The surface-frozen raw materials are usually known not to be processed with separators of the said type – mainly, because of rapid wear of the pressing band of separation unit and lower, comparing to screw separator machines, pressure effecting the raw materials. When raw materials are surface-frozen by minus 2 °C and are to be processed with the use of band separators, the said raw materials shall be preliminary ground with the use meat grinders (meat wolves) equipped with the plates with big diameter orifices.

Assessment of the data adduced within the table makes a conclusion possible, that lower (in average by 9–10%) output of mechanically separated poultry meat is characteristic for soft separation comparing to hard separation, while the average content of bone inclusions in the case of hard separation is by 40% higher. The most proper, considering technology and food safety issues, temperature range of raw materials is from 2 °C to 6 °C. The use of raw materials their temperature being lower than minus 2 °C is not applicable. The above said is especially true for hen necks, as with the decline in temperature the raise in bone inclusions content in end product is drastic. The latter regime is less proper considering the longevity of the separating equipment used to perform the process its effectors undergoing significant wear.

Conclusion

When producing mechanically separated poultry meat, the principal technological parameter is the temperature of raw materials to be processed. The said implies raw materials with different values of meat/bone index. For the raw materials with low values of meat/bone index, e.g. broiler backs and hen necks, the most proper, considering output of end product and its content of bone inclusions, temperature range is higher temperatures area, namely from 2 °C to 6 °C. For the raw materials with higher meat/bone index the technologically proper temperature range is from minus 2 °C to plus 2 °C, complying with the said range making it possible to obtain mechanically separated poultry meat of minimal bone inclusions content while output values of end products being significant.

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Obtaining and study of the effect of liposomal solution of the follicular chicken eggs' extract on the quality of bread

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Abstract

Introduction. The article describes the process of fermentation by means of yeast cells in a lipid liposome solution in alcohol, which containing pure Phosphatidylcholine and the mixture of Phosphatidylethanolamine and Phosphatidylcholine (PE and PC).

Materials and methods. In this work we used methods of microbiological analysis and test bread baking in the laboratory. During the microbiological research we used a nutrient medium (wort), *Saccharomizces cerevisiaeyeast* cells, the yeast suspension of a pure culture and the liposomal solution. For the study of the effect of liposomal extracts on the quality of bread it was carried out baking of it.

Results and discussions. During the microbiological experiments at 36 hours it was observed the most efficient process of fermentation in liposomal extract which contained 3.24 g of pure Phosphatidylcholine and mixture of Phosphatidylcholine and Phosphatidylethanolamine. The fermentation process was slowed down in samples that contained less than 2 g of phospholipids in liposomal solutions. The fermentation process wasn't beginning at the content of phospholipids less than 0.1 g in liposomal solutions. Because preparation of lipid solution with a mixture of PC and PE has technological and economic advantages in comparison with preparation a solution, which containing of pure FC, then it was used lipid extracts of follicular eggs with the mixture of PC and PE for baking bakery samples. 2.5, 5, 10, 15, 20, 30 ml of liposomal extract was injected in samples. The obtained samples of bread were analyzed after cooling for 24 hours with the proposed methodological parameters: specific volume, dimensional stability of bread H/D organoleptic evaluation of bread quality, pH.

Conclusions. It was obtained samples with high consumer properties that fully meet quality standards due baking bread using liposomal solutions of lipid alcohol extract.

Introduction

Liposomes are artificial-generated lipid vesicles, which consist of one or more phospholipid bilayers separated by water phase.

Currently, there are several main ways of obtaining of liposomes: processing by ultrasound of aqueous suspensions of phospholipids, their extrusion and homogenization under high pressure.

Liposomes used as a model of biological membranes. Hereinafter it was found that they can be used as microcontainer which is able to deliver different drugs to different organs and tissues. It can be placed enzymes, hormones, vitamins, antibiotics and bioactive compounds in liposomes.

In the food industry, liposomes are used to encapsulation and controlled release of biologically active components, as well as improving stability and shelf life of sensitive ingredients of food products. Liposomes can be a carrier of antimicrobial agents to protect food products from microbial pollution, nutrients, nutraceuticals, enzymes and food additives for enrichment of food products by relevant ingredients [1]. Currently liposomal solutions are widely used in the dairy and meat processing industries [2-4]. Injection of liposomal forms in foods allows to create a completely new range of products for baby food, nutrition for pregnant women and the elderly, which has prospects of development of food industry [5-9].

Liposomes are widely used in fields of chemistry and biomedicine, pharmaceutics, cosmetology and food production. It caused by certain physicochemical properties of liposomes: they are completely biocompatible in the body of humans and animals, because they obtained from natural phospholipids; they able to include many bioactive substances, including enzymes, hormones, vitamins, antibiotics, immunomodulators, cytostatic agents, pharmacology drugs and others; they provide purposeful transportation and prolonged release of the included substance; substances, included in the liposomes, are more stable, because they isolated by lipid membrane from the negative influences of factors of surrounding environment.

Liposomes are formed from both natural and synthetic phospholipids, as well as from mixtures of phospholipids.

Main substances for generation liposomes are lecithin (Phosphatidylcholine (PC) and Phosphatidylethanolamine (PE)) which obtained from soybeans, rarely from sunflower seeds. However, content of PC and PE at soybeans, it is a main source of production of lecithin from vegetal resources, amounts at most 22-35,5% from a total amount of the phospholipids, then its content amounts close 72% in the yolks of chicken eggs. It requires a highly a more vegetal resources than chicken eggs for obtaining equal amounts of PC. Lecithin, which obtained from the chicken eggs, has high bioactive properties, but high commercial price cause limited-use of chicken eggs as sources for receiving of quality lecithin.

Therefore obtaining phospholipids from alternative sources remains actual. One of such alternative sources of the extraction of Phosphatidylcholine and Phosphatidylethanolamine can be follicular chicken eggs. This product unites bioactive properties of the yolks of chicken eggs, a commercial availability of vegetal resources and has a technological advantage - there is absence of a protein native shell, which complicates the process of the extraction of original natural material due receiving of lecithin.

Technologies of obtaining liposomal lipid solutions of follicular chicken eggs in alcohol with PC and mixture of PC+PE content are giving in refs. [10,11]. These allow to establish that liposomal lipid solutions of follicular eggs has economic, technological and biological advantages compared with lipid solutions, which obtained from normal chicken eggs or vegetal resources of natural phospholipids, for example, from soybeans or sunflower seeds.

Review of scientific literature has allowed establishing that investigation regarding the making of liposomal lipid solutions of follicular chicken eggs in alcohol and use of them in different branches of industry do not present.

Considering the advantages of liposomal lipid solutions of follicular eggs it may be appropriate to consider a capability of using these solutions in technologies of producing of bakery products to the end its usage as the potential "containers" for the transportation of the bioactive substances for development of new bread products with promotional positive properties.

Materials and methods

Microbiological study

Liposomal solutions, which are containing pure Phosphatidylcholine (PC) and mixture of Phosphatidylethanolamine (PE) and phosphatidylcholine (PC), were used for bakery. For this purpose, model samples were prepared from mentioned liposomal solutions of follicular eggs using *Saccharomyces cerevisiae* yeast.

To do this, yeast *Saccharomizces cerevisiae* was injected in a nutrient medium (wort (6-7 ml) by way of a yeast suspension (0.5 ml) and formed the initial sample so-called “control” (C). It was injected to control sample liposomal solutions of follicular chicken eggs with different concentrations.

Thus following model samples of liposomal solutions of follicular eggs was prepared (Table 1).

Table 1

Composition of liposomal solutions of follicular chicken eggs

Samples	Solution's compositions
C	Nutrient medium (wort), 5 ml + yeast suspension of a pure culture, 0.5 ml
2 (PC 0.1 ml)	"C" + 0.1 ml of liposomal solution with Phosphatidylcholine (FC) content
3 (FC 2 ml)	C + 2 ml of FC
4 (FC 4 ml)	C + 4 ml of FC
5 (PC 6 ml)	C + 6 ml of PC
"C"	Nutrient medium (wort), 5 ml + yeast suspension of a pure culture, 0.5 ml
2 (FE+FC 0.1 ml)	C + 0.1 ml of liposomal solution with content of mixture of Phosphatidylcholine and Phosphatidylethanolamine (PC + PE)
3 (PE+PC 2 ml)	"C" + 2 ml of FE+FC
4 (PE+PC 4 мл)	"C" + 4 ml of FE+FC
5 (PE+PC 6 мл)	"C" + 6 ml of PE+PC

The technology of obtaining lipid extracts of follicular chicken eggs in alcohol with the contents of FC and mixture of FC+PE is given in refs. [10,11]. It was considered the advantages of the lipid extract, which contained the mixture of Phosphatidylcholine and Phosphatidylethanolamine. It was proved advantages of obtaining lipid extracts of follicular chicken eggs over other natural plant and animal sources of phospholipids.

Laboratory baking of bread samples

After conducting microbiological studies to determine the impact of the most effective concentration liquid on the fermentation process was carried out baking bakery samples.

The preparation of the dough for bread samples was carried out without sponge, the matter of which is as follows. For kneading yeast was diluted with water with a temperature of 30-35°C. Margarine dosed out according to the calculated amount in the melted state. Sugar and salt were added to components in the aqueous solution. Liposomal extract was introduced into components according to the recipe (table 2).

Table 2

Formulation of investigated samples with the addition of liposome extract of follicular chicken eggs

Raw materials	Samples of bakery products							
	"C"	2	3	4	5	6	7	8
Flour (g)	280	280	300	300	300	300	300	300
Yeast (g)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Salt (g)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Sugar (g)	28	28	28	28	28	28	28	28
Margarine (g)	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Chicken eggs (g)	-	5.6	-	-	-	-	-	-
Water (ml)	168	162.4	145.3	143.0	138	133	128	118
Liposomal extract FC+PE (ml)	-	-	2.5	5.0	10.0	15.0	20.0	30.0
Liposomal extract FC+PE, (%)	-	-	0.49	0.98	1.97	2.95	3.94	5.90
Total weight (g)	508.2							

It was used the straight dough method due cooking. The required amount of water was weighed in capacity for dough kneading, then it was added a prepared yeast, salt, sugar, margarine and flour. Components were thoroughly mixed until a homogeneous consistency of the dough in laboratory dough kneading machine LT–900.

Fermentation of dough was carried out in the thermostat at the temperature t =37-40°C and relative humidity φ = 78-80% for 1.5 hours. Then the dough was weighed, divided into pieces according to the calculated weight of formed and hearth dough's samples that were stood in the thermostat at t=37-40 ^{0}C and φ = 78-80%. End-proofing was determined organoleptically as a test and the mind blanks. Bread was baked in the laboratory oven ESh-3 at t = 200–220 ^{0}C.

The quality of the resulting bread samples after cooling for 24 hours was analyzed for the following parameters: specific volume (Figure 1), dimensional stability of hearth bread, H/D (Figure 2), organoleptic evaluation of bread quality (table 3), a measure of the acidity (Figure 3).

Results and discussions

Biochemical and microbiological processes, which were occurred in dough, were conditioned to vital functions of microorganisms and the activation of fermentation's systems. At that substances are accumulated in dough which participates in formation of quality of finished products.

It was investigated the activity of the main microflora of wheat dough, this is yeast *Saccharomizces cerevisiae*, at environment of investigated liposomal solutions of follicular eggs to assess the possibility of using of model samples of these solutions in the recipe of bakery products.

Activity of fermentation process was investigated by microbiological method in model of sample solutions at 30 ºC. It was established that the highest activity of fermentative microflora was observed due 36 hours in samples # 3, # 4, which contains 2 ml and 4 ml of pure Phosphatidylcholine and mixture of Phosphatidylcholine and Phosphatidylethanolamine, respectively (contents of phospholipids is 1.62 and 3.24 g, respectively). The fermentation process starts after 42 hours without the usage of liposomal solutions. Fermentation was not started at a concentration 0.1 ml of liposomal solutions (the content of phospholipids was less than 0.1 g; sample # 2) . The fermentation process was slowed down in sample # 5, that was contained 6 ml of liposomal solution (the content of phospholipids was 4.86 g).

It was mentioned that lipid solutions with the mixture of PC and PE has technological advantages in comparison with samples, which were contained pure PC, then it was used lipid extracts of follicular chicken eggs with PC and PE for baking bakery samples. 2.5, 5, 10, 15, 20, 30 ml of liposomal extract was injected in samples. Analysis of organoleptic indicators of quality of finished bakery products is presented in Table 3.

The results show that the usage of liposomal solutions of follicular eggs allows obtaining products without foreign tastes and odors. It was obtained products at injecting 2.5 ml and 5 ml of liposomal solutions (samples # 3 and 4) in investigated samples that are not inferior to the control samples by the organoleptic characteristics. However, it was defined deterioration of the crust's color of products in samples # 5, 6, 7, 8 with increasing content of liposomal solution of follicular eggs and the formation of thick-walled crumb structure. This is possible due prominent influence of alcohol component of these model solutions of follicular eggs on activity of enzyme system of the dough, the state of proteins and yeast.

It was investigated a specific volume of products and their dimensional stability (Figure 1).

Results are showed that the usage of model samples # 3 and 4 allows improving the specific volume of products with comparison to both the control and product with the introduction of eggs. This is conditioned of emulsifying properties of utilized liposomal solutions that also promote to improve of the dimensional stability of products and the formation of a thin-walled structure of the products' porosity.

It was marked deterioration both the specific volume of products and their dimensional stability in samples of bread # 5, 6, 7, 8. The cause of this influence of the increasing of the concentration of alcohol in the studied liposomal lipid solutions, which does not allow to sufficient swell of fibrin proteins of dough and gain a good elasticity of dough. Dough structure was too strengthened then it is deteriorated the dimensional stability of the products. This causes the formation of thick-welled porosity of the products' crumb. Usage of these model solutions suppresses the carrying biochemical and microbiological processes in the dough, that reduces the accumulation of the substances in the dough that forming the taste properties of products and its acidity, especially. This is confirmed by the data in Figure 1, 2. Acidity of the finished products was reduced in samples # 5, 6, 7, 8 (Figure 3).

Table 3

Organoleptic quality assessment of bread's samples

Characteristics of bread	Form of bread	"C"	2	3	4	5	6	7	8
The appearance of the bread									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Form	hearth	Regular				wrong			
	pan	Regular				wrong			
The surface of the crust	hearth	smooth crust				uneven			
	pan	smooth crust				uneven			
Crust color									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Crust color	hearth	dark brown		brown	dark brown	lightbrown			pale
Crust color	pan				brown	light brown			pale
The crumbs									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Color	hearth	White							
	pan	White							
The color's smoothness	hearth	uniform							Irregular
	pan	uniform							
Elasticity	hearth	Good				middle	bad		
	pan	Good				middle	bad		
Porosity of crumb									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Size of pores	hearth	Average					small		
	pan	Average					small		
Uniformity of pores	hearth	Uniform					uneven		
	pan	Uniform					uneven		
The thickness of the pore walls	hearth	Thin					thick-walled		
	pan	Thin					thick-walled		
Taste									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Taste	hearth	normal, typical bread without foreign tastes							
Taste	pan								
Caking during chewing									
Characteristics of bread	Form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Caking	hearth	no caking					the presence of		
Caking	pan	no caking					the presence of		
The fragility of the crumb									
Characteristics of bread	form of bread	The samples of bread							
		"C"	2	3	4	5	6	7	8
Fragility	hearth	No fragility							
Fragility	pan	No fragility							

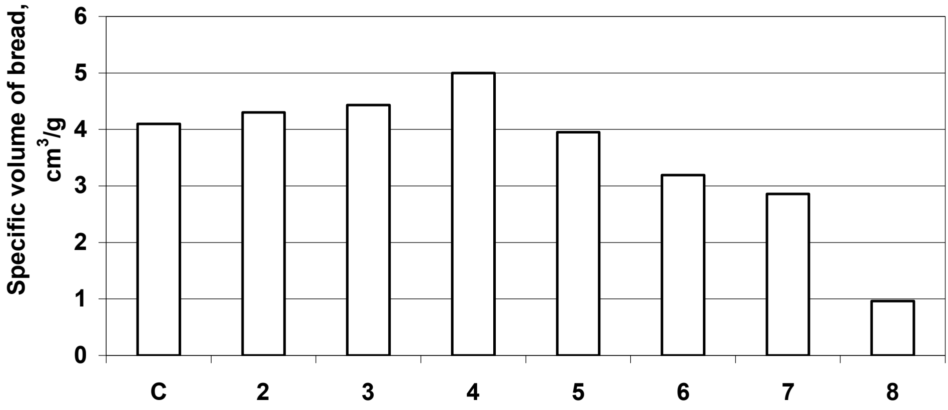

Figure 1. Specific volume of bread

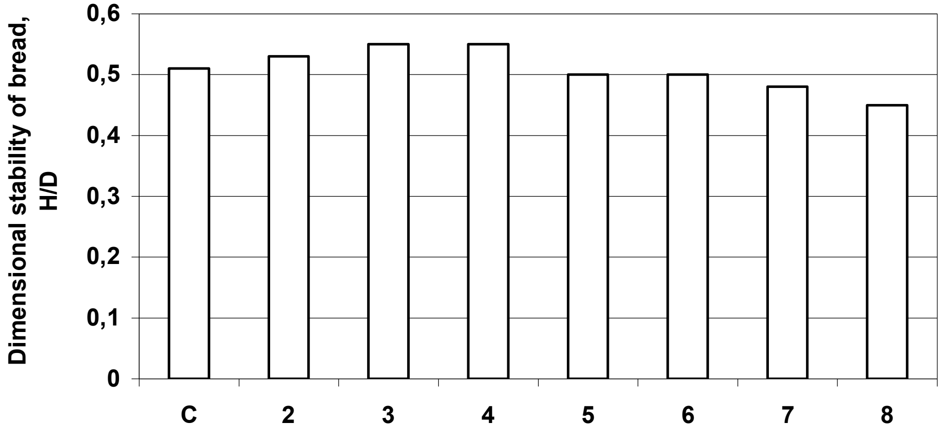

Figure 2. Dimensional stability of bread

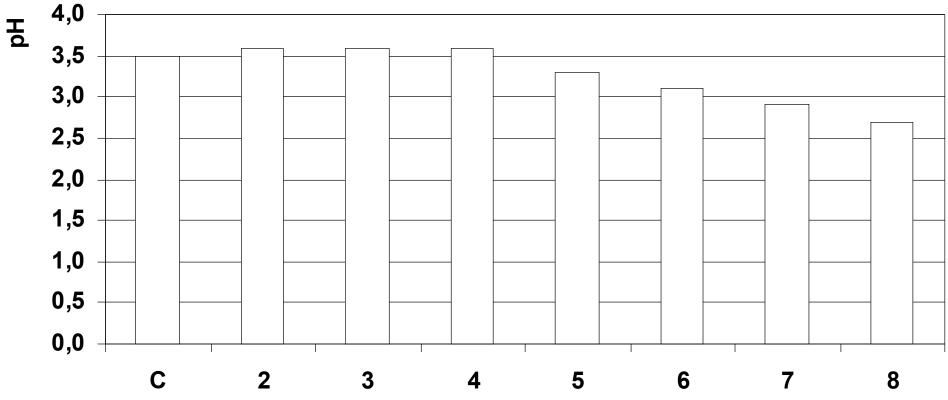

Figure 3. The pH of the wheat bread of the highest grade

Conclusions

1. When conducting microbiological experiments the most effective fermentation process was observed at 4 ml of liposomal solutions (the amount of phospholipids is 3.24 g), which were contained pure Phosphatidylcholine and the mixture of Phosphatidylcholine and Phosphatidylethanolamine.
2. Sufficient quality of bread was obtained during adding 2.5 ml (0.49% from total mass, sample # 3) and 5 ml (0.98% from total mass, sample # 4) of liposomal solutions with the mixture of PC and PE (phospholipid's content is 2.03 g and 4.05 g, respectively, in 508.2 g of dough). It was received products at these dosages with good organoleptic indicators of the quality and the volume.
3. Introduction liposomal forms in food products allows to create a completely new product assortments, then the usage of liposomal solutions is promising direction in the food industry.

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Aspects of wet wool cleaning

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Abstract

Introduction. The actual problem of the primary wool processing is economical consuming of water and energy resources.

Materials and methods. This article contains optimization of the parameters of wool soaking according to the planned experiment using Latin squares. It was determined the technological conditions of wet wool cleaning. Among the factors that affect wool cleaning while soaking, we've also investigated hydraulic kit (ratio water : dry wool), temperature, duration. As a response on changing factors we've chosen refractive index n, the pH of exhaust water.

Results and discussion. In the first stage we've determined the impact of hydraulic kit in the range of 10–100, temperature of 20–50 °C and duration of 5–25 minutes. To compare the effect of the studied factors we've normalized values of the factors' levels. Presented equations show that the smaller hydraulic kit soaking, the more extractives are in the water.

In the second stage we've determined the impact of hydraulic kit in a range of 10–90, temperature of 10–30 °C and duration of 2–10 minutes. With the increase in the ratio of water : wool the content of the reduced extractives in waste water is decreased. It was also found that there's a directly proportional linear describing dependence of content of extractives in waste water after soaking on temperature. The higher temperature, the more extractives are removed from the wool to the waste water.

Factors have been ranked according to their influence on the process of wool soaking. The most influential factor that affects removal of extractives is hydraulic kit. Temperature is another influential factor. There are certain rational conditions for extraction of hydrophilic extractives of the wool such as hydraulic kit 60, temperature of 42 °C and duration of 6 min.

Conclusion. Rational mode to extract hydrophilic extractives hydrological of the wool is hydraulic kit 60, temperature of 42 °C and duration of 6 min.

Introduction

The actual problem of the primary wool processing is wool cleaning from the dirt taking into account economical use of water and energy resources, environment protection, and getting the wool suitable for the production of natural fabrics in enterprises of light industry, and wool fat [1-3, 5-7]. Refined oil when taking into account safety indicators [4] could be used in the pharmaceutical, food and cosmetic industries.

There is a classic wool processing which includes dry and wet cleaning. Wet cleaning is carried out with water in three stages: soaking, washing and rinsing. In the first two stages of wet cleaning - soaking and washing - dirt and wool fat are being removed from the wool using the soap-soda solute. Such fat is subsequently used for technical purposes. During wet cleaning the organic and mineral dirt are being removed from the wool. Upon completing the classic process of wet cleaning of the wool fiber they use the following proportions: 100-600 parts of water to one part of dirty wool (hydraulic kit). Output of the dry scoured wool is 40-60% of the original mass.

Wool is a commodity agricultural product. Wool pollution is directly related to the technology of animal housing and keeping it after its cutting. In this article we pay attention to the process of wool soaking. This process is aimed to soak dirt which has been stuck to the fibers and to remove contamination from the fiber.

The objective of the research is to investigate the impact of factors on the wool soaking process, to rank factors according to their influence on the process and to determine optimal values of the factors in their selected range.

Materials and methods

It was determined the technological conditions of wet wool cleaning. To achieve the set objective we've applied mathematical planning of the experiment using the Latin squares. The mathematical planning of the experiment is provided in the Table 1.

Table 1

The mathematical planning of the experiment

Hydraulic kit	Temperature, °C	Duration, min.
100	20	15
10	20	5
50	20	25
50	35	5
100	35	25
10	35	15
10	50	25
50	50	15
100	50	5

This experiment plan declares absence of any mid-factorial influences. It foresees a choice of independent factors and use of regression equations of depending repercussion on the factors' change for finding the optimal factor's value in the selected range of its impact on response. Each research of the experiment has been performed in threefold repetition.

Among the factors that affect wool cleaning while soaking, we've also investigated hydraulic kit (ratio water : dry wool), temperature, duration. As a response on changing factors we've chosen refractive index n, the pH of exhaust water.

Results and discussion

Soaking was performed in two stages with the planning of the experiment and processing of data.

In the first stage we've determined the impact of hydraulic kit in the range of 10–100, temperature of 20–50 °C and duration of 5–25 minutes. Data from the experiment with averaged results (refractive index of waste water and contents of lipid in wool) is provided in the Table 2.

Table 2

Impact of factors during wool soaking on the refractive index of waste water and contents of lipids which have been extracted from the dried wool

Hydraulic kit	Temperature, °C	Duration, min.	Refractive index, n	Content of lipids, %
100	20	15	1,3336	20,29
10	20	5	1,3348	18,72
50	20	25	1,3338	20,03
50	35	5	1,3338	21,05
100	35	25	1,3336	21,45
10	35	15	1,3336	21,40
10	50	25	1,3340	24,96
50	50	15	1,3338	26,84
100	50	5	1,3332	30,18

After soaking not only extractives fall into the water, but also sand, particles of mineral and organic origin. That's why we've filtered the water before determination of the refractive index.

Hydraulic kit and temperature are influential factors, and duration affects the process of soaking the least.

To compare the effect of the studied factors we've normalized values of the factors' levels. The regression equation which approximates impact of the normalized factors on the refractive index of waste water, has the following form:

$$y_n = -0{,}0003\, x_1 + 0{,}0002 x_2^2 - 0{,}0009 x_1 + 0{,}0002\, x_3^2 - 0{,}0007\, x_3 + 4{,}0037,$$

and the influence of factors on the residual content of lipids in wool after soaking is being approximated by the following equation:

$$y_c = 1{,}0154\, x_1 + 1{,}424\, x_2^2 - 2{,}652\, x_2 - 0{,}5213\, x_3 + 65{,}415,$$

where x_1 – hydraulic kit; x_2 – soaking temperature; x_3 – duration of soaking hair.

Presented equations show that the smaller hydraulic kit soaking, the more extractives are in the water. The lower the temperature, the less extractives would be extracted. Experimental data show (Figure 1), that in this planning and coincidence levels of factors in experiments, most of extractives was in the water, which is obtained at a temperature of 42 °C. That means that perhaps at a lower temperature hydrophilic substances will also be extracting from the wool.

Also, the second approximation equation indicates that by increasing content of extractives in waste water we decrease the lipid content in wool. In this case, it seems logical to extract lipid-containing fractions from the waste water.

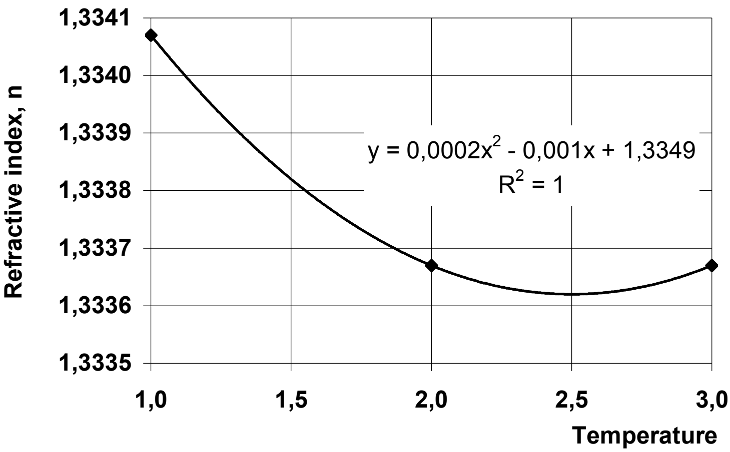

Figure 1. Effect of temperature on the refractive index of waste water after soaking (fat bottom line is a line which describes the equation)

In the second stage we've determined the impact of hydraulic kit in a range of 10–90, temperature of 10–30 °C and duration of 2–10 minutes. Data from the experiment with averaged response (refractive index of waste water) is displayed in the Table 3.

Table 3

Effect of factors during wool soaking on the refractive index of waste water

Hydraulic kit	Temperature, °C	Duration, min	Refractive index, n	pH
10	20	10	1,3346	7,54
90	10	6	1,3330	6,97
50	30	2	1,3332	6,65
10	10	2	1,3340	7,08
50	20	6	1,3334	7,09
90	30	10	1,3332	7,57
50	10	10	1,3334	7,36
90	20	2	1,3330	7,25
10	30	6	1,3354	7,29

Regression equation which approximates impact of the normalized factors on the refractive index of waste water, has the following form:

$$y_n = 0{,}0006x_1^2 - 0{,}0032x_1 + 0{,}0004x_2 - 0{,}0004x_3^2 + 0{,}0018\,x_3 + 4{,}0023$$

where x_1 – hydraulic kit,
x_2 – soaking temperature,
x_3 – duration of soaking hair

The most influential factor is the hydraulic kit (Fig. 2). With the increase in the ratio of water : wool the content of the reduced extractives in waste water is decreased. This pattern was observed also in the previous experiment.

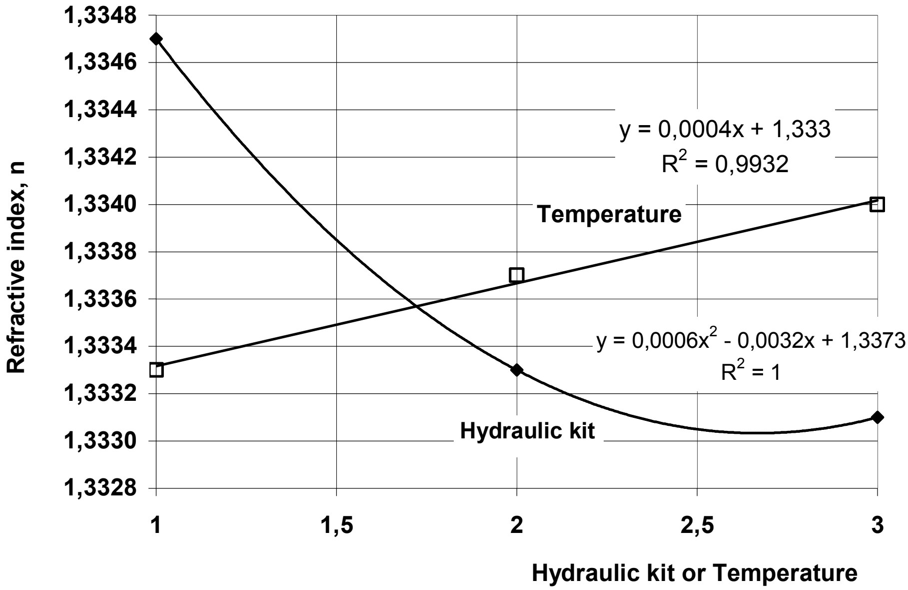

Figure 2. Effect of hydraulic kit and temperature on the refractive index of waste water

Graphically we could find (see Figure 2) hydraulic kit values in which the contents of extractive substances in waste water reach saturation (not reduce). This hydraulic kit 2.2 in normalized measurement or 60 parts of water to one part of wool. In order to reduce water consumption in the process of soaking we should reduce hydraulic kit to 10 and perform soaking in several stages (three to six).

It was also found that there's a directly proportional linear describing dependence of content of extractives in waste water after soaking on temperature. The higher temperature, the more extractives are removed from the wool to the waste water. Therefore, decrease in temperature will make it possible to reduce wool pollution by hydrophilic substances. The smallest impact on the removal of extractives has length of soaking in the selected range of variation factor (Figure 3).

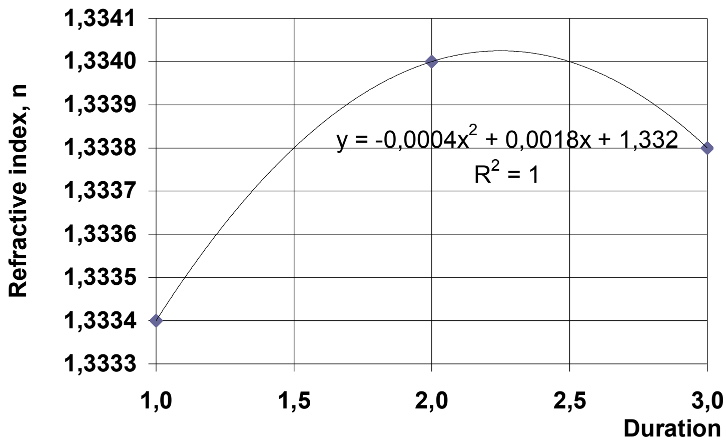

Figure 3. Impact of duration on the index of refraction of waste water

For this variation of factors we only needed six minutes for obtaining the highest content of extractives in waste water. Interesting thing is fact of removal of extractives by alkaline reaction, while the pH was not sensitive response to changing factors.

Conclusion

It was determined the technological conditions of wet wool cleaning. To achieve the set objective we've applied mathematical planning of the experiment using the Latin squares.

Rational mode to extract hydrophilic extractives hydrological of the wool is hydraulic kit 60, temperature of 42 °C and duration of 6 min.

We've performed ranging of factors according to their influence on the process of wool soaking. The most influential factor in the process of extracting extractives is hydraulic kit. Another influential factor is temperature.

Further studies are planned to fulfil the conditions of detection of clean wool fat related substances.

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Investigation of the extraction process of spicy aromatic raw materials in the production of bitter tinctures

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Abstract

Introduction. The research was conducted to determine the influence of the parameters of the extraction process on the extraction of target components from spices and aromatic raw materials for its intensification, and the ability of cardamom, ginger and red pepper to determine the accumulation of heavy metal ions was determined.

Materials and methods. The study of changes in the content of vitamin C and phenolic compounds in the extracts was carried out by titrometric and spectrophotometric methods. Determination of the ability to accumulate spicy aromatic raw materials of ions of heavy metals was carried out according to the schemes of complex formation of heavy metal ions with functional active groups.

Results and discussion. The optimum values of the relation and the length of the extraction process were respectively for cardamom 14.5 and 83 min; for ginger – 13 and 70 minutes; for bitter pepper – 17 and 92 minutes, provided that the process of extracting water as an extractant at a temperature of 40 ° C for maintaining vitamin C and constant mixing, due to the chemical composition of spicy aromatic raw materials.

The ability to accumulate metal ions of cardamom Hg^{2+}, Pb^{2+} та Cd^{2+} is 94%, 66.52% and 72.57%, for ginger – 92%, 38.84% and 35.16%, and for red bitter pepper – 94%, 24.11% and 20.19% respectively. Cardamom, slightly lower ginger and red pepper are bitter in the ability to accumulate heavy metals, due to the presence in their composition of a significant amount of carbohydrates, vitamins, amino acids and pectin substances.

Conclusions. Research results can be effectively applied in the liquor industry to develop beverage formulations that would have high biological value and technological or hardware-technological schemes.

Introduction

The production of bitter tinctures is becoming increasingly popular due to the use of various spices and aromatic herbal extracts in the formulation that give the finished drink harmonious organoleptic properties, so it can be noted that bitter tinctures have a positive effect on the human body, as is known tinctures – it is alcoholic drinks obtained by blending of infusions or extracts of various raw materials [1].

The traditional technology of the production of bitter tinctures involves infuse in containers for infuse over a period of 10-14 days on a water-alcohol mixture of 70%vol. Infuse is carried out by means of two showers, the duration of which varies from 5 to 7 days each. Then, in the blended tubs, the infusion is blended and brought to a strength of 40% vol [1].

Spicy aromatic raw material used in the production of bitter tinctures can be the most diverse, depending on the desired result. In our research, ginger, cardamom, red bitter pepper and honey were selected as raw material due to the rich chemical composition and excellent organoleptic properties.

One of the main benefits of using honey, ginger and cardamom extracts in the production of bitter infusions is the complex application of vitamins, glucose, fructose, enzymes, phenolic compounds, micro and macro elements with antioxidant and radioprotective properties.

It is recommended to use bitter tincture as a food of high biological value. Therefore, it is advisable to investigate the tread properties of the main components of bitter tinctures.

The addition of ginger and cardamom extracts to bitter tincture contributes to the enrichment of its vitamins, especially ascorbic acid. Also, it has now been proved that phenolic compounds that exhibit P-vitamin activity perform in a human body a number of important functions: they take part in the processes of formation of red blood cells – erythrocytes, strengthen walls of vessels, are powerful antioxidants [1].

Materials and methods

During research, such spicy aromatic raw materials were selected as cardamom, ginger and red pepper bitter.

Ginger contains such substances as magnesium, phosphorus, sodium, silicon, potassium, manganese, calcium, chromium, iron, zinc, nicotinic acid, caprylic acid, oleic acid, linoleic acid, vitamin C, vitamins of group B, asparagine, choline. The aroma is spicy, astringent, due to the presence of essential oil (1-3%), the taste – acute, burning, depends on the presence of phenol-like substance gingerola – 1.5% [2].

Cardamom contains the following substances: thiamine, riboflavin, pyridoxine, ascorbic acid, niacin equivalent. It is also noted for high calcium, magnesium, potassium, copper. Cardamom contains essential oil (4–7%), which includes cineol, termineol, lemonoeol, and others [2].

As for spicy aromatic raw materials like **red pepper bitter**, it can be said that the most important part of pepper is alkaloid-like amide capsaicin, which has a very burning taste. The mass fraction of capsaicin in pepper varies from 0.5 to 1.5% depending on the species.

However, red bell pepper contains mono- and disaccharides and a large amount of ascorbic acid, sodium and potassium [2].

In the role of extractant was selected **prepared water** and **water-alcohol mixtures with a strength of 40%vol.** and **70% vol.** The choice of the extractant for the extraction process depended on the chemical nature of the substance removed from the spicy aromatic raw material.

Determination of the vitamin C content by the titration with a solution of 2,6-dichlorophenolindophenolate sodium.

Determination of the content of phenolic compounds spectrophotometric method with post determination of phenolic compounds with the help of a calibration schedule for Gallic acid.

Method of determining the binding ability of spices and aromatic raw materials powders for metal ions. To the inoculum powder of the spicy aromatic raw material under study, 50 cm^3 of warm (45-50 °C) distilled water was added, stirred and left for 10 minutes to swell. To the resulting mixture was added 1 cm^3 of 0.1 mol/dm^3 solution of the salt of the test metal, stirred for 1 hour on a magnetic stirrer, filtered through a folded filter. In the filtrate, the content of ions of the investigated metals was determined by the calibration graph method. The amount of Pb (II), Hg (II), Cd (II) absorbed by the main components of spicy aromatic raw material was determined as the difference between $m_{Pb,\ Cd,\ Hg}$ and $m_{Pb,\ Cd,\ Hg}$, which was found in the filtrate. pH of solutions was created using cristal urotropin [].

Processing of experimental data. To obtain and analyze experimental data, a multivariate experiment of type 2^2 was planned and mathematical and statistical methods of research, methods for determination of vitamin C and phenolic compounds were used. For the processing of experimental data, experimental and statistical methods of mathematical modeling were used. In order to find the optimal values of the process parameters, an experiment plan of type $N = 3^n$ was planned and implemented to obtain the second order regression equation.

Results and discussions

Determination of the ability to accumulate spicy aromatic raw materials of heavy metal ions. During the study of the tread properties of spicy aromatic raw materials, the following data were obtained, which are presented in Table 1.

Table 1

Data on tread properties of spicy aromatic raw materials

№	Name of powder of spicy aromatic raw materials	Ability to accumulate metal ions,%		
		Pb^{2+}	Cd^{2+}	Hg^{2+}
1	Cardamom	94	66,52	72,57
2	Ginger	92	38,84	35,16
3	Red pepper bitter	94	24,11	20,19

Based on Table 1, high tread properties are cardamom, slightly lower ginger and red pepper bitter.

The sorptive properties of heavy metal ions of ginger powder are due to the presence of a significant amount of carbohydrates and vitamin C in its composition. Complex formation occurs with pectin substances and vitamin C due to the substitution of hydrogen in hydroxyl groups with the formation of 4-membered cycles.

The protective properties of heavy metal ions of cardamom powder are carried out in 3 schemes of complex formation, namely amino acid fragments, with pectin substances and vitamins.

Protective properties concerning heavy metal ions of red bitter pepper powder are complexed with vitamin C, while the coordination of metal ions will be carried out by oxygen atoms due to the substitution of hydrogen in hydroxyl groups with the formation of 4-membered cycles [5,6].

Investigation of the influence of extraction parameters on the output of the target components

Due to the fact that in the production of bitter tinctures raw material containing vitamin C is destroyed under the influence of high temperatures, the temperature of the extraction process of 40 °C was chosen for research, which intensifies the process and preserves all the useful substances [7].

The extraction process was carried out in flasks on the vibration stand, with correlation 10, 15 and 20. The mixing frequency was 100 rpm. As an extractant, water, water-alcoholic mixture of 40%vol. and 70%vol. is selected. Guided by the chemical composition as a vegeTable raw material was taken cardamom, ginger and red pepper bitter. These spices contain a significant amount of vitamin C and phenolic compounds and are used in the production of bitter tinctures.

The chemical composition of the extracts obtained from dry vegeTable raw materials is given in Table 2.

The data in Table 2 indicate a higher yield of phenolic compounds from spicy aromatic raw materials in a water-alcoholic mixture of 40% vol.

The influence of the type of raw material on the chemical composition of the extracts was considered, in the first case, the dry powders, the extraction data of which is given in Table 7, as well as fresh raw materials. When using fresh raw materials in terms of dry matter, the data were given, which are given in Table 3.

In this case, cardamom was not investigated, since this spice is used only in dry form. The correlation 10 created hydrodynamic conditions that prevented a full-fledged biologically active substances exit to the extractor and it was not advisable to carry it out. Summarizing the obtained data on the release of vitamin C and phenolic substances into the extractant, one can conclude that there is no significant difference in the kind of raw material (dry, fresh), therefore, for saving and convenience, for further research, dry powders were used.

The choice of the optimal correlation was based on the percentage of satisfaction in vitamin C for the products of the healing effect. Satisfaction with vitamin C was calculated taking into account the daily use of bitter tincture – 80 ml, and the daily needs of the population in vitamin C – 75 mg/day. While satisfaction with vitamin C should be 10-50% [7,8], as presented in Table 4.

Table 2

Chemical composition of the extracts obtained from dry powders

Sample name	Indicator	Cardamom extract	Ginger extract	Red pepper bitter extract
Correlation 20, extractor – water	Concentration of phenolic substances, mg/dm^3	85,12	140,73	220,59
	Ascorbic acid content, mg/100 ml	8,36	7,92	16,28
Correlation 20, extractor – water-alcohol mixture of 40% vol.	Concentration of phenolic substances, mg/dm^3	105,08	374,59	421,65
	Ascorbic acid content, mg/100 ml	7,92	10,12	13,2
Correlation 15, extractor – water	Concentration of phenolic substances, mg/dm^3	154,99	231,99	395,98
	Ascorbic acid content, mg/100 ml	9,24	7,92	13,64
Correlation 15, extractor – water-alcohol mixture of 40% vol.	Concentration of phenolic substances, mg/dm^3	294,74	530,02	597,04
	Ascorbic acid content, mg/100 ml	11,44	11,0	8,8
Correlation 15, extractor – water-alcohol mixture of 70% vol.	Concentration of phenolic substances, mg/dm^3	73,70	434,48	143,58
	Ascorbic acid content, mg/100 ml	8,36	9,24	13,2
Correlation 10, extractor – water	Concentration of phenolic substances, mg/dm^3	177,81	377,44	621,28
	Ascorbic acid content, mg/100 ml	13,2	26,5	17,6
Correlation 10, extractor – water-alcohol mixture of 40% vol.	Concentration of phenolic substances, mg/dm^3	400,24	699,71	836,60
	Ascorbic acid content, mg/100 ml	11,0	17,73	14,96

These tables show that, given the satisfaction with vitamin C, the correlation 10 is optimal. As for extractants, good indicators give a water-alcohol mixture 40%vol., and water-alcohol mixture 70%vol. is not appropriate, since the percentage of satisfaction in vitamin C below 10%. Such an extractant as water is very interesting, as satisfaction with vitamin C is low, but there is a way to increase it, namely, to evaporate excess moisture and obtain an aqueous concentrate.

Consequently, for obtaining qualitative vitamin C-rich extracts, it is necessary to adhere to the following extraction conditions from spices and aromatic herbs:

- the duration of the process should be 80 minutes at constant stirring at a frequency of 100 rpm;
- the extraction temperature should not exceed 40 °C.

Table 3

Chemical composition of extracts from fresh raw materials

Sample name	Indicator	Cardamom extract	Ginger extract	Red pepper extract bitter
Correlation 20, extractant – water	Concentration of phenolic substances, mg/dm^3	—	120,78	173,53
	Ascorbic acid content, mg/100 ml	—	7,92	10,56
Correlation 20, extractant – water-alcohol	Concentration of phenolic substances, mg/dm^3	—	361,76	542,85
	Ascorbic acid content, mg/100 ml	—	8,8	13,2
Correlation 15, extractant – water	Concentration of phenolic substances, mg/dm^3	—	249,10	172,10
	Ascorbic acid content, mg/100 ml	—	7,92	9,68
Correlation 15, extractant – water-alcohol	Concentration of phenolic substances, mg/dm^3	—	127,90	511,48
	Ascorbic acid content, mg/100 ml	—	8,8	11,44

These conditions will enable us to intensify the extraction process and obtain extracts that will be used in the production of bitter tinctures. Given that in the method of obtaining a bitter tincture there is a process of concentration of water extracts, it would be advisable to compare the chemical composition of water extracts and concentrates from them, the data are given in Table 5.

The data in Table 5 indicate that the extraction concentration step allows increasing the content of biologically active substances, thereby increasing the biological value of the beverage. On the basis of the research, a new method of obtaining bitter tinctures was developed.

In the developed method, the replacement of the water-alcohol mixture with the prepared water can be explained by the fact that extraction of water results in a greater amount of vitamin C, as well as during the blending, the possibility of enriching the finished vitamin C with the concentration of the extracts is possible. At the same time, the costs of alcohol for extraction are excluded.

The duration of the extraction process should ensure the maximum yield of biologically active substances. Conducting the extraction process for more than 120 minutes is not feasible, since the extracts are contaminated by adjacent compounds, the diffusion rate of which is much smaller than that of biologically active substances. And the duration of less than 40 minutes does not allow the maximum removal of biologically active substances.

Table 4

Satisfaction in vitamin C with bitter tinctures

Sample name	**Ingredients of the formulation**			**Content of ascorbic acid in extracts, mg/100 ml**	**Content of ascorbic acid in water-alcohol mixtures is 40% vol., mg/100 ml**	**Satisfaction in ascorbic acid,%**
	Cardamom extract	Ginger extract	Red pepper extract bitter			
Correlation 20, extractant – water	2	1	3	12,25	5,25	5,6
	3	1	2	10,93	4,68	5,0
	4	1	1	9,61	4,12	4,39
	1	1	4	13,57	5,81	6,2
Correlation 20, extractant – water-alcohol 40%vol.	2	1	3	10,93	—	11,66
	3	1	2	10,05	—	10,72
	4	1	1	9,17	—	9,78
	1	1	4	11,81	—	12,59
Correlation 15, extractant – water	2	1	3	11,22	4,81	5,13
	3	1	2	10,49	4,49	4,79
	4	1	1	9,75	4,18	4,46
	1	1	4	11,95	5,12	5,46
Correlation 15, extractant – water-alcohol 40%vol.	2	1	3	10,05	—	10,72
	3	1	2	10,49	—	11,19
	4	1	1	10,93	—	11,66
	1	1	4	9,61	—	10,25
Correlation 15, extractant – water-alcohol 70%vol.	2	1	3	10,93	6,24	5,6
	3	1	2	10,12	5,78	5,0
	4	1	1	9,31	5,32	4,39
	1	1	4	11,73	6,70	6,2
Correlation 10, extractant – water-alcohol 40%vol.	2	1	3	17,20	7,37	11,66
	3	1	2	16,89	7,24	10,72
	4	1	1	16,16	6,92	9,78
	1	1	4	18,36	7,87	12,59
Correlation 10, extractant – water	2	1	3	15,04	—	16,04
	3	1	2	13,74	—	14,66
	4	1	1	12,45	—	13,28
	1	1	4	16,33	—	17,42

Table 5

Chemical composition of water extracts and concentrates from spicy aromatic raw materials

№	Name of the raw material	Content of vitamin C, mg/100 ml		Content of phenolic compounds, mg/100 ml		Dry matter content,%	
		I	II	I	II	I	II
1	Cardamom	12,76	24,16	89,40	156,42	1	2,5
2	Ginger	25,65	32,12	301,87	508,63	3,3	4,5
3	Red pepper bitter	16,72	21,82	662,64	823,77	3,5	8,5

Note. I - extracts; II - concentrated extracts

The temperature of 40 °C will accelerate the extraction process and preserve vitamin C containing vegeTable raw materials. The temperature below 35 °C will not ensure the complete removal of biologically active substances, and temperatures above 45 °C will contribute to the destruction of vitamin C.

When stirred, the extraction rate increases, as the layer of the non-volatile fluid decreases and convectional streams are created that facilitate the transfer of matter to the extractor.

Mathematical and statistical processing of data

The vast majority of investigated objects belong to a class of complex systems characterized by a large number of interconnected parameters. In conditions of selection of optimal parameters of the process of extraction, the issue is solved by means of experimental statistical methods [9].

Having determined what factors influence the content of phenolic compounds and vitamin C in extracts of spicy aromatic raw materials, we determined their levels of variation, which are given in Table 6 and constructed the matrix of the two-factor experiment.

Table 6

Levels of variation

Factor	Unit of measurement	0-level	Upper level «+»	Lower level «-»
Correlation		15	20	10
Duration	min	80	120	40

A coherent comparison of the values of the main factors for each target component made it possible to determine the optimal values of process parameters for each type of raw material.

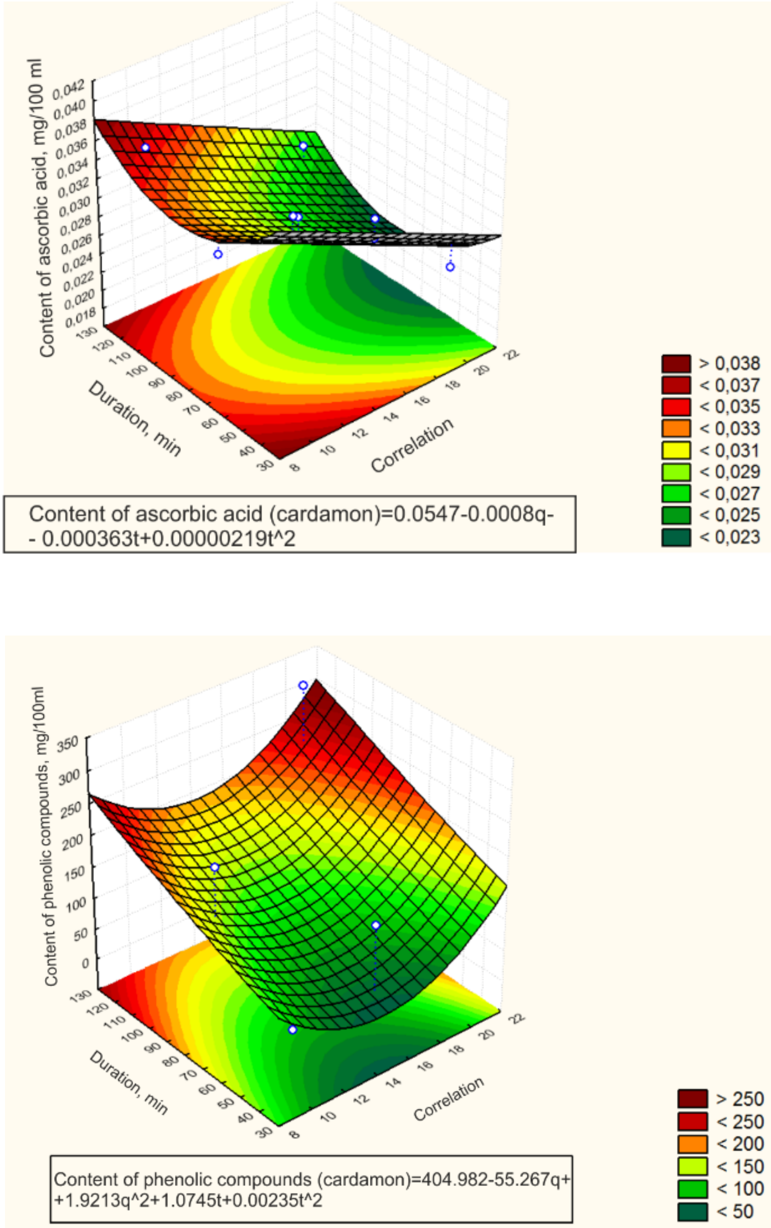


Figure 1. Surfaces of the response to the dependence of vitamin C and phenolic compounds on the correlation and the duration of the extract in cardamom

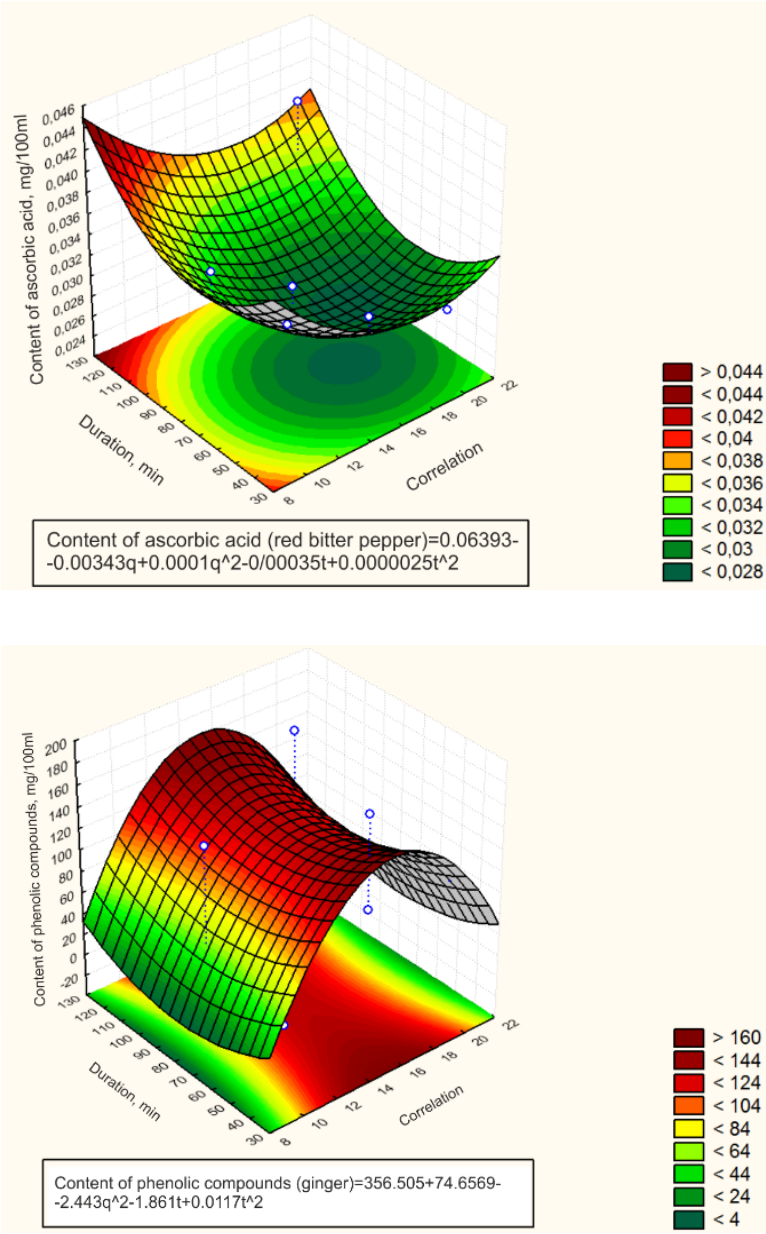
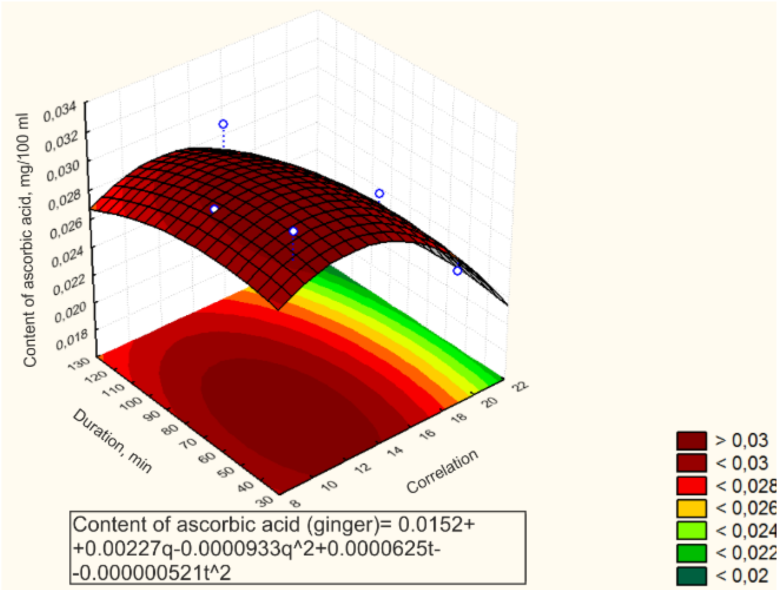


Figure 2.Results of the response of the dependence of the content of vitamin C and phenolic compounds on the correlation and the duration of the extract from red bitter pepper



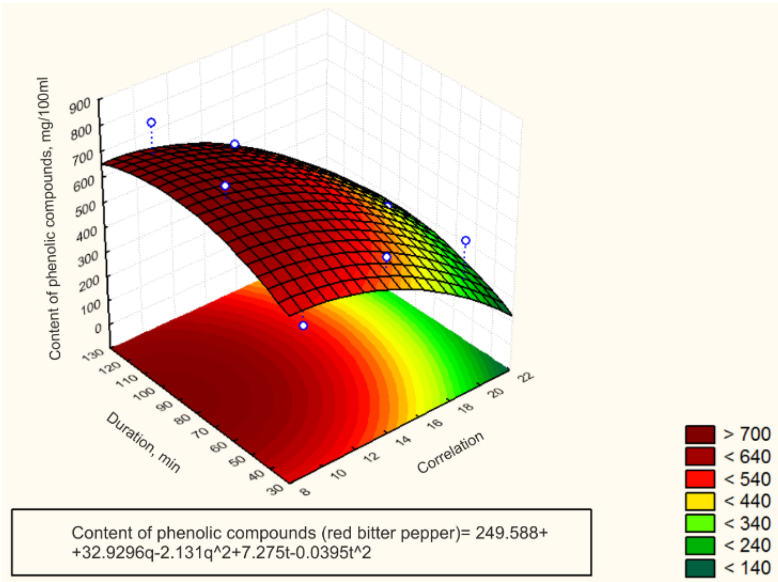


Figure 3. Surfaces of the response of the dependence of the content of vitamin C and phenolic compounds on the correlation and duration of the extract in ginger

Thus, the optimal values of the correlation and the length of the extraction process were respectively for cardamom 14.5 and 83 min (Figure 1); for ginger – 13 and 70 minutes (Figure 2); for pepper bitter 17 and 92 minutes (Figure 3).

Conclusion

Taking into account the above we can conclude that it is advisable to consider such a parameter of nutritional value as the ability of the main components and food additives to bind toxic metals (Pb (II), Cd (II), Hg (II)) when developing tincture formulations and withdraw them after digestion of food from the human body. To do this, it is necessary to select the following types of raw materials that would have this indicator.

Also presented are the results of scientific research in the liqueur industry, namely in the technology of production of bitter tinctures based on extracts of cardamom, ginger and red pepper.

To evaluate the tread properties of extracts, we first studied the ability of the components of it to bind ions Pb^{+2}, Cd^{+2}, Hg^{+2}. Protective properties concerning heavy metal ions of spices and aromatic raw powders are carried out in 3 schemes of complex formation, namely amino acid fragments, with pectin substances and vitamins.

Based on the research data, when developing the formulation of alcoholic beverages, it is recommended to be guided by the data obtained to create products of high biological value.

Also, the selection of optimal parameters of the extraction process, namely, the correlation and the duration, have been carried out. It was found out that in order to obtain high quality extracts, the optimum values of the correlation and the length of the extraction process should be 14.5 and 83 min respectively for cardamom; for ginger – 13 and 70 minutes; for pepper red bitter 17 and 92 minutes.

The technology of production of bitter tinctures is described and the hardware-technological scheme of production of bitter tinctures has been developed, which will provide in-depth extraction of biologically active substances from spicy aromatic raw materials, increase of biological value, shortening of the process duration, decrease of alcohol consumption and processing of swirling without additional evaporation of alcohol, obtaining at the output ready drink.

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Improvement of grain drying technology through the rapid grain heating and heat recuperation of wet gases

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Abstract

Introduction. The technology of drying the grain is a bottleneck in the technology of its storage. The modern dryings technology of the grain does not meet the requirements of productivity, energy intensity and quality of its drying.

Materials and methods. An object of researches is kinetics of temperature of layer of grain. Standard methods of research of the grain. Known methods for studying gas parameters and mathematical methods of research calculating the results.

Results and discussion. We have established the reasons for the growth of energy consumption for grain drying and influences. The main reason for growth of energy consumption consist in the increase in resistance to the intracapillary moisture diffusion in the grain body. The main growth factor of the resistance to the internal diffusion in the grain body is the imbalance of the intracapillary pressure in layers of the seed body. We have found the numerical dependence of the intracapillary resistance to moisture diffusion on the drying rate and body size of the seeds. Probably we are first who in the testing conditions developed and verified the method for reducing intracapillary resistance to diffusion. We have not still encountered such studies in publications that`s why in article we gave calculations on the decrease in resistance of the intracapillary moisture diffusion for modes and design of American GH-2419 shaft dryer. The application of our method for reducing energy consumption of drying does not require essential changes in the design of the shaft dryer and will not lead to the decrease in the performance of this dryer. This article provides for the theoretical substantiation of the method for reduction of unit costs for grain drying heat via decrease in the resistance to internal moisture diffusion in the capillaries of the body of the seed.

The theoretical interest consists in our research of numerical dependence of the internal resistance to moisture diffusion in the capillaries of the seed body on drying rate and body size of the seed. The practical importance in studies set forth in the article can be perceived in the possibility to reduce the specific energy consumption in grain drying up to 25% through the improvement of drying technology and design of dryers. Both scientists and manufacturers of grain dryers may get interested in this article in order to improve their design.

Experimental studies have shown technological possibility and economic feasibility of the method for the grain pre-heating. The use of heat of exhaust drying gases for these needs will allow accelerating the drying of grains up to 25% and reducing energy consumption for drying up to 35%. Our developed method does not require significant capital investments and may be applied to existing designs of domestic or foreign shaft grain dryers.

Conclusions. Experimentally proved the technological feasibility of using heat of the exhaust drying gas with the limited relative humidity ($\varphi_2 \approx$ 97 to 99 %) for pre-heating of wet grain before its dehydration and tested technological method and modes in which the dehydrated grain is heated almost ten times faster and humidified only by δW= 0.3 – 1.7 %.

Introduction

The indicators related to drying technologies, such as the grain drying speed, layer-by-layer uniformity of moisture content in a grain body and chemical changes in thermolabile components associated not only with the grain body temperature, as a whole, but with a nature of the grain layer heating, heat exchange method and temperature in seed body layers. Because the drying speed and drying uniformity are in power-law dependence on its temperature, thus, in practice a grain layer is sought to be heated as quickly as possible up to the threshold values. However, in terms of interphase heat-and-moisture exchange with heated working gases, at the initial drying stage not only the grain is not heated, but also it may be somewhat cooled down.

This is due to the priority use of the heat of working gases on phase transformations of moisture contained in the surface seed layers, and shortage of energy of these gases for further heating of the seed body. With the increase in moisture content and grain body size not only the duration of the heating is increased, but it concerns a layer-by-layer heterogeneity of moisture content and temperature in the seed body as well that leads to the microtrauma of the seed body, damage to chemical constituents and excess heat losses [1, 4, 6, 8]. Based on the known drying technologies, the heating time of the grain layer of different sizes of the seed body and a moisture content may range from 10 to 15 till 90 to 120 minutes, and the grain microtrauma increases up to 25% and more [3, 7, 9].

Substantiation of the idea. The relevance of the grain layer heating is supported by the direct dependence of the kinetics of its heating with the kinetics and energy consumption of dehydration [5, 6]. This is due to the fact that the speed of internal and external moisture diffusion in the pores of the seed body is in the power-law dependence on the temperature of the seed body. And the intensity of grain drying, in turn, is directly related to the moisture diffusion rate in these pores. Therefore, at the initial drying stage the important thing is to rapidly heat a dehydrated body. To do this, it should create conditions of interphase heat exchange in which the greatest possible share of the heat of drying gases will be spent on the grain heating, and smaller one – on its dehydration. Such conditions are characterized by minimum values of the *Kosovich* criteria ($Ko \to 0$).

In our opinion, the most technically acceptable and cost-effective way of ensuring conditions of acquiring the $Ko \to 0$ requirements for convective dryers is the use of exhaust working gases with an increased moisture content. In this case, the difference in the moisture content of phase environments (partial pressures) reaches minimum values and the heat of working gases will be to the maximum used for heating the seed body. That is, $Ko \to 0$. However, to prevent or to reduce the risk of grain humidification due to the steam condensate of such gases, it is necessary to establish rational modes for the interphase interaction.

Materials and methods

An object of researches is kinetics of temperature of layer of grain.

Standard methods of research of the grain [7]. Known methods for studying gas parameters and mathematical methods of research calculating the results [6–9].

Measuring devices

Mass – by scales laboratory electronic ET-600P-E (Pat Bec) and scales electronic BTHE-6L1;

Temperatures of grain – by mercury thermometers, by thermocouples with the electronic transformer of TM-914C;

Temperatures of drying gases and air - by the thermoanemometer of TTM-2 and by the portable measuring device of humidity and temperatures of gases of IBTM- 7;

Humidities of grain – by the expressanalyzer of Wil Digital, Grain MastureTester PM-400, and also in the drying closet of SESH-3;

Content of moisture of drying gases and air - by the portable measuring device of humidity, content of moisture and temperatures of gases of IBTM-7, by the psychrometer of PBU-1;

Speed of flow of drying gases and air, aerodynamic resistance and losses of pressure - manovakometrom digital MMC-200 with tubes pressure, by the micromanometer of MMH-200, by the thermoanemometer of TTM-2;

Duration of experiment – by stop-watches.

Methods of calculations

Humidity of layer of a grain was set by expressanalyzers, standard and exemplary methods. A standard method is taken to drying of portions of the ground up grains in the drying closet of Sesh-1 at a temperature 130 ºC during 40 min with the further cooling.

A calculation to the coefficient was executed the to the exchange of moisture layer of grain and gases after a well-known formula [1–4]:

$$g_m = \beta \cdot \rho_o(u_{п.к.} - u_p), \quad (1)$$

where g_m is intensity of evaporation of moisture from the surface of weevil in an environment, kg/(m^2·h); β is a coefficient of to content of moisture; ρ_o is a closeness of dry substances of grain, kg/m^3; u_g - content of moisture on the surface of grain, that answers a critical point, kg/kg d.m; u_p - equilibrium content of moinsture, kg/kg d.m.

The coefficient of to the exchange of moisture was expected after a well-known formula [1, 2, 5]:

$$\beta = \frac{N \cdot R \cdot p_{н\cdot} \cdot \phi}{100 \cdot (p_м - p_п) \cdot \omega_p}, \quad (2)$$

where N is speed of drying, of %/min.; R - the brought radius over of grain, m (took from a table or accepted dекв≈4·Rs).

The methods of calculations of experimental data executed in accordance with the chosen plan of experimental researches. The number of reiterations of experiments answered the criterion of logically-possible rejections and sufficientness for establishment of dependence.

The statistical estimation of the got results was carried out after the mean values of supervisions y_u. For the numeral estimation of coefficients in empiric dependences applied a least-squares method [2, 6–8]. Essence of that is taken to the estimation of authenticity of the got results of researches thus.

Results and discussion

Actual data of the exhaust drying gas indicators, obtained by us on the basis of the drying of different crops for different seasons of dryers` operation, allowed establishing the technological and economic feasibility of their use for pre-heating the grain layer. The temperature of these gases exceeds the temperature of the wet grain in summer period from 15 to 25 °C and in winter from 30 to 45 °C.

The heat of the exhaust drying gases in terms of the steam contained in them can be calculated by the known formula of the difference in enthalpies of gases in the environment (I_0) and exhaust ones (I_2):

$$Q_{\text{grain heating}} = M \cdot (I_2 - I_0), \tag{1}$$

where I_0 and I_2, respectively, the enthalpy of the air and the exhaust drying gas in moisture content of the air d_0 and gases d_1, kJ/kg $_{\text{dry air}}$, M – losses of working gases for the grain drying, kg/h

By considering the ambient air and exhaust working gases as a mixture of gases and moisture steam contained in them, respectively, the enthalpy can be expressed in a similar and acceptable way for further calculations by using thermal characteristics of components of gases:

$$Q_{\text{grain heating}} = M \cdot [\, c_{\text{dry air}} \cdot (t_2 - t_0) + \lambda_0 \cdot (d_1 - d_0) + c_s \cdot (d_1 \cdot t_2 - d_0 \cdot t_0)], \tag{2}$$

where: t_0 and t_2 – temperature of environment gases and exhaust drying gases, °C; d_0 and d_1 – moisture content of the ambient air and exhaust drying gases, g/kg $_{\text{dry air}}$; $c_{\text{dry air}}$ – specific heat of dry air, kJ/kg ($c_{\text{dry air}}$ = 1.004 kJ/kg $_{\text{dry air}}$); λ_0 is heat of vaporization at temperature t = 0 °C (λ_0 = 2.500 kJ/kg); c_s. – specific heat of superheated steam, kJ/kg (c_s = 1.842 kJ/kg).

Given the heat of gases of the air and moisture steam contained in the exhaust gases, the heat loss with these gases in recalculation to the drying of the planned one ton of grains for various drying conditions can be ranged from 130–240 MJ per 1 planned ton, or in recalculation to the heat generating capacity of natural gas is 4.2–7.8 m^3 per 1 planned ton.

This heat may be enough to heat one ton of wet grain at 50–100 °C. Taking into account the technical heat losses of the convective heat exchanger, we can assert that the heat from exhaust drying gases can reliably heat one ton of grains up to the limit temperature.

To clarify rational modes of convective grain heating by means of exhaust working gases in compliance with the $Ko \rightarrow 0$ requirements and a minor risk of grain humidification, there were experimental investigations close to the manufacturing conditions in terms of the thickness of the grain layer with different designs of dryers (h = 0.22–0.31 m) and parameters of the exhaust gases. The moisture content (d_1) and relative humidity (φ_2) of the exhaust drying gases in the experiments were by 20–30 % more than average production indicators of the shaft dryers. Such worse indicators of interphase moisture for grain heating were provided by us in order to create comparatively more risk for humidifying the grain with condensate of this gases from production ones.

Studies related to convective heat-and-moisture exchange of wet grain (θ_0, W_0) with the exhaust drying gases (t_2, d_1) based on which $t_2 >> \theta_0$ and $W_0 \leq W_{\text{equilibrium}}$ it was established that by means of the provided heat of these gases (Q_2) and variable speed of their flow (υ_2)

one can control the moisture energy in the surface grain layer ($I_{s.l.}$) and on the surface of the seed body ($I_{s.s.}$) and, accordingly, the moisture gradient of phase environments.

It was experimentally proved that under conditions of significant temperature differences of phase environments ($(t_2 - \theta_0)$>>0), a little difference in the moisture content of these environmental ($W_{r.h} \approx W_0$)) and counter gradients of temperature and moisture, the direction of interphase moisture diffusion is more significantly affected by the energy status of the moisture in surface layers of the grain body [6]. This can be explained by the fact that already at the initial stage of phase-to-phase interaction the layer temperature of the grain rapidly grows and, accordingly, increases the energy state of moisture in the surface layers of the seed body. In its turn, this leads to the increase of propulsive potential for grain dehydration. In our opinion, this additional potential for grain dehydration, most likely, hinders its humidification by wet gases under conditions of excess in equally weighted moisture over the grain humidification.

The heating rate of barley grain layer with thickness h = 0.25 m by using gases with the increased moisture content (d_0 = 20–21 g/kg $_{\text{drv air}}$) was increased by 8 to 11 times compared to the dry gases (d_0 = 6–10 g/kg$_{\text{drv air}}$) with the same temperature (t_2 = 22–28 °C), and amounted to $d\theta/d\tau$ = 4.5–6.5 (ºC/min). Larger values of the grain heating speed were consistent with larger temperature difference between phase environments (t_2–θ_0) and higher gas flow speed υ_2.

To prevent pyrocondensation on the surface of remote grain layers, we increased the flow rate of gases with increased moisture content (υ_2) from 0.2 to 2.7 m/s and changed the pressure gradient of gases (±H).

The value of the actual grain moisture (W_i) during its heating in the heat-exchange chamber was defined on the basis of the condensate value $\delta W_{w.v}$ (W_i = $W_0 + \delta W_{w.v}$) and compared with those obtained in a standard way in the drying box. The condensate value $\delta M_{w.v}$ was established by the product of the difference in moisture content of gases before and after the grain layer (d_t, d_2) on the consumption of working gases L:

$$\delta M_{\text{condensate}} = L\cdot(d_t - d_2)/1000, \tag{3}$$

The current temperature of the grain layer was detected on the basis of indicators of temperature sensors placed in the grain layer.

Figure 1 shows the temperature dynamics for barley grain with different moisture contents (W_0 = 13–25%) when heating it with warm gases of high humidity (t_2 = 26–28 °C, $\varphi_2 \approx$ 97–99 %, d_1 = 20–21 g/m^3).

The temperature kinetics for control sample of barley grain with moisture content W_0 = 25%, and initial temperature Θ_0 = 12 °C for the heating operation with dry gases (d_0 = 6–10 g/kg $_{\text{drv air}}$) at the same temperature (t_2 = 26–28 °C) are shown with the graphical dependence 5 in Figure 1.

Figure2 shows the moisture kinetics for the wheat grain layer when heating the same gases. The obtained values of the calculated and actual moisture contents of the wheat grain allowed confirming the possibility of reducing the moisture of the grain layer by 2–6% in comparison with the calculated data established by heat exchange modes.

It was experimentally proved that with the increase of the temperature difference of the phase environments, the actual increase of grain moisture content is reduced based on the results of its humidification of gas condensate (graph *b,* Figure 2) compared to the calculated (graph *a*) Figure2). The estimated increase in the grain moisture, the initial temperature θ=6°C (graphical dependence 1a, Figure2) is ΔW=1.9%.

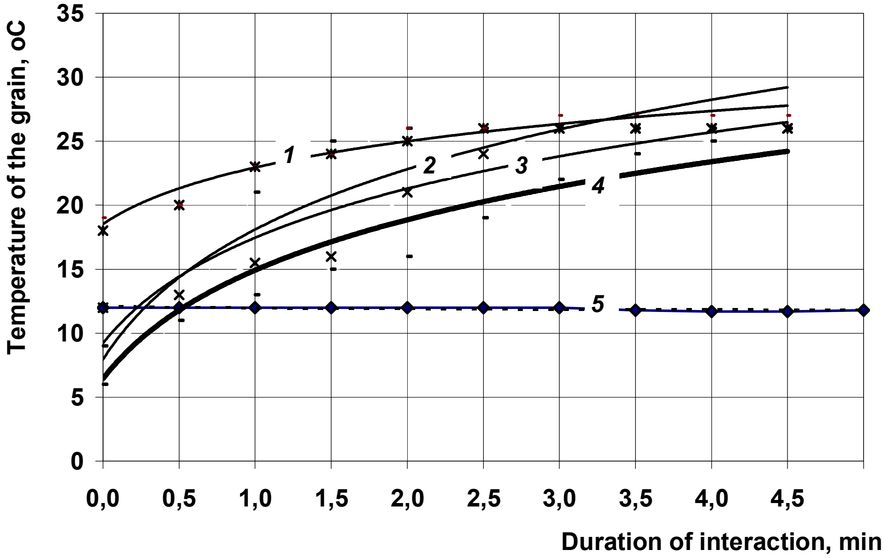

Figure 1. Dynamics of barley grain temperature with different moisture contents (W_0) and temperature (Θ_0):
1 – W_0 = 25 %, Θ_0 = 19 °C; 2 – W_0 = 20 %, Θ_0 = 12 °C; 3 – W_0 = 25 %, Θ_0 = 9 °C; – W_0 = 13 %, Θ_0 = 9 °C; 3 – W_0 = 21 %, Θ_0 = 12 °C.

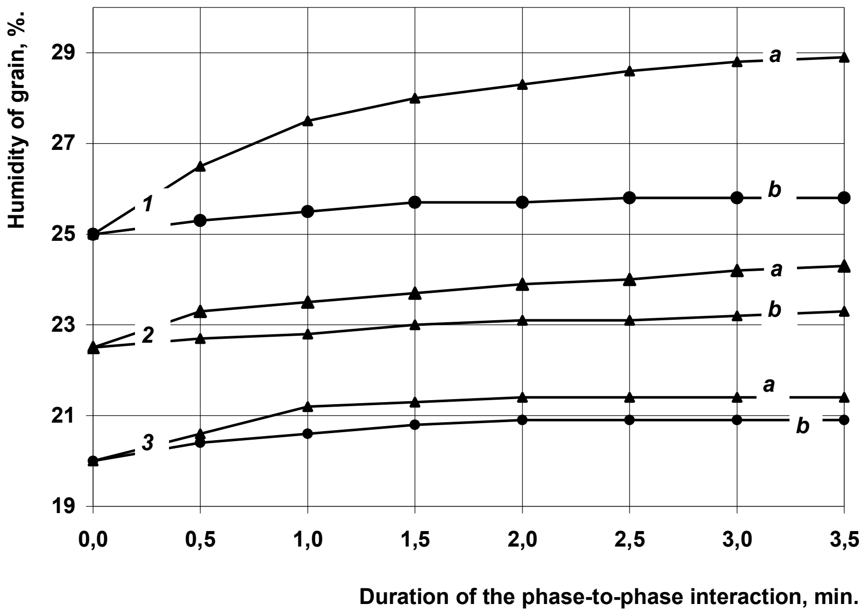

Figure 2. Dynamics of wheat grain moisture contents of calculated (a) and actual (b):
1–θ =6°C, W=20%; 2 – θ =10 °C, W=22.5%; 3 – θ =11 °C, W=25%.

However, the actual one, pursuant to established supply modes of exhaust drying gas, is only ΔW=0.2 %. With increasing initial grain temperature θ=11 °C and humidity W_0=25% (graphical dependence 3a and 3b in Figure2) the risk of grain humidification is significantly reduced when it is heated by exhaust drying gases.

Experiments established that in addition to the difference of temperatures of phase environments (θ_0–t_2) the condensate hydration of these gases is significantly affected by the penetration speed of the grain layer. Therefore, with the increase of the flow rate of wet gases the probability of grain humidification by the condensate of these gases decreases.

Below you can find calculations of the economic feasibility for the method on heating of the wet grain of the exhaust drying gases. For summer period of dryers` operation such exhaust gas parameters are as follows: temperature $t_2 \leq 50$ °C, humidity of upper drying zones $\varphi_2 \approx 90\%$ and $\varphi_2 \approx 55\%$ for lower ones [4]. Taking into account the design features of shaft dryers and gas pipelines from supply of exhaust gases for re-use of their heat, heat loss through the heating surfaces of pipelines and heat exchange chamber can reach 7% [3] to 15% [1, 2, 4].

The temperature of the grain harvested during the day can vary in a wide range θ_0 = 5–20 °C and humidity W_0 =15–30%.

It is obvious that while heating a wet grain by exhaust gases, its temperature cannot exceed the temperature of the coolant ($\theta_1 \leq t_2$, $\theta_1 \approx 28$ °C) and grain moisture for the worst conditions of phase-to-phase interaction can be moistened at δW = 0.5–1.5 %.

Heat losses $Q_{\delta\theta}$ for heating the grain up to the temperature of the exhaust gases can be calculated by using the known formula [1, 2]:

$$Q_{\delta\theta} = G \cdot c_0 \cdot (\theta_1 - \theta_0)\,, \tag{4}$$

where G – grain mass, kg; c_0 – specific heat of grain with humidity W_0, kJ/(kg·K); θ_0 and θ_1 – final and initial grain temperature, °C.

Heat losses of dehydration of extra grain moisture (condensate), which can penetrate into it from the exhaust gases, can be calculated by the known formula [1, 2]:

$$Q_{\delta W} = G \cdot \delta W \cdot (r + \Delta r)\,, \tag{5}$$

where r is the latent heat of vaporization at the grain temperature θ_1, kJ/kg$_{\text{humid.}}$; Δr – specific heat for overcoming the internal resistance to moisture diffusion, kJ/kg$_{\text{humid}}$, δW – value of moisture condensation on the grain surface, kg.

According to the performed estimates of the method of wheat grain heating with relative humidity W_0=17.5–20% and temperature θ_0 = 16–17 °C by exhaust drying gases with moisture content 20.5 - 22.5 g/m^3 and t_2=28°C, heat savings may be: $\delta Q = Q_{\delta\theta} - Q_{\delta W}$ = 13 to 20 (kJ/kg$_{\text{grain}}$).

$$\delta Q = Q_{\delta\theta} - Q_{\delta W} = 13 \text{ to } 20\ (\text{kJ/kg}_{\text{grain}}). \tag{6}$$

Or in recalculation to the natural gas for heating one ton of grains – 0.45 to 0.66 m^3/t.

In addition, it should note the following technological advantages of pre-heating by such method as ten-fold increase in the heating speed of the wet grain layer before its dehydration. This will allow not only to accelerate intracapillary moisture diffusion and to level a layer-by-layer heterogeneity of moisture content in the grain body, but also to reduce the risk of the layer-by-layer overheating of thermolabile components in the seed.

The given calculations in the experimental studies provide that under these conditions a phase-to-phase interaction (flow rate of working gases, state of the mobility of the grain layer and difference between gas temperature t_2 and grain temperature θ_0) the grain layer is heated ten times faster than conventional methods for heating the grain via dry gases.

Conclusions

1. The largest share of heat losses of modern technologies for grain drying applies to the exhaust drying gases. In a majority of domestic dryers, the losses are 35–45% of the total heat losses and for foreign ones – 25–40%;
2. The temperature of the exhaust drying gases exceeds the grain temperature in summer by 15–25 °C and in winter by 3–45 °C, absolute humidity is 21–23 $g/kg_{dry\ air.}$ The heat of these gases can heat almost twice more grain supplied to the grain dryer;
3. The heating rate of wet grain via exhaust drying gases is ten times more than heating rate of dry gases and duration of its heating up to the temperature of these gases is 2–5 min;
4. The specified phase-to-phase modes of interaction (speed of their flow, mobility state of the grain layer and method of supplying gases) can significantly reduce the risk of condensation of the condensed moisture on the grain layer surface;
5. We experimentally proved the technological feasibility of using heat of the exhaust drying gas with the limited relative humidity ($\varphi_2 \approx$ 97–99 %) for pre-heating of wet grain before its dehydration and tested technological method and modes in which the dehydrated grain is heated almost ten times faster and humidified only by δW= 0.3– 1.7 %.
6. Based on actual indicators of working gases of shaft dryers (φ_2 = 45–75 %), the risk of grain humidification in the process of heating such gases will be even less.
7. Re-use of heat by exhaust drying gases for heating the grain before its dehydration can reduce at 0.45–0.66 m^3/t the unit costs of drying in recalculation to the natural gas.

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Determination of the factor space of the process of extrusion of sausage products

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Abstract

Introduction. The analytical researches were conducted for the purpose of scientific substantiation of the main factors and to determine the factor space of the process of sausage stuffing extrusion.

Materials and methods. Methods of research: theoretical – studying and generalization of a priori information on the conditions for the extrusion of sausages; qualimetric. An additive mathematical model as most widespread in a qualimetry is used for joining the quality rating into the generalized (complex) index.

Results and discussion. One of the main processes in the formation of sausage products, which guarantees the receipt of high-quality products is the filling (extrusion) of the shell by sausage mince.

The main factors of the process of sausage mince extrusion are ascertained: pressure of extrusion; mince temperature; vacuum evacuation. It is determined that the amount of pressure of extrusion depends on the type of membrane, type of product, its composition, physical-mechanical and rheological properties, which is 0,30–2,00 MPa. The minced meat temperature affects the stability of the emulsion, therefore, when extruded in the sausage shell should be in the range from +8 to +18 ºC. Vacuuming has a positive effect on: reducing the volume of air void; color; texture; maturation of the product; the terms of its storage; reduction of oxidative processes in adipose tissue, as well as bacterial insemination; improvement of the rheological characteristics of the product; water-holding capacity (WHC); improving the density of the long loaf. The evacuation measure for individual types of mince is individual and can have pressure up to –0,09 MPa.

The coefficient of regression and the value of confidence interval are calculated Δb_i=0,004 (α=0,2; f=8). The coefficients of regression are checked for significance with a confidence intervals: b_0=0,654>±0,004; b_1=0,041>±0,004; b_2=0,06>±0,004; b_3=-0,021>±0,004l; b_{12}=-0,008>±0,004, b_{13}=0,006>±0,004, b_{23}=0,018>±0,004, b_{123}=-0,051>±0,004. It has been established that all variables influence the complex quality index statistically significant.

Conclusion. Generalization of literary facts has been carried out, which allows to establish the main factors in the process of extruding sausage mince, which depend on the type of shell, the type of product, its composition, physical-mechanical and rheological properties. In order to increase the complex quality index, it is necessary: to increase the pressure of product (x_1) to 2,25 МПа; maximize residual pressure (x_2) to –0,8 МПа; reduce the temperature to (x_3) to 275 K.

Introduction

Today, the Ukrainian meat and sausage products market is experiencing both negative and positive changes. According to the technical report, among to the negative one can be distinguished: depressed state of the meat market; large-scale using of cheap imported raw materials as an alternative to more expensive domestic; increase in energy prices and the main components of the sausage production; constant fluctuation (increase) prices of finished products; reduction of qualitative and taste indicators in pursuit of a mass consumer with low solvency; monopolization of the market – crowding out of the network of small and medium-sized producers; the export of domestic sausage products remains in perspective.

The positive changes concern with: renovation of production facilities; the desire of produce in the manufacturing of competitive products from high quality raw materials; the activation of brand products and the expansion of assortment presence in the middle and low-end segments; an increase in the volume of production of fine-packed products, as well as smoked and dried sausages in branded packaging; the introduction of new national standards for meat and meat products that allow the release of new names of sausage products.

All these positive/negative trends strongly affect the industry. For producing of high-quality products manufacture should use all possible measures(Kuzmin O. et al, 2016, 2017; Pasichnyi V.M. et al, 2015) [21, 18, 19, 20]. One of such measures is to improve the quality of the production of the most widespread group of sausage products – boiled sausages, which, due to its range and high taste and consumer properties has high demand among the population. The consumption of boiled sausages, sausages and small sausages in the total amount is almost 60%, while semi-smoked and boiled-smoked sausages, respectively, 30 and 10 %.

Materials and methods

Methods of research: theoretical – studying and generalization of a priori information on the conditions for the extrusion of sausages; qualimetric. An additive mathematical model as most widespread in a qualimetry is used for joining the quality rating into the generalized (complex) index.

Results and discussions

The group of sausages includes meat products made from sausage mince in the shell, or without it, subjected to heat treatment or fermentation and ready to be consumed.

General classification of sausages:

– by type of meat: beef; pork; horses; from poultry meat etc.;

– on the composition of raw materials: meat; by-product; bloody;

– in the form of a shell: in natural; artificial; without shell;

– on the pattern minced meat in the cut: with a homogeneous structure; with the inclusion of tongue or shredded meat;

– by appointment: for general use; delicacies; for dietary, for baby food.

– according to the production technology: boiled; semi-smoked; smoked (boiled, smoked and dried); stuffed; sausages and small sausages; liver sausages; blood sausages; meat loaves; paste; gulls and studs.

By food value, sausage products have no equivalent, because the variety of recipes include foods of different nutritional values: protein content – 10 to 30 %, fat content – 10 to 50 %, moisture content – from 20 % (smoked and dried) to 80 % (gipsies). Therefore, the energy value of these products varies from 800 kJ in boiled sausages to 2400 kJ in smoked.

The group of boiled items includes: boiled sausages; sausages; small sausages; meat loaves. A distinctive feature of the production of this group is the careful grinding of raw materials, which, as a result, acquires certain properties: it actively binds water and fat; forms a secondary structure; exhibits stickiness and viscosity. In turn, all these properties depend on the quality of raw materials and technological aspects (the method of salting, the level and type of mince, the temperature of mince, parameters of extrusion, precipitation, heat treatment, etc.).

The process of making sausage products includes the following main operations: collapse – separation of meat from bones; venation – branch of veins, cartilage, blood vessels; cutting the prepared meat on the weight pieces; salinization in metal containers and endurance in brine; grinding on a wolf or a whistler; stuffing and mixing in a stuffing mixer; formation of the sausage at the following stages: preparation of sausage shell; serving sausage stuffing for filling; minced shell extrusion; distortion of the loaves; clipping; shaving; a pile of sausage loaves on a stick and a frame. Further sedimentation and compaction of mince; roasting, cooking, smoking in thermocouples; cooling and delivery of the finished product to the warehouse (Huazi Wang et al, 2017; Yi-Chen Lee et al, 2012) [1, 2].

One of the processes that guarantees the receipt of high-quality products is the process of forming sausage products, which includes (table 1): preparation of the shell; handing of the mince; dosage and filling (extruding) of the shell by mince; distortion of loaves, bundles, clipping, shaving; A swath of sausage loaves on a stick and frame.

Sausage shell is a technological capacity that gives the product certain characteristics (Zonin V.G., 2006) [3]: keeps a form that is convenient in storage, protects against external factors, excess weight loss, microbiological and oxidative damage, due to its own strength, density, elasticity, and moisture resistance, a certain level of water, steam and gas permeability.

For each type of sausage according to the technological instruction picked up shell of a certain type, diameter and length is selected. Shells are divided into four groups (Essien E., 2003) [5]: natural (natural, intestinal); protein (collagen), artificial; artificial viscose and cellulose; synthetic (polymeric).

The extrusion (Grazyna Budryn et al, 2016) [4] – is the process of forced filling of the membranes, which is carried out by squeezing the minced meat from the syringe through the tongue, or its dosage with subsequent sealing in a certain form.

After extruding sausage loaves or clips with aluminum brackets on clipsators (Zonin V.G., 2006; Marianthi Sidira et al, 2015; Feiner G., 2006) [3, 6, 10, 8], or twisted on special semiautomatic machines, or tie with twine. After that, the natural shells of raw sausages are stamped (Rogov I.A., et al, 2000) [7] to remove air, the artificial shells do not dent, because their mechanical strength is reduced. In the upper part of the twine baton do a loop for hanging them on sticks and placing on mobile frames.

Consider the main factors that, in our opinion, are weighty in the process of extruding sausage minced: the pressure of extrusion; minced meat temperature; vacuum evacuation.

The pressure at which the minced meat is displaced in the shell (the pressure of the extrusion) is an important factor characterizing the degree of filling of the shell with minced meat (Grazyna Budryn et al, 2016) [4] and affects the compressibility of the structure, the density of stuffing mince (Gorbatov A.V., 1982) [12], the presence of the gas phase (Marianthi Sidira et al, 2015) [6, 10] and change in offset characteristics (Gorbatov A.V., 1982) [12]. With increasing of the pressure, the value of all structural and mechanical characteristics increase (Gorbatov A.V., 1982) [12], except for the plastic viscosity, which does not depend on pressure (Essien E., 2003) [5]. Under the influence of pressure, the reorientation of particles in the structure of sausage minced is carried out, which leads to a more compact packaging with simultaneous volumetric deformation (Gorbatov A.V., 1982) [12]. The number and volume of air cavities are reduced, the rest are deformed (Yi-Chen Lee et al, 2016) [9], and the change in the size of the particles of the shells of hydrates (Gorbatov A.V., 1982) [12] and the redistribution of the liquid between the particles and the disperse medium (Gorbatov A.V., 1982) [12], or its slight separation from the structure (Grazyna Budryn et al, 2016) [4] due to the reduction of WHC (Essien E., 2003) [5]. Such a mechanism of action of pressure leads to a strengthening of bonds between particles, that why the strength of the structure increases and for the destruction of the system required more intense external actions (Orawan Winther-Jensen et al, 2014) [11].

The magnitude of the pressure of the extrusion is regulated by a change in the ratio of the velocity of leakage of minced meat from the tufts and movement of the shell (Grazyna Budryn et al, 2016, J.-P.G. Piette et al, 1998) [4, 13]. If the extrusion pressure is too weak, the emulsion gives additional shrinkage, if the packing is too dense, the product may burst during heat treatment.

The process of extrusion is characterized by a pressure that depends on the type of membrane, type of product, composition, physical-mechanical and rheological properties (viscosity, plasticity).

So, boiled sausages are syringe with a small density on pneumatic syringes under pressure from 0,4 to 0,6 MPa (0,4–0,5 MPa (Rogov I.A., et al, 2000) [7], 0,49–0,59 MPa (Zonin V.G., 2006) [3], 0,5–0,6 MPa), on hydraulic ones – in the range 0,8–2,5 MPa (0,8–1,0 MPa (Rogov I.A., et al, 2000) [7], not more than 2,5 MPa), in order to prevent the extension of minced meat and further breaking of the shell (Rogov I.A., et al, 2000) [7].

The mince of sausages and small sausages are syringe under pressure 0,3–0,8 MPa (0,3–0,4 MPa (Yordanov D., Dinkov K., 2000) [14], 0,39–0,49 MPa (Zonin V.G., 2006) [3], 0,4–0,5 MPa (Rogov I.A., et al, 2000) [7], 0,4–0,6 MPa, 0,4–0,8 MPa).

Stuffing of semi-smoked sausages is sucked densely than boiled sausages, as the volume of loaves is greatly reduced with drying (Rogov I.A., et al, 2000) [7]. The pressure value for pneumatic syringes is 0,5–1,2 MPa (0,5–1,2 MPa (Rogov I.A., et al, 2000) [7], 0,59–0,78 MPa (Zonin V.G., 2006) [3], 0,6–0,8 MPa), for hydraulic – 1,0–1,2 MPa.

The mince of boiled-smoked sausages is also densely syringed using hydraulic piston syringes at a pressure of 0,5–2,0 MPa (0,5–1,2 MPa, up to 0,7–0,8 MPa, up to 1,2 MPa (Zonin V.G., 2006) [3], 1,3 MPa (Rogov I.A., et al, 2000) [7], up to 2,0 MPa).

The mince of smoked sausages is syringed the most densely (Rogov I.A., et al, 2000) [7] using hydraulic piston syringes at a pressure of 0,8–2,0 MPa (0,8–0,9 MPa (Yordanov D., Dinkov K., 2000) [14], 1,3 MPa (Rogov I.A., et al, 2000) [7], 1,3–1,5 MPa, up to 2,0 MPa).

During extrusion, the meat emulsion is subjected to mechanical effects: compression, friction and pressure, which causes an increase in its temperature. Exceeding the level of +18 ºC on the syringe can lead to a change in the physical and chemical parameters of minced meat: a decrease in rheological characteristics (Gorbatov A.V., 1982) [12] – (the decrease of emulsifying and WHC, the appearance of fatigue, bouillon and fatty edema in the finished product), in addition to the rate of destruction of the protein structure (Gorbatov A.V., 1982) [12] due to denaturation; increase in the rates of oxidation of fatty acids (Warriss P.D., 2000) [15]. In the complex with liquid and gas phases, an increase in the level +18 ºC (James S.J., James C., 2002) [16] leads to the growth of pathogenic microorganisms (James S.J., James C., 2002) [16], which affects further product damage (Sams A.R., 2001) [17].

Table 1

List of technological operations in the formation of sausage products

№	**The name of the operation** (Zonin V.G., 2006; Rogov I.A., et al, 2000; Feiner G., 2006) [3, 7, 8]	**Technological parameters and additional information of the operation**	**Technical facilities**
1.	Preparation of sausage shell	Saline natural shells are liberated from salt, washed in cold running water. Dry bladders soak in warm water for 10-15 minutes. After, the shell is washed, blown with compressed air, calibrated, sorted and cut into segments of a certain length.	– a bath for a sausage casket; – a binding table; – calibration device
2.	Submission of sausage mince to fill the shell	Transportation of minced meat in technological carts, feeding and loading of a syringe with the help of lift-loader. The temperature of mince is 12 ... 16 °C, and for semi-smoked sausages and boil-smoked sausages 12 ° C.	– carts technological; – lift-loader
3.	Dosage and filling (extrusion) of the shell by the mince	Dosage is carried out on the length of the loop or by the method of volume dosage. The crumb in the melting process is degassed.	– a syringe for filling the sausage membrane; – the dispenser of the mince; – an alternating set of threads
4.	Distortion of loops or viscous, clips (imposing metal clips at the end of the loaves), trimming	Strapping with special stitched straps. In the upper part of the loins of twine do a loop for hanging them on a stick.	– disturber; – clipsator; – a table for knitting sausage loaves
5.	Winging of sausage loaves on a stick and frame	Loaves hang on a stick and placed on the frames so that there is a gap between them to prevent clogging. The rate of placing sausages on one frame is 100-250 kg, depending on the type of sausages.	– mobile frames; – sticks

However, an excessive decrease in temperature also leads to changes in physical and chemical parameters: the reduction of oxidation rates of fatty acids (Warriss P.D., 2000; Kuzmin O. et al, 2017), [15, 18]; reduction of the degree of dispersion of fat, which negatively affects the fat holding capacity (FHC), slows down the development of the process of color formation and microbiological parameters: the decrease of the growth of pathogenic microorganisms (James S.J., James C., 2002; Sams A.R., 2001) [16, 17]. With a sufficient density of loaves, lowering the temperature can increase the content and break the shell of the sausage during cooking.

In addition, one of the important factors is the oxidations-reduktions potential consideration of fat in the main raw materials of the formulations and the antioxidants and food additives used in the manufacturing process that regulate the rheological and functional-technological characteristics of the mince (Pasichnyi V.M. et al, 2015) [20].

The mince temperature is an important and too critical factor, which in the process of making sausage minced meat affects the stability of its emulsion (Gorbatov A.V., 1982) [12]. According to a priori information, the temperature of the minced meat can vary from +2 °C to + 20 °C (Gorbatov A.V., 1982) [12], and when extruded in the sausage shell should be in the range from +8 to +18 ºC.

The presence in the pores and capillaries of the meat raw material of the gas phase (air) (Essien E., 2003) [5], which may be in a free state – with the formation of individual blistering and voids, or dissolved state – in the entire volume of the product, negatively affects (Sams A.R., 2001) [17]: color (red → green → gray); taste; consistency; stability of the lipid fraction; oxidation; fermentation; microbial contamination; expiration date.

Evaporation – deaeration (Warriss P.D., 2000) [15] is used to remove/reduce the gas phase in the raw materials and finished products, which positively affects: reduction of the volume of air void; color; texture; maturation of the product; the terms of its storage; reduction of oxidative processes in adipose tissue, as well as bacterial insemination; improvement of the rheological characteristics of the product; WHC; improving the density of the loaf.

The main stages of evaporation of minced meat result in processes (Marianthi Sidira et al, 2015) [6, 10]: milling; mixing; rubbing; extrusion. Evaporation during syringing is carried out with the aim of removing air, which gets into mince at previous stages of making minced meat. The evacuation measure for individual types of mince is individual, vacuuming is carried out at a pressure up to «–» 0,09 MPa.

The main operations that affect the concentration of the gas phase in mince: the crushing of raw materials on the dormouse (growth from 3,00 to 4,61 % vol.); mixing of the components of the formulation (growth from 4,75 to 5,80 % of volume); fine grinding on a whistle (growth at rubbing to 8,62 % vol. reduction after vacuum rubbing to 1,82 % vol.); extrusion in the mode of vacuuming and without it (vacuum extrusion removes up to 53,7 % than without it).

The amount of minerals in the process of extrusion is controlled by the rate of flow of mince from the flint, the linear velocity of the shell (Essien E., 2003) [5] and the diameter of the shell. The tension of the membrane during irradiation is not the same, therefore, the degree of stuffing is not the same. In addition, the individual segments of the shell have a different mass, since the shell itself has an uneven diameter along its entire length.

Vibration. The effect of vibration on the displacement characteristics of minced meat is investigated both during mixing and with the settling of stuffed mince in the shell. Treated in different variants, yielded 1,5–2,5% higher with a quality improvement of 0,3–0,4 points (with a five–point system) compared with the control. The voltage of the cut of the studied finished products was 38–43 kPa, compared with the control – 32 kPa (Gorbatov A.V.,

1982) [12]. The studied minced meat batches had higher values of the marginal strain of displacement compared with the control (Gorbatov A.V., 1982) [12]. In our view, vibration can be used in the process of extrusion as an additional factor that will help to remove the residual air from the stuff.

Our research (Pasichnyi V.M. et al, 2015) [20] and the priori information that was obtained allow us to determine the region of the factor space of variables (x_1, x_2, x_3) taking into account the actual conditions of the production process (Table 2). The criteria for optimizing the process of extrusion are determined by the characteristics of sausage mince: y_1 – tasting score (points); y_2 – moisture content of mince (%); y_3 – WHC of the mince (%); y_4 – fat–retaining capacity mince (%); y_5 – the effective viscosity (Pa·s); y_6 – effective shear stress (Pa); y_7 – volumetric deformation (%); y_8 – mass fraction of protein (%); y_9 – mass fraction of moisture (%); y_{10} – the number of mesophilic aerobic and facultative anaerobic microorganisms (number/cm^3); y_{11} – number of bacteria in the group of intestinal sticks (number/cm^3); y_{12} – yield of finished products to the mass of raw materials (%).

$x_1(+1) = 1{,}35 + 0{,}9 = 2{,}25$; $x_1(-1) = 1{,}35 - 0{,}9 = 0{,}45$;

$x_2(+1) = -0{,}64 + (-0{,}16) = -0{,}8$; $x_2(-1) = -0{,}64 - (-0{,}16) = -0{,}48$;

$x_3(+1) = 280 + 5 = 285$; $x_3(-1) = 280 - 5 = 275$.

Table 2

The scope of the experimental space of the experiment

Factor		Name of the factor	Level of factors			
			Upper	Lower	Null	Step
			+1	–1	0	–
$P_{p.e.}$	x_1	Pressure of extrusion, MPa	2,25	0,45	1,35	0,90
$P_{v.p.}$	x_2	Vacuum pressure, MPa	–0,80	–0,48	–0,64	–0,16
T	x_3	Mince temperature, K	285	275	280	5

The coefficient of regression and the value of confidence interval are calculated Δb_i=0,004 (α=0,2; f=8). The coefficients of regression are checked for significance with a confidence intervals: b_0=0,654>±0,004; b_1=0,041>±0,004; b_2=0,06>±0,004; b_3=-0,021>±0,004; b_{12}=-0,008>±0,004, b_{13}=0,006>±0,004, b_{23}=0,018>±0,004, b_{123}=-0,051>±0,004. It has been established that all variables influence the complex quality index statistically significant.

According to the obtained data, all variables influence the integrated quality index. We will write down the equation obtained:

$$y_к = 0{,}654 + 0{,}041x_1 + 0{,}006x_2 - 0{,}021x_3 - 0{,}008x_1x_2 +$$
$$+0{,}006x_1x_3 + 0{,}018x_2x_3 - 0{,}051x_1x_2x_3$$

The given experimental data allow us to conclude, that in order to increase the complex quality index, it is necessary: to increase the pressure of product (x_1) to 2,25 МПа; maximize residual pressure (x_2) to –0,8 МПа; reduce the temperature to (x_3) to 275 К.

Conclusions

Generalization of literary facts has been carried out, which allows to establish the main factors in the process of extruding sausage mince, which depend on the type of shell, the type of product, its composition, physical-mechanical and rheological properties. Found rational ranges of values that affect to the physico-chemical, microbiological and organoleptic characteristics of the finished product.

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Optimization of the recipe of toothpaste by carrageenan addition

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Abstract

Introduction. The physicochemical properties of toothpaste with the addition of carrageenan to optimize the structure of the toothpaste have been investigated.

Materials and methods. Three samples of toothpaste with containing carrageenan from 1% to weight to 3% to weight and a sample with 1% containing to the weight or sodium carboxymethyl cellulose (NaCMC) were prepared. The rheological parameters of the samples are determined using a rotary viscometer. Organoleptic assessment of the quality of toothpaste is carried out by using a descriptor-profile method.

Results and discussion. The list of organoleptic parameters is proposed. There are consistency, color, smell, taste. 5-point scale of assessments is also proposed. Profiling of quality metrics on this scale has been done. The best consistency for a toothpaste has a sample with 2% content of carrageenan to weight. The highest color rating have the samples of toothpaste with 1% and 2% content of carrageenan to weight. The smell and taste are satisfactory for all toothpaste samples. The best overall assessment of organoleptic quality parameters was obtained samples of toothpaste that contain 1% to weight NaCMC and 2% and 3% to weight of carrageenan. According to organoleptic indications, the most expedient is adding of carrageenan in an amount of 2% to weight. According to the rheological parameters, the indexes of the greatest viscosity of the system with practically no damaged structure (η_m=76,16 Pa•s) and the least viscosity of the system with a practically destroyed structure (η_0=86,37 Pa•s) are optimal. Adding of carrageenan form a gel-like consistency of the toothpaste. Regarding the calculated rheological parameters of this paste sample, which characterize the strength of structural bonds (Pk_1/Pk_2=1,68) and the range of stresses (P_m/Pk_1=8,87), which structure destruction occurs, are also satisfactory.

Conclusion. The resulting toothpaste with 2% content of carrageenan has a gel structure. The introduction of the additive optimizes the properties of the components of the toothpaste and promotes a rational impact on the physiological features of the oral cavity.

Introduction

The toothpaste is a cosmetic product for the care of the teeth and oral cavity, which is a suspension of abrasive-polishing substances in a water-glycerine solution with the addition of aromatic, biologically active, odor and surface-active, special medical and preventive components.

The ratio of toothpaste components determines the properties, purpose, mechanism of action and efficiency of the toothpaste.

Paste-like consistency of toothpaste allows entering various useful additives that have therapeutic and prophylactic action. Toothpastes are convenient and hygienic using. Currently, toothpastes are the most commonly used oral care products. Hygienic and therapeutic and prophylactic toothpastes are a massive oral care product, therefore the consumer's qualities of this product – color, taste, form [1] – play an important role.

The development of new technologies for competitive cosmetic products with high consumer, biological value and long shelf life is a perspective direction for the development of the cosmetic industry. Properties of toothpastes are largely determined by the characteristics of thickeners, such as viscosity and plasticity. The thickeners make up from 0,5% to 2,0% to weight of paste. That is why the paste is easily extruded from the tube, doesn't spread on the brush, and is easily distributed in the oral cavity. These substances also contribute to reducing the abrasiveness of the toothpaste while retaining cleansing and polishing properties. Hydrocolloids are used as gelling agents in most toothpastes. Viscosity, ductility and thixotropy to gel pastes are provided by natural and synthetic hydrocolloids. Natural hydrocolloids that are extracted from seaweed include sodium alginate and sodium carrageenate. Occasionally use vegetable gum and pectin derived from fruits and juices.

Arne Graf-Andersen, Garris Bicksler, Kenneth Nassen is considered that carrageenan is a perspective in producing toothpastes.

Adding a nutritional supplement E407 – carrageenan, obtained by extraction of red algae improve the physico-chemical properties of toothpastes to their composition [2]. Carrageenan is a very good stabilizer and gellant, it keeps the structure of the substance, even at room temperature and low heating, prevents the formation of lumps, its drying and hardening [3]. It is perfectly compatible with any natural and synthetic materials, therefore has found wide applying in cosmetology[4, 5].

Materials and methods

Based on the compiled and calculated recipes, 4 toothpastes with different content of carrageenan were prepared, samples were prepared in the laboratory of the department of chemical technologies of food supplements and cosmetic products:

- sample 1 – 1% content of sodium carboxymethyl cellulose.
- sample 2 – 1% carrageenan content;
- sample 3 – 2% of carrageenan content;
- sample 4 – 3% content of carrageenan.

According to the recipe of Table 1, four samples of toothpaste with different content of carrageenan were prepared:

Table 1

Toothpaste recipes

Composition	Weight, g			
	Sample №1	Sample №2	Sample №3	Sample №4
Calcium carbonate	20,00	20,00	19,20	18,80
Glycerin	5,00	5,00	4,80	4,70
Sorbitol	5,00	5,00	4,80	4,70
Sodium carboxymethylcellulose	0,50	0,00	0,00	0,00
Carraggenan	0,00	0,50	1,00	1,50
Sodium lauryl sulfate	0,90	0,90	0,86	0,85
Calcium glycerophosphate	0,75	0,75	0,72	0,71
Sodium monofluorophosphate	0,50	0,50	0,48	0,47
Dioxide of titanium	0,50	0,50	0,48	0,47
Saccharin	0,05	0,05	0,05	0,05
Aroma	1,00	1,00	1,00	1,00
Water	15,80	15,80	16,60	16,80

Sodium lauryl sulfate was dissolved in a portion of purified water (five times the amount of sodium lauryl sulfate) at a temperature of 60–70 °C. In the porcelain mortar, the recipe amounts of calcium carbonate, calcium of glycerophosphate, sodium monofluorophosphate, sorbitol, titanium dioxide and saccharin were thoroughly rubbed. To the resulting mixture was added a solution of sodium lauryl sulfate, glycerol and carrageenan. After thorough mixing, the flavor was added.

The manufactured toothpaste is packaged and labeled according to the sample number.

The rheological properties of the structured systems were studied, the potentiometer readings for each of the studied systems were studied at different (twelve) deformation rates and the steady stresses of the displacement P=const.

The study of structural and mechanical properties of the samples were performed on viscometer [6]. Viscosity measurements were carried out using the device, which operates on a constant shear rate.

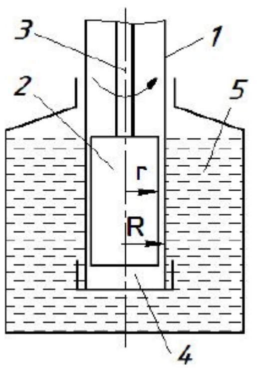

Figure 1. Chart of device

1. Prepare a sample of 50 gram of the set system, mix her and maintain 20–30 minutes.
2. In the immobile external cylinder of device 1 (Figure 1) inundate 30–40 cm^3 of the investigated system.
3. Put an internal cylinder 2 on an axis 3 that is connected with an electric engine.
4. An external cylinder 1 with the structured system is put on the fixed internal cylinder 2 and lift to support.
5. Fix position of external cylinder by means of nut. The investigated system is evenly distributed in a gap 4between coaxial cylinders (external 1 and internal 2). If necessary the system is maintained in a thermostat 5 at a certain temperature (Figure 1)

6. On condition of permanent tension of change P=const to the internal cylinder deformations (12 or 24) give certain permanent speed, here an external cylinder staysstill.

7. Register velocity of circulation of movable cylinder 2 by means of potentiometer. Velocity of circulation of cylinder is proportional to speed of deformation of the investigated system.

8. Tensions of change of P expect, that arises up in the system, after equalization:

$$P = Z \bullet \alpha$$

Z – became internal cylinder (driven to the passport of device, for example, for the cylinder of S2 – Z=5,39 Pa); α – it is a value of scale on an indicatory device (potentiometer).

9. The values of gradients of deformation έ for every velocity of circulation (12 values) take from passport data.

10. After the values of tension of change of *P* and gradient of deformation έ expect dynamic viscidity η:

$$\eta = P / \acute{\varepsilon}$$

η – dynamic viscidity, Pa·s; P – is tension of change, Pa; έ – it is speed of change.

11. The experimental data build complete rheological curves of viscosity $\eta = f(P)$ and fluidity $\acute{\varepsilon} = f(P)$.

The rheological parameters of the toothpaste, which characterize the strength of structural bonds and the range of stresses in which the structure is destroyed are calculated [7].

An organoleptic assessment of the quality of toothpastes is carried out using the descriptor-profile method [8].

Appearance, color, smell and taste were determined organoleptically by applying a small amount of paste on a smooth glass plate. Light grains were determined by the absence of grains, as well as the color, smell and taste of the paste.

Not all consumer goods in standards have developed a description of quality indicators and their characteristics.

We were offered a list of organoleptic indicators:

1. Appearance.
2. Color.
3. Smell.
4. Taste.

A 5-point scale was created and profiles of quality indicators were performed on scale. This made it possible to systematically approach the quality assessment and clearly assess the quality of indicators and determine the level of quality. Also, identify indicators with significant deviations.

Results and discussion

We carried out an organoleptic assessment of the quality of toothpastes. Depending on the composition, the toothpastes must comply with the requirements and norms approved by the normative documentation. Form, color, smell and taste were determined by applying a small amount of paste to a smooth glass plate. The light grains recorded the absence of grains, as well as the color, smell and taste of the paste. The results are presented in Table 2.

Table 2

Results of organoleptic quality assessment

Quality	Examples			
	№ 1	№ 2	№ 3	№ 4
Appearance	Consistency paste, with small grains	Consistency of liquid gel, with small grains	Consistency gel-like, with small grains	Consistency gel-like, with small grains
The color	White	Pure white	Dull white	White with a beige shade
The smell	Thin, light	Thin, pleasant	Pleasant lemon	Weak orange
Taste	Sweet to taste with a pleasant after feeling	Sweet to taste with a pleasant after feeling	Sweet to taste with a pleasant after feeling	Sweet to taste with a pleasant after feeling

Samples of toothpaste №1, № 3 and № 4 with the content of CMC 1% and carrageenan 2% and 3%, were the best overall estimation for organoleptic quality.

We have chosen the following descriptors: consistency, color, smell, taste. Using the developed profiling table (Table 3), evaluated the quality of samples of the toothpaste with different content of carrageenan.

Table 3

Profiling descriptor toothpaste

Valuation	Characteristics of organoleptic quality indices (descriptors)
Consistence	
5	Viscous, homogeneous pasty
4	Paste, not homogeneous
3	Not homogeneous, slightly liquid
2	Inhomogeneous, liquid mass
1	Inhomogeneous, camouflaged, liquid mass
Color	
5	Clean white
4	White with a beige shade
3	White with brown tint
2	Beige color
1	Light brown color
Smell	
5	Pleasant, according to the fillers used
4	Characteristic, but less pronounced
3	Slightly strong.
2	Unpleasant, strong
1	Strong, distorts the paste
Taste	
5	Sweet with a pleasant after taste
4	Sweet
3	Sweet with bitter after taste
2	Sweet with sour after taste
1	Bitter taste, unpleasant.

The descriptor-profile method sensory analysis is used for the study of cosmetic and food products. It is a method of scientific substantiation of the research and one of the methods of objective assessment of organoleptic parameters.

Using profiling table evaluated the quality of samples of toothpaste with different contents of carrageenan. Profilograms were constructed (Figure 2), the average estimate was calculated and the result was rounded to integer value for the purpose of visual perception of the results, profilographers were constructed, calculating the mean value of the estimation and rounding the result to the integer value.

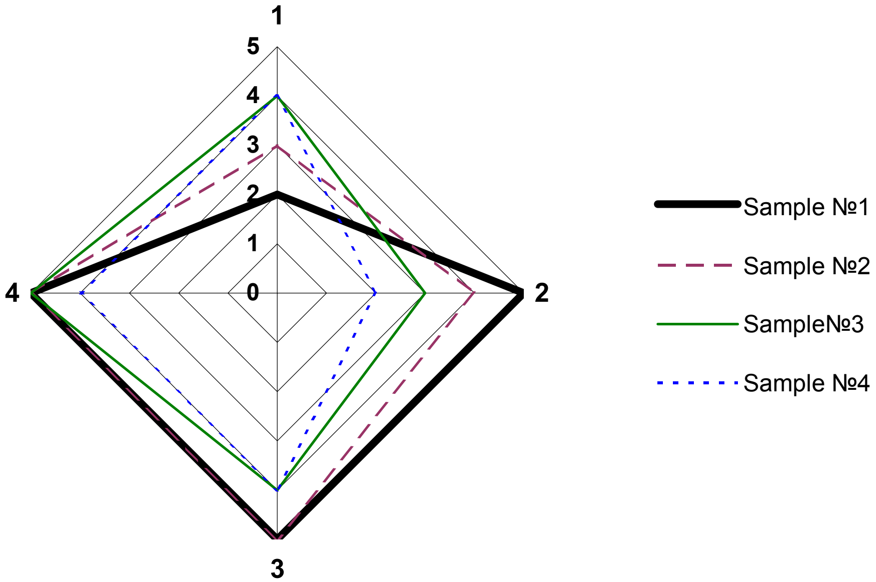

Figure 2. Prophylagram of evaluation of toothpaste samples.
The sides of the square are descriptors: 1 – consistency, 2 – color, 3 – smell, 4 – taste.

The best consistency has sample №3, the highest score by color was obtained samples of toothpaste №1 and №2. The smell and taste are satisfactory for all samples of toothpaste.

The rheological properties of the structured systems were studied. The potentiometer readings for each samples were studied at different (twelve) deformation rates and the steady stresses of the displacement P=const. The rheological parameters that characterized changing viscosity of the structured system in destruction of supramolecular structure as a result of the load were determined. The values: η_0 is the greatest viscosity of the system with practically no destroyed structure, η_m is the least viscosity of the system with a practically destroyed structure and their difference (η_0- η_m), which is on the magnitude of the anomaly of viscosity and characterizes the strength of the system formed in the supramolecular system structures (Figure 2).

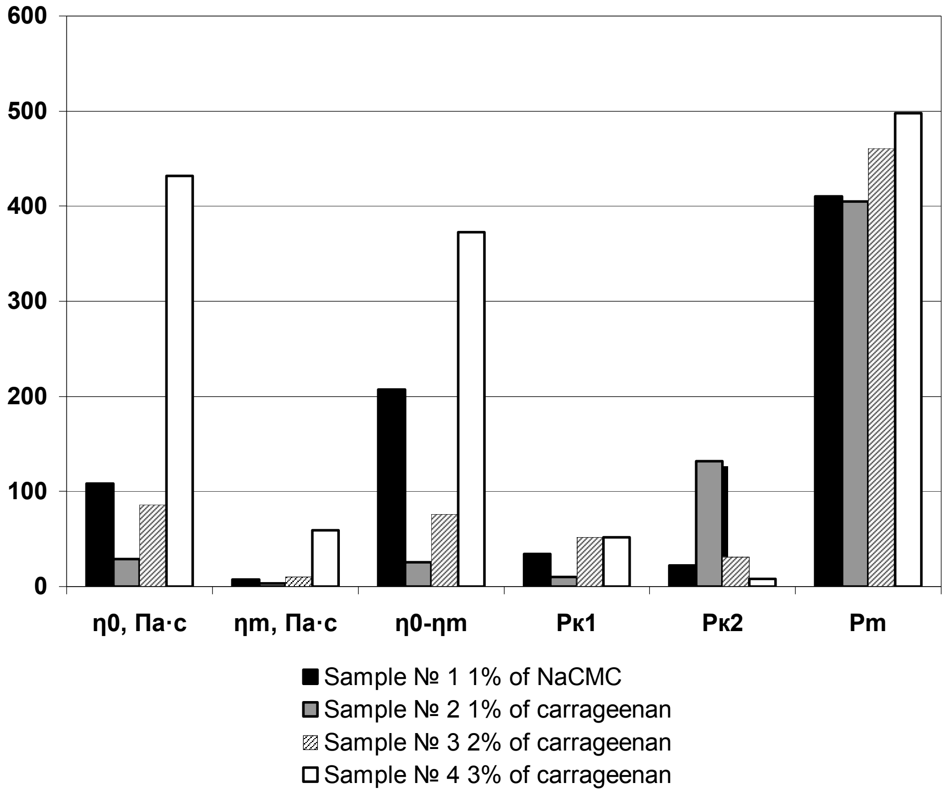

Figure 2. Viscosity and strength indicators for samples of paste with different contents of carrageenan

Some ratios of rheological parameters: Pk_1/Pk_2 characterizes the strength of structural bonds; P_m / Pk_1 characterizes the range of stresses in which the structure is destroyed were calculated (Figure 3).

The parameters that characterize the change in the toothpaste viscosity in the destruction of supramolecular structure as a result of the load are determined. Calculated rheological parameters that characterize the strength of structural bonds and the range of stresses in which the destruction of the structure occurs.

The most expedient is the introduction of carrageenan in an amount of 2% to weight. The parameters of the highest viscosity of the system with practically no destroyed structure (η_m=76,16 Pa•s) and the least viscosity of the system with a practically destroyed structure (η_0=86,37 Pa•s) are optimal. At the same time adding carrageenan create a gel-like consistency of toothpaste which meets the requirements of existing standards. The rheological parameters of this paste sample, which characterize the strength of structural bonds and the range of stresses in which structural destruction is taking place, are also satisfactory.

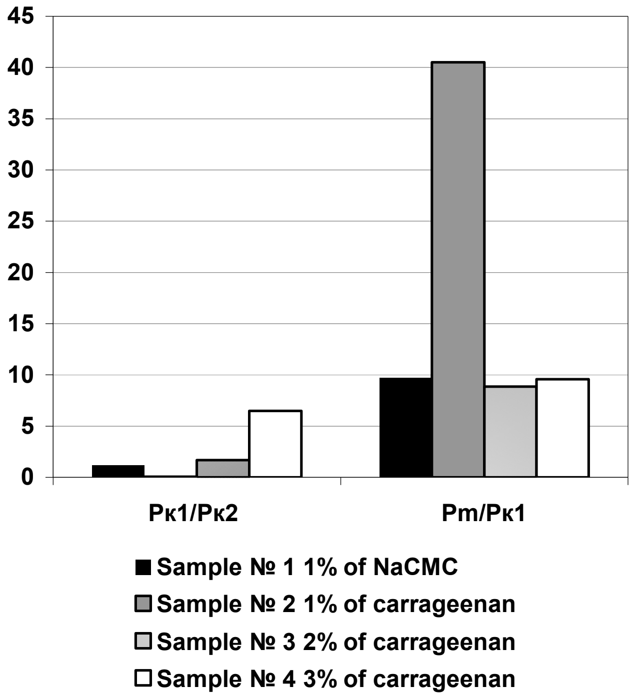

Figure 3. Strength indicators for samples of paste with different contents of carrageenan

Conclusion

The studies confirm the expediency of the introduction of carrageenan in the amount of 2% to weight of the toothpaste. The viscosity (η_m=76,16 Pa•s, η_0 =86,37 Pa•s) and the strength (Pk_1/Pk_2=1,68) of the toothpaste obtained are optimal, and the best generalized organoleptic profile received a sample of toothpaste №3 with 2% carrageenan content. Since the toothpaste has a gel structure, the introduction of carrageenan optimizes the properties of the components of the toothpaste and promotes a rational impact on the physiological features of the oral cavity. This type of toothpaste is recommended to use for the general population.

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Structural and mechanical properties of the jostaberry jelly

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Abstract

Introduction. It was investigated the use of the the jostaberry – new berry pectin-containing raw material species with high content of biologically active substances in the development of structured foods such as jellies for prophylactic nutrition.

Materials and methods. There were used such materials, as: jelly, berries of the Gooseberry family, namely – Jostaberry. There was made an analysis of the literary for substantiation of form factors selection in the jelly dishes development with the Northern Black Sea region`s raw material – jostaberry. The jelly structural strength was determined by the penetration method. The adhesive strength of jelly masses was determined by measuring the plate`s separation force, which characterizes the form surface from the jelly mass.

Results and discussions. As a dredging raw material for the jelly dishes with high nutritional value production it is expedient to use new berry raw materials of the Northern Black Sea region, namely jostaberry. Jostaberry is characterized by high content of biologically active substances, as well as pectin (0.8–1.5 g per 100 g of raw matter). Due to the high content of pectin, jostaberry is a promising raw material for the structured sweet dishes production, such as jelly.

It has been shown the possibility of partial gelatin exclusion from the formulation while the jostaberry is being added, without significant changes in the rheological characteristics of the product and to obtain jelly with the necessary structural properties. Thus, the values of density indices are 1,037 kg / m^3 and marginal displacement voltage of $30 \cdot 10^3$ kPa jostaberry jelly samples with 50% gelatin content from the formulation quantity meet the requirements. The reduce of gelatin mass content in the jostaberry jelly up to 50% of formulation quantity allows to reduce the adhesion tension in 1,2-1,3 times in comparison with control samples.It was established that the smallestjelly mass adhesive strength is observed when it is in contact with the silicone surface. The interaction strength increases by 1,2 times when ceramic surface is being used and by 1,6 times –when the surface is steel.

Conclusions. There has been substantiated the formulation composition of ingredients of structured dishes with high nutritional value for restaurant enterprises through the use of new pectin containing raw materials – jostaberry.

Introduction

The assortment expanding, improving the quality and nutritional value of desserts, including jellies, should be carried out by introducing into their formulations a new fruit and berry raw material, which includes valuable biologically active substances and structure-forming compounds.

During thejelly desserts from the new raw materials technology development, it is necessary to take into account both the balance of its chemical composition, the nutritional value, the original organoleptic parameters and its functional and technological suitability for obtaining the product with the given structural and mechanical characteristics.

Depending on the used draft agent, the production conditions and the technological process, you can get a jelly of different structural strength and with given surface properties. Too strong durability gives the jelly toughness of the consistency, and low strength leads to the finished product deformation, as well as the rapid separation from it of the liquid phase.

The most versatile structure-makers in the technologies of jelly sweet dishes arethe fruit and berry raw materialspectins. Pectins are characterized by good solubility in a wide range of dry substances, stable and controlling draft-forming properties. Compared with agar and gelatin, pectin is more resistant to acid [1,2]. This is very important for the fruit and berry desserts production that occur in acidic environment. By its drafting ability in the production conditions, pectin is stronger by 5 ... 8 times than gelatin [3,4].

We believe that it is expedient to use pectin-containing raw materials, such as jostaberry, in the jelly preparation. Jostaberry contains pectin in the amount of 0.8-1.5 g per 100 g of raw matter, which possesses sorption properties, promotes the radionuclides removal from the human body, hasdrafting properties [5]. Clinicians and nutritionists recommend include pectin in the diet of people in the radionuclidescontaminatedenvironment and who have contact with heavy metals. Consequently, the use of jostaberry – a pectin-containing additive in jelly will not only add the preventive properties of this sweet dish, but will also reduce the gelatin mass fraction in the formulation, or refuse it at all, without significantly structural and mechanical propertiesaltering of the jelly.

Jostaberry is the hybrid of gooseberry and currant. High content of biologically active compounds is its main advantage, as jostaberry contains components of gooseberry and currant at the same time[6]. Comparison of chemical composition of gooseberry, currant and jostaberry as shown in Table 1 allows to recommend its usage for dessert production. At present time jostaberry is widely popular in Western Europe while in Eastern Europe this culture is used mainly for decoration [7].

Jostaberry has high technological and consumer characteristics and is considered to be the rich source of natural biologically active compounds (Table 1). Together with black currant, jostaberry contains high concentrations of vitamins, in particular vitamin C. Consumption of 30 g of jostaberry supplies human organism with daily dose of ascorbic acid.

Jostaberry contains iron, which makes berries useful for those with anemia. Potassium ion of jostaberry positively influences on cardiovascular system and helps to reduce risk of heart-attack and stroke. Jostaberries are recommended for prevention of gastrointestinal diseases [7].

Table 1

Comparison of nutrition value of berries [6, 8, 9, 10, 11, 12]

Component	Black currant	Gooseberry	Jostaberry
Proteins, g	0,6	0,7	0,7
Fats, g	-	-	0,2
Carbohydrates, g	8,0	9,9	9,1
Pectin, g	1,0	0,7	1,1
Ash, g	0,6	0,6	0,9
Vitamins, mg/100g			
Beta-carotene	0,1	0,2	0,2
Vitamin B_1	0,01	0,01	0,01
VitaminB_2	0,02	0,2	0,03
VitaminB_3	0,3	0,25	0,3
VitaminC	200	30	450
Minerals, mg/100g			
K	372	224	275
Ca	36	22	40
Mg	35	9	17
Na	21	20	21
P	30	28	33
Fe	0,9	1,6	1,2
Energy value, ccal/100 g	40,0	44,0	45,0

It is reported that jostaberry contain polyphenol compounds, such as catehins, anthocyanins, flavonols and other. Total content of bioflavonoids in jostaberry is close to 320–380 mg/100 g. Jostaberry is rich dietary source of polyphenols with reported health benefits. More than 50 different flavonols (glycosides of quercetin, myrice-tin, kaempferol, isorhamnetin, syringetin and laricitrin) have been detected and quantified with HPLC–MSnin fruits of jostaberry. Quercetins represent the highest percentage (46–100%) among flavonols in jostaberry. In jostaberry the prevailing flavonols belong to the group of isorhamnetins (50–62%) and kaempferols [13,10].

A broad range of anthocyanins (glycosides of cyanidin, pelargonidin, peoni-din, delphinidin, malvidin, and petunidin) was identified and quantified in josta-berry species using HPLC-DAD-MS2. Cyanidin was the most commonly occur-ring anthocyanidin in jostaberry [14].

Jostaberry berries contain significant amount of cellulose and pectin. In case of regular intake they can perform detoxication function and stimulate the excretion of heavy metal ions and radionuclides. Jostaberry has low calorific value (45 ccal/100 g) and can be considered as diet product.

Thus, on the basis of the literary and patent sources analysis, it was concluded that jostaberry, although it is a new raw material for the Northern Black Sea region, is already actively grown, which will determine the economic efficiency of making dishes with the addition of these raw materials.

Materials and methods

The subject of studies of desserts with high nutritional value development was selected new raw materials, which is rich in chemical composition namely: jostaberry. While the new sweet dish technology development, in a jelly was added jostaberry adding in the amount of 15% to the mass of the product, with a partial (50%) and complete gelatin replacement.

For the whole quality control of the new product, a complex of its properties was studied: organoleptic and physical properties of the jelly mass. There were also studied some changes of its structural and mechanical properties provided to replace gelatin to jostaberry.

To determine the density of samples, a picnometric method was used, which is based on measuring the mass of a certain volume of the product at a temperature from the following absolute and relative density.

Structural-and-mechanical properties of the dough quality were determined with the help of the penetrometer of firms "Labor" of the OV-2G5, modification by determining the resistance of the food masses to the penetration of the body of immersion with strictly defined dimensions, mass and material at a precisely defined temperature for a certain time [15].

The study of jelly's adhesion properties was carried out on an adhesive. The measuring adhesion method is based on the destruction of the adhesive seam by applying external force. The characteristic of adhesion is the pulling force, which is related to the contact area. The adhesion force is characterized by the value of the resistivity of the separation [16].

Results and discussion

Given the high nutritional value, technological characteristics and economic availability of the new raw material of the Northern Black Sea region - jostaberry, we consider it expedient to use it to improve the technology of jelly.

At various technological stages of the jelly-fruit masses production, data on their rheological properties for the quality control of finished products is required. The jelly-fruit masses formulation contain draft agents, which lead to a significant change in the structural, mechanical and organoleptic properties of these products. Different components can be used to create a jelly – agar, gelatin, pectin. In our work, as such an ingredient used jostaberry`s pectin, which is a skeleton of drafts. The jelly quality depends not only on the pectin amount, but also on the quality of pectin, which depends on the pectin origin, on the degree of its hydrolysis, and others. [17].

For the good berry jelly formation the content of pectin-containing raw material changes due to water content, sugar content and acid [18]. If the stable conditions are technological, the needed pectin content will depend on its quality. But the jostaberry`s pectin quality, the jostaberry additives influence on the structural and mechanical characteristics change is not sufficiently studied and requires additional research. The detection of regularities of jostaberry pectin substances structuring will give the opportunity to reduce the need for structure stabilizers and to achieve the technological effect in the dessert producing process due to only natural plant ingredients.

For the pectin-containing raw material influence studying – jostaberry on the structural and mechanical change of jelly, there were developed model ingredient compositions of the jelly formulation, namely – jostaberry jelly with different gelatin content: 50, 100 % from the formulation content in traditional jelly formulation, which is 3 g of gelatin on 100 g of jelly. The model samples quality was compared with control sample – jelly with black currant, the structural and mechanical properties of which are sufficiently studied.

The jelly semi-finished product has gelatinous non-crystalline mass, and the finished products have elastic consistency. The research of structural and mechanical characteristics of the gelatinous systems largely determines the technological operations conducting peculiarity during the jelly preparation.

The structural strength, density, adhesive strength, which is expressed by the jelly masses separation specific force from the contacting surfaces from different materials – the indicators that most fully characterize the jelly structural and mechanical properties.

It is found, that the jelly density index with jostaberry adding is increases in comparison with a control sample – black currant jelly (Figure 1). It is known, that the increase of jelly density leads to an increase in its structural strength. Therefore, it was decided to study the rheological characteristics of jostaberry jelly samples, in where was reduced the formulation content of gelatin by 50 % and the samples with complete elimination of it in the formulation. From Figure 1 it is well seen that the jostaberry jelly density and the 50 % of gelatin on the formulation content is not significantly reduces in comparison with a control sample and is 1,037 kg/m^3, that meets the requirements.

Figure 1. Dependence of jostaberry jelly density p, kg/m^3 on the gelatin mass content a, %: 1 – Control; 2 – jostaberry jelly100 % of gelatin; 3 – jostaberry jelly 50 % of gelatin; 4 – jostaberry jelly without gelatin.

The jostaberry jelly structural strength dependence on the gelatin mass content is presented in Figure 2. As we see, the structural strength og jelly with jostaberry adding increases in comparison with control sample in 1,9 times, and decreases when the 50 % of gelatin is withdrawn from formulation till 30 kPa*10^3, that requires the control sample and confirms the expediency of jostaberry`s gelatin reduction in jelly formulation.

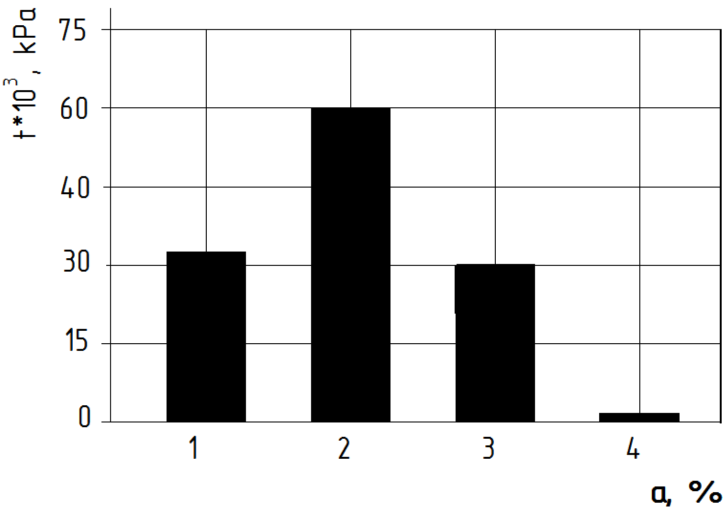

Figure 2. Dependence of jostaberry jelly structural strength t, kPa·10^3 on the gelatin mass content a, %:
1 – Control; 2 – jostaberry jelly100 % of gelatin; 3 – jostaberry jelly 50 % of gelatin;
4 – jostaberry jelly without gelatin.

From this point of view, a huge practical interest is the consideration of draft agents properties for the desserts production and the technological properties change by interaction of several draft agents of different character [19], in our case – jostaberry pectin and gelatin.

The complex gelatin jellies with low- and high-esterified pectin [20]. The author found that pectin is able to create jelly with gelatin in the range of pH from 2,5 to 4,75.As a result – a new grid is formed. In the formation of structures involved the associations with different character: intermolecular, which are characteristic of gelatin jelly, ionic, formed by oppositely charged groups of gelatin and pectin and, probably, hydrophobic interactions ofgelatin or pectin non-polar groups [21, 22].

In food technologies during the raw material preparation, getting the semi-finished products, formation the finished products, their packaging and storage, the interaction with different surfaces is very important [23, 24]. This kind of interaction usually leads to product sticking to the surfaces ofworking bodies of technological and packaging equipment, structural and packaging materials, containers, etc. In technology, this phenomenon of sticking is calls adhesion. The food masses adhesion is often undesirable. It is negatively affects the product use efficiency, the product quality, leads to the raw material outgoings and energy resources increase [25, 26, 27].

The adhesive strength interaction study between thejostaberry jelly masses with different gelatin content and the various materials contacting surfaces is presented in Figure 3, 4 and 5. The contacting surfaces were chosen: silicone, ceramic and metal surfaces. The disk surface temperature was 20±2^{0}C. The duration of the previous conversation was constant and was 30 seconds.

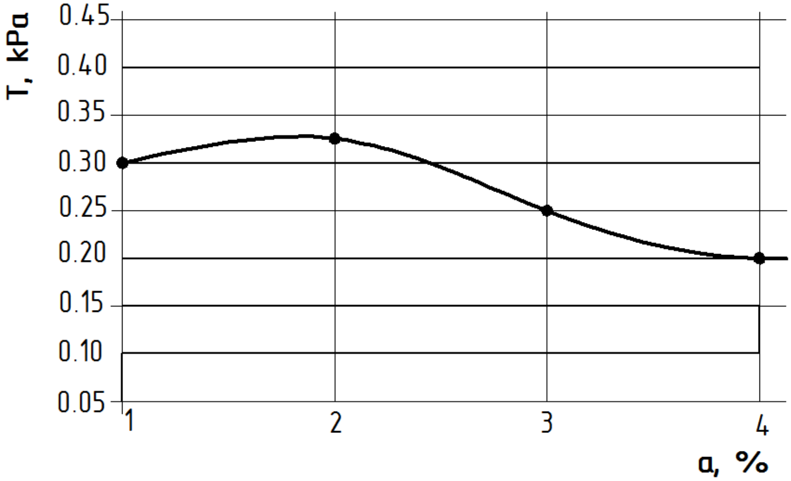

Figure 3. Dependence of jostaberry jelly mass separation force T, kPa on the gelatin mass content a, % in contact with the silicone surface:
1 – Control; 2 – jostaberry jelly100 % of gelatin; 3 – jostaberry jelly 50 % of gelatin; 4 – jostaberry jelly without gelatin.

From the given data it can be seen (Figure 3, 4 and 5) that the adhesive strength of the jostaberry jelly sample is somewhat higher in comparison with the control sample. This tendency can be traced regardless of the contact surface material type. Thus, the specific separation force of the control sample (black currant jelly) of jostaberryjelly with a silicone surface contact: 0,25 kPa and 0,3 kPa, respectively; with a ceramic surface: 0,3 kPa and 0,32 kPa, respectively; with a metal surface: 0,4 kPa and 0,43 kPa.

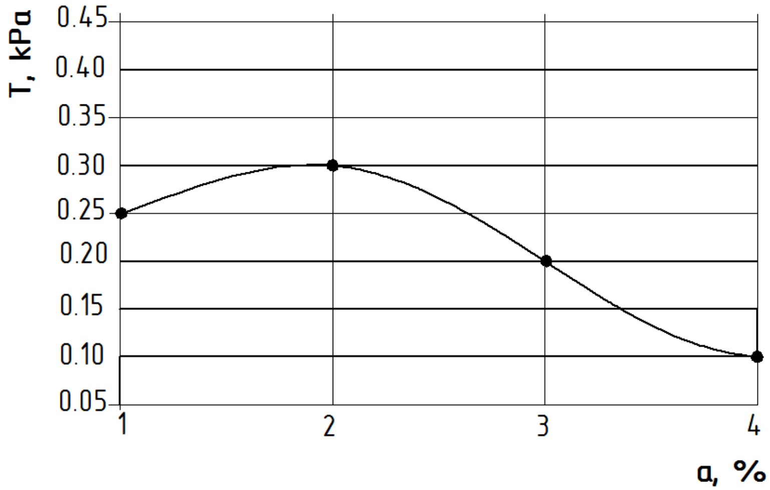

Figure 4. Dependence of jostaberry jelly mass separation force T, kPa on the gelatin mass content a, % in contact with the ceramic surface:
1 – Control; 2 – jostaberry jelly100 % of gelatin; 3 – jostaberry jelly 50 % of gelatin; 4 – jostaberry jelly without gelatin.

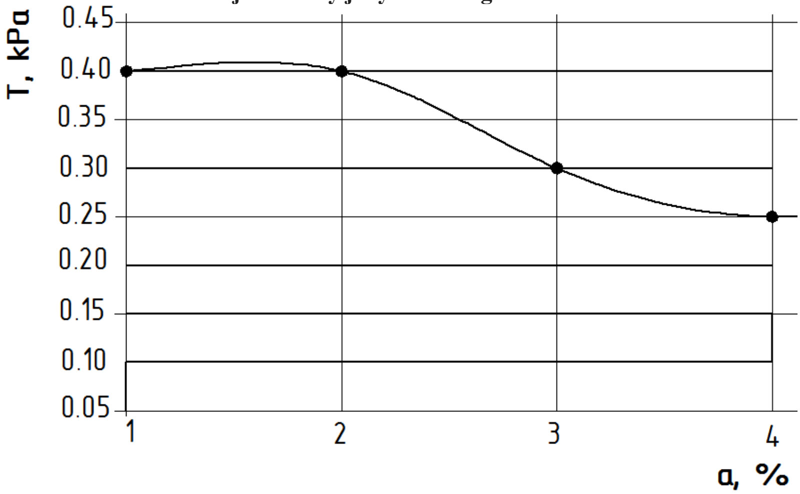

Figure 5. Dependence of jostaberry jelly mass separation force T, kPa on the gelatin mass content a, % in contact with the metal surface:
1 – Control; 2 – jostaberry jelly100 % of gelatin; 3 – jostaberry jelly 50 % of gelatin;
4 – jostaberry jelly without gelatin.

Reducing the mass content of gelatin in jostaberry jelly to 50% of the formulation quantity allows to slightly reduce the adhesion stress in comparison with samples of jostaberry jelly from 100% of gelatin from the total formulation quantity and with control samples. Consequently, the separation specific force of jostaberry jelly mass 50% of gelatin, in contact with the silicone surface (Figure 3), is: 0.21 kPa with the value of the same index for the control sample: 0.25 kPa; in contact with the ceramic surface (Figure 4): 0,26kPa and 0,3 kPa, respectively; in contact with the metal surface (Figure 5): 0.3 and 0.4, respectively. Thus, a decrease of the gelatin mass content in the jostaberryjelly mass improves their rheological characteristics, as it contributes to a reduction in the value of the specific gravity separation mass from the adhesive.

Similarly, from the Figure 3, 4 and 5 it can be seen that the greatest separation force for jelly masses, both for jostaberry jelly and black currant jelly, is observed when they are in contact with a metal surface. The use of ceramic and silicone surfaces allows you to slightly reduce the adhesion voltage. From the all tested materials, the advantage should be given to the silicone coating, which differs by the lowest values of the separation force in contact with jostaberry jelly.

Conclusion

Therefore, during the jelly preparation, it is expedient to use raw materials containing pectin, such as jostaberry. The influence of jostaberry pectin-containing raw materials additives on the jelly structural and mechanical properties change has been determined. It has been established that with the jostaberry use it is possible to reduce the gelatin mass fraction in the jelly formulation without significant changes in its structure and even the improvement of the rheological characteristics of this gelatinous product. The conducted researches can become a basis for the new jellies formulations development with the raised nutritional value, which have preventive properties.

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Influence of edible coatings on rye and rye-wheat bread quality

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Abstract

Introduction. The influence of edible coating on the quality of rye and rye and wheat bread in order to preserve the products of freshness and improve the nutritional value were studied.

Materials and methods. Samples of bread coating are made of potato starch, gelatin, flaxseed oil and water. The emulsion was applied to the bread by glazing. The control sample of the products was stored in a stretch film (rye bread) and in a package of synthetic polymer materials. The study of changing the characteristics of bread was made during the period of more than 24 hours. Organoleptic properties, the number of crumbs, water absorbing by crumb, and the structural and mechanical characteristics of the bread crumb were determined.

Results and discussion. The coating does not affect the shape of the products, allows to level the surface and makes it shiny, gives the colors a yellowish tint, does not affect the taste, because the coating itself has a neutral taste, it is easy to chew, the smell remains unchanged. The edible coating is an effective packaging material since the moisture of the products decreases slowly and at the same level with synthetic packing materials. The moisture preservation of products in the edible coating can be attributed to the vapor permeability of the coating, which is 4.77 mg/(m·h·kPa). The thickness of the coating is 0.540±0.005 mm. The thickness of the bread bags is 0.030 mm. The ability to absorb water by the bread crumb stored in synthetic material is slightly higher. The bread in the edible coating has crumbles as well as the bread stored in synthetic packaging. Freshness of products in edible coating for 48 hours of storage is higher by 3 % compared to products in synthetic packaging, at the end of storage (72 hours) – is greater by 2 % in the product in synthetic packaging. The moisture content of coating is 72 %, after drying and forming the coating on the bread surface, the moisture content of the coating is 5 %.

Conclusions. Edible coating is a complete environmental replacement of synthetic packaging for rye and rye-wheat bread.

Introduction

One of the tasks of the baking industry is improving the quality of the raw materials and to expand the range of products.

The following materials are used for packaging bread: paper, wax paper, polyethylene, bioreferenced polypropylene, polypropylene, polyvinyl chloride, polymer compositions. Smart packaging used for long-term storage of bakery products. The bactericidal materials used to prevent the molding products, which contains the surface layer of a polymer film with antiseptic and plasticizer [2].

Rye bread differs from wheat bread by chemical composition: essential amino acids, non-crystalline polysaccharides, minerals, and vitamins. The brewing varieties of rye flour have lower energy value due to higher humidity [3].

Raising the nutritional value of bread is carried out in the following areas:

- production of bread from whole grains for the enrichment of natural vitamins and minerals;
- use of various nutritional supplements: dairy products (natural and dry milk, buttermilk, whey), soy and pea flour;
- addition of non-traditional raw materials for baking (using potato, corn starch and other products) [4].

The study of rye bread quality is relevant since rye bread reduces plasma cholesterol levels in hypercholesterolaemic pigs when compared to wheat at similar dietary fibre level [5].

Consumption of wholemeal rye bread increases serum concentrations and urinary excretion of enterolactone compared with consumption of white wheat bread in healthy Finnish men and women [6].

In addition, the study of components of rye is still ongoing, for example, in the article [7–10].

The results of study [11] show that rye bread can be used to decrease hunger feelings both before and after lunch when included in a breakfast meal.

One of the main indicators of consumer properties of bakery products is the duration of their preservation of freshness. The peculiarity of bakery products is a sharp deterioration of consumer properties during storage. The problems of extension of freshness, improvement of qualitative indicators by introducing special components, technology improvement and packaging are also relevant today.

To prolong the shelf-life of bread, use of non-traditional raw materials and additives, which, in addition to slowing down the process of drawing, increase the nutritional value of bread [12, 13]. It was established that the addition of 5 % of rye-malt extract and 0.04 % of the enzyme preparation «Novamil» increases the mass fraction of dextrin in bread, which helps to slow down the process of drawing of finished products and extends their storage up to 10 days, and the use of jets of ultrahigh-frequency radiation allows extend the storage of such bread up to 1 month [14]. A recipe for bread made from rye flour and second grade wheat with addition of 3 to 5 % of extruded rye flour has been developed. It allows to obtain high quality bread and with extended shekf-life according to the Patent 47514. The addition of maltogenic α-amylase and rye-malt extract significantly extends the shelf-life of rye-wheat bread. Combined use of starter and food ingredients increases the nutritional value, eliminates the probability of microbiological damage during storage, and prolongs the freshness of the products. The use of dry potato mashed potatoes in the form of grains in the production of bread made on a liquid pre-dough has the best qualitative and organoleptic characteristics, as well as slow down the process of drawing in 1.5-2 times [15].

The introduction of soy flour improves the quality of bread, slows down staling and improves the amino acid composition of the product [16]. The use of the Jerusalem artichoke powder in the technology of bakery products as a food additive has positively effect, intensifying the fermentation, improving the quality of bakery products, giving them a functional orientation, and extending the storage [17]. It has been established that the rye bread formula with the addition of 5 % laminaria powder and 5 % anise to the mass of flour allows for a new functional product – rye bread with high content of minerals, in the first place such scarcity of modern Ukrainians as iodine and iron [18].

The expediency of using blueberries in the formulation of rye and wheat bread «Improved» to improve biological value has been developed and scientifically proved [19].

The new types of functional bakery products include: rye-wheat bread on hop sourdough with sprouted wheat grain «Family», rye-wheat bread on hop sourdough with sprouted wheat grains and pumpkin mashed potatoes «Seliansky», rye-wheat bread on hop sourdough from sprouted grain of wheat with a concentrate of leavened wort and milk thistle «Slavic» [20].

Residual oat flour, acquired during the production of β-D-glucan concentrate «Betaven», contained comparable amounts of dietary fiber as rye flour, and higher ash, crude fat and protein, as compared to both bread flours: wheat and rye [21].

The study [22] demonstrates that starch coating could be a simple, effective and practical application for reducing acrylamide levels in bread crust without changing the texture and crust color of bread.

Consequently, there is no development of biodegradable edible materials for rye and rye-wheat bread according to the above-mentioned literary data. In addition, the following ways to improve the nutritional value of products are made by placing the appropriate raw materials into the product at the dough preparation stage, which prevents the use of non-thermostable substances, such as vitamins C, F, etc.

Materials and methods

Samples of bread coating are made of potato starch – 5 %, gelatin – 15 %, urea (E 927b) – 3 %, flaxseed oil – 5 %, water – the rest (72 %). The coatings were prepared as follows: film formers – starch and gelatin were mixed in dry form, water was added and heated to dissolve gelatin and starch gelling, then added plasticizer – urea. The solution was cooled to 40 ^oC and flaxseed oil was added to a homogeneous emulsion. The emulsion was applied to the bread by glazing and held for 12 hours until it was completely dry.

The control sample of the products was stored in a stretch film (rye bread) and in a package of synthetic polymer materials at the temperature of 20 ^oC and a relative humidity of air not exceeding 75 %. According to the labeling of rye bread has a shelf life of 48 hours, and rye-wheat – no more than 5 days. The storage of products is no more than 72 hours for bread packed, but with the approval of the admissions committee, the storage of the packaged product can be set for more than 3 days. In this case, the storage is indicated in a standardized formulation that is subject to a state sanitary-and-epidemiological examination. The study of changing the characteristics of bread was made during the period of 24 hours longer than the specified time on the marking to check the suitability of replacing synthetic packaging with biodegradable edible and the possibility of lengthening the storage.

Organoleptic of bread were determined by tasting.

The freshness of bakery products was determined according to the methods given in the literature [23], according to the following indicators: the number of crumbs, water absorbing by crumb, and the structural and mechanical characteristics of the bread crumb on the penetrometer.

The thickness of the film was measured by a micrometer.

Results and discussion

The following organoleptic parameters: appearance: shape, surface, color; crumb; taste and smell monitor in the rye and rye-wheat flour bread.

In accordance with tasting application of the coating does not affect the shape of the products, allows to level the surface and makes it shiny, gives the colors a yellowish tint, does not affect the taste, because the coating itself has a neutral taste, it is easy to chew, the smell remains unchanged.

Reducing the humidity of products is the most characteristic indicator indicating the waning of products whose study results are shown in Table 1.

Table 1

Changing the moisture of bread products depending on the type of packaging

Storage, hours	Moisture, %			
	Rye bread		Rye-wheat bread	
	Synthetic film	Edible coating	Synthetic film	Edible coating
3	49.3±0.5		46.2±0.5	
24	47.2±0.5	46.9±0.5	44.5±0.5	44.7±0.5
48	45.4±0.5	45.2±0.5	43.0±0.5	43.3±0.5
72	43.8±0.5	43.3±0.5	41.4±0.5	41.6±0.5
96	-	-	39.8±0.5	40.0±0.5
120	-	-	38.4±0.5	38.5±0.5
144	-	-	37.9±0.5	37.7±0.5

The results presented (Table 1) show that the edible coating is an effective packaging material since the moisture of the products decreases slowly and at the same level with synthetic packing materials. The difference in the values of sample moisture lies within the error of the experiment. Consequently, edible coating helps maintain moisture inside the product.

The moisture preservation of products in the edible coating can be attributed to the vapor permeability of the coating, which is 4.77 mg/(m·h·kPa). The given value refers to the developed packaging material for materials with a high barrier to water vapor [24].

The thickness of the coating is 0.540±0.005 mm. The thickness of the bread bags is 0.030 mm.

The cost of synthetic packaging (bag with a clip) is 0.5 UAH (0.017 euro, may 2017), the coast of edible coating – 1.81 UAH (0.062 euro, may 2017). However, the use of edible coatings will solve the environmental problem of recycling synthetic packaging materials, which also requires investment. Without waiting for the onset of the biodegradable polymer era, in April 2015, the European Parliament approved Directive 94/62/EU [25] on reducing the use of lightweight (<50 microns thick) and ultra light (<15 microns) plastic bags currently in the vicinity economic and technological reasons are subject to recycling in very limited quantities. It is said that until December 31, 2019, the annual consumption of light bags per capita should not exceed 90 pcs. and 40 pcs. until December 31, 2025. Package fees will be charged in all EU countries by the end of 2018. These measures can be commented rather rigid, because according to statistics in 2010, average Europeans use around 200 such bags annually. These measures can be commented rather rigid, because according to statistics in 2010, average Europeans use around 200 such bags annually [26]. In addition, some ingredients of edible coating can increase the nutritional value of products. The composition of the proposed edible coating includes flaxseed oil rich in vitamin F. This vitamin is not heat-resistant, therefore it is impossible to enrich the food with this anticholesteric vitamin that is subjected to heat treatment (baking in this case).

During the storage, natural polymers that are part of the grain products are aging and decrease the ability to absorb water [3, 27]. Crumb worse absorbs water in the case that aging is more intense. The results of the study of the change in the properties of absorb water are shown in Table 2.

Table 2

Changing the absorbing water by bread crumbs during the storage

Storage, hours	Absorbing water, % on solids			
	Rye bread		Rye-wheat bread	
	Synthetic film	Edible coating	Synthetic film	Edible coating
3	292±5		416±5	
24	245±5	239±5	348±5	353±5
48	217±5	208±5	311±5	305±5
72	182±5	177±5	282±5	273±5
96	-	-	254±5	249±5
120	-	-	240±5	234±5
144	-	-	218±5	207±5

Results of Table 2 show the ability to absorb water by the bread crumb stored in synthetic material is slightly higher, but the difference in values is within the error of the experiment. Consequently, the absorbing water by bread crumbs indicates the expediency of replacing the synthetic material with a biodegradable edible coating.

Aging of natural grain polymers will also increase the number of crumbs of products. The results of the study the number of crumbs are shown in the Table 3.

Table 3 shows that the bread in the edible coating has crumbles as well as the bread stored in synthetic packaging. This can be explained by the fact that the humidity of the products is kept at the same level regardless of the type of packaging. The difference in values for rye bread of 0.3% and 0.2% for rye and rye-wheat bread is within of experiment error.

Table 3

The number of crumbs changing during the storage

Storage, hours	The number of crumbs, %			
	Rye bread		Rye-wheat bread	
	Synthetic film	Edible coating	Synthetic film	Edible coating
3	2.2±0.1		0.4±0.1	
24	3.0±0.1	2.8±0.1	0.8±0.1	0.9±0.1
48	3.6±0.1	3.9±0.1	1.1±0.1	1.2±0.1
72	4.0±0.1	4.3±0.1	1.4±0.1	1.5±0.1
96	-	-	1.8±0.1	1.9±0.1
120	-	-	2.0±0.1	2.0±0.1
144	-	-	2.2±0.1	2.0±0.1

Another factor that characterizes freshness is the structural and mechanical properties are determined by a penetrometer.

The results of the study are presented in Table 4, 5 and Fig. 3, 4.

Table 4

Changes in the structural and mechanical properties of the crumb during the storage of rye bread

Storage, hours	Synthetic film			Edible coating		
	General deformation, units of the device	Plastic deformation, units of the device	Elastic deformation, units of the device	General deformation, units of the device	Plastic deformation, units of the device	Elastic deformation, units of the device
3	45.0	37.0	8.0	45.0	37.0	8.0
24	39.5	32.0	7.5	38.0	31.8	6.2
48	33.0	29.0	4.0	34.0	27.5	6.5
72	26.4	22.3	4.1	25.5	20.5	5.0

Results Table 4 show that the change in the deformation characteristics of rye bread varies at the same level regardless of packaging material type.

According to the results (Fig. 3) freshness of products in edible coating for 48 hours of storage is higher by 3 % compared to products in synthetic packaging. However, at the end of storage (72 hours) the freshness of products is greater by 2% in the product in synthetic packaging.

The structural and mechanical properties of rye-wheat bread (see Table 5), similar to rye bread, vary with the same intensity regardless of the type of packaging material.

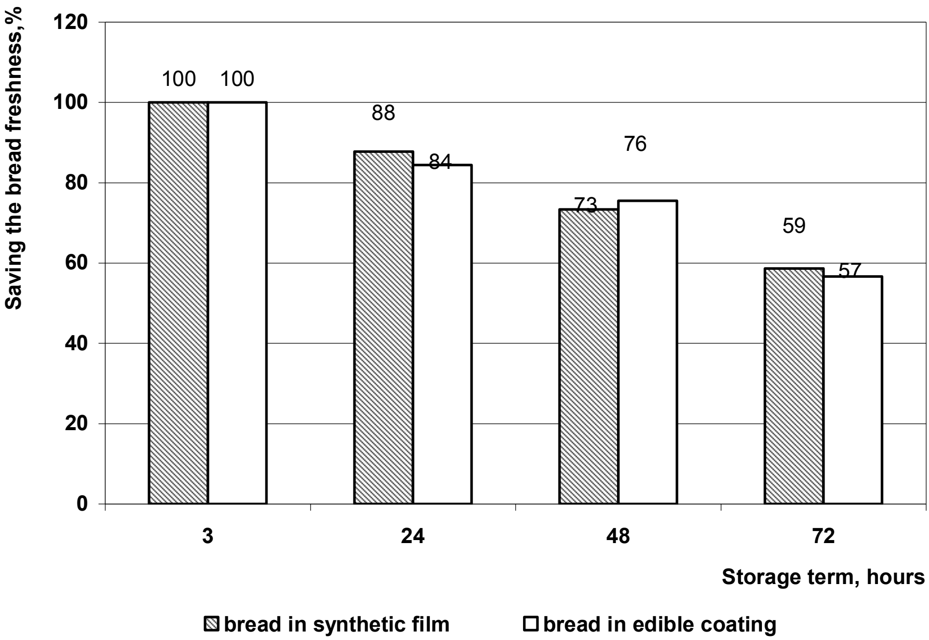

Figure 3. Preserving the freshness of rye bread depending on the packaging material type

Table 5

Change of structural and mechanical properties of the crumb during the storage of bread rye-wheat

Storage, hours	Synthetic film			Edible coating		
	General deformation, units of the device	Plastic deformation, units of the device	Elastic deformation, units of the device	General deformation, units of the device	Plastic deformation, units of the device	Elastic deformation, units of the device
0	51.5	43.0	8.5	51.5	43.0	8.5
24	43.5	35.2	8.3	43.3	34.8	8.5
48	41.5	34.0	7.5	39.5	31.7	7.8
72	33.5	25.0	8.5	36.8	29.6	7.2
96	30.2	22.6	7.6	33.4	26.8	6.6
120	28.1	21.2	6.9	27.9	21.8	6.1
144	26.8	20.0	6.3	25.5	19.7	5.8

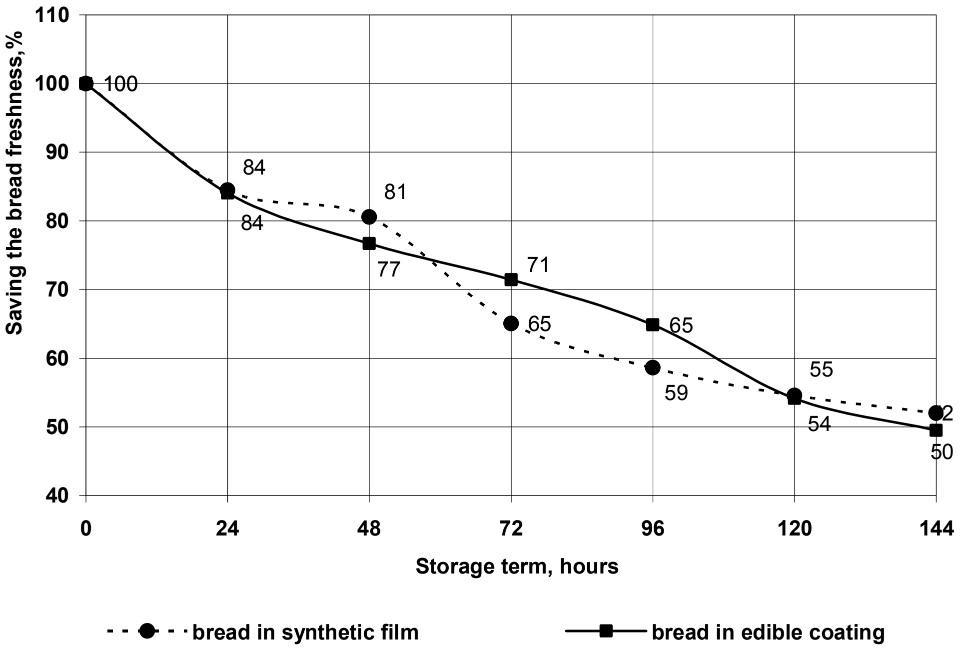

Figure 4. Saving the freshness of rye-wheat bread depending on the type of packaging material

Freshness of rye and wheat bread in edible coat is better than bread in synthetic packaging material. For example, for 72 hours, the bread in the edible coating is fresher by 5 % compared with bread in synthetic material. However, the difference in the values of freshness decreases to 2% at the end of storage.

The preservation of structural and mechanical properties and freshness of products were stored in the edible coating at the same level as products were stored in synthetic materials also due to barrier properties of edible coating. In addition, the edible coating includes moisture. At the coating stage, the moisture content is 72 %, after drying and forming the coating on the bread surface, the moisture content of the coating is 5 %. Therefore, it is logical to assume that during the drying of the coating on the surface of the product, part of the moisture is absorbed by bread, which will delay the aging of natural grain polymers, and thereby maintain the properties of bread at the level with packaging synthetic materials.

Conclusions

Replacing synthetic packaging material with biodegradable edible coatings have shown that it is quite expedient, since the organoleptic of products with edible coating do not deteriorate, and even improve due to leveling the surface and gaining gloss. Moisture of products in edible coating at the end of storage is maintained at the same level as for products in synthetic packaging: 43.8 % (in synthetic packaging) and 43.3 % (in edible coating) for rye bread and 37.9 % (in synthetic packaging) and 37.7 % (in edible coating) at the end of storage of rye-wheat bread. The absorbing water the crumb, structural and mechanical properties and freshness for products in synthetic packaging and edible coating are at the same level at the end of storage, so edible coating is a complete environmental replacement of synthetic packaging for rye and rye-wheat bread.

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Comprehensive evaluation of the hot sweet soufflé dessert quality

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Abstract

Introduction. The aim of the research is to evaluate the quality of innovative hot soufflé dessert from the standpoint of physiological needs of the child of preschool age by qualimetry methods.

Materials and methods. The basis of the research was established by the methods of theoretical generalization, scientific induction and deduction, methods of systematic, structural, qualimetric and mathematical analysis of the dish quality.

Results and discussion. Taking into consideration physiological needs norms of 4-6 years old child, the innovative hot sweet soufflé dessert was developed. The comprehensive evaluation was given to this dish, and it showed the benefits of an improved recipe in comparison with the traditional one. The hierarchical structure of quality indicators of the dish was improved and the scale of nodal values of quality indicators that characterize the critical point of the meal was created on its basis.

Basic qualitative indexes (*m*) innovative hot sweet dessert of macronutrients, mineral matters and vitamins are the following: for proteins – 0,20; fats – 0,40; carbohydrates – 0,40; sodium – 0,10; potassium – 0,10; calcium – 0,10; zinc – 0,40; iron – 0,30; thiamine – 0,20; β-carotene – 20; riboflavin – 0,20; pyridoxine – 0,20; ascorbic acid – 0,20.

The biggest value of the complex index (K_0) is for: fats and carbohydrates - 0,4; zinc – 0,4; The minimum value is typical of calcium, potassium, sodium

Conclusion. The benefits of innovative hot sweet soufflé dessert in comparison with the prototype were established by methods of qualimetric quality analysis. The expediency of β-glucan usage in the dish recipe is proved by these methods to enhance nutrition value and to reduce the food energy value.

Introduction

Cardiovascular diseases remain the main cause of mortality in many countries around the world. The highest mortal rate caused by cardiovascular diseases in 1990-2015 according to the statistics analysis conducted by professor Gregory Roth (Washington University «School of Medicine») is observed in Eastern Europe, Central Asia, Near East and South America. The lowest indexes are recorded in such countries as Japan, Andorra, Peru, France, Israel and Spain (Dean R. Owen, Rachel Fortunati, 2017) [1]. These diseases develop because of the increase of blood cholesterol level. The main reasons for cholesterol increase are:

– eating foods with high animal fat saturation;
– bad habits;
– heredity.

It is believed that only elderly people suffer from cholesterol affects, but nowadays not only they, but also children, pregnant women, adolescents are also in hazard because of the consumption increase of foods with a high glycemic index and food that contains a significant amount of saturated fatty acids and easily digested carbohydrates.

The scientific studies of scholars highlight the main researches of the excess cholesterol accumulation in the human's body and they point out essential ways to reduce it:

– restriction of eating products with high glycemic index;
– eating products, where animal raw materials are replaced with the plant;
– physical exercises;
– treatment with medecines (Negin Sharafbafia, Susan M.Toshb et al 2014; Butt M, 2014) (Table 1) [2–3].

Materials and methods

The basis of the research was established by methods of theoretical generalization, scientific induction and deduction, methods of systematic, structural, qualimetric and mathematical analysis of the dish quality.

According to the theoretical and methodological basis of qualimetry, the method of quality evaluation of innovative hot sweet soufflé dessert was developed. The absolute values of indicators of quality expressed in different units cannot be directly reduced to a general integrated index without transforming them into a common measurement scale (Topol'nik, Ratushnyj, 2008; Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013) [11, 12, 13, 14].

According to the principles of qualimetry, the value of a single quality indicator and product quality as a whole should be evaluated by means of comparison with the basic or absolute value (Kuzmin et al, 2014–2016; Jean-Louis Sébédio, 2017) [15, 16, 17, 18] This valuation is a dimensionless quantity .

Numerous ways of determining the quality evaluation are currently being studied; the most common two methods are:

– comprehensive quality evaluation;
– quality determination with the help of desirability scale of Harrington method.

Table 1

Comparative chemical composition of cow milk and oat broth

Substance name	**Content of components in 100 g of raw materials**	
	Cow's milk	**Oat broth**
Water	88,1 [4]	-
Ash	0,7 [4]	3,2[4]
Mineral substances, mg		
Iron	0,1 [4]	5,5 [4]
Calcium	120 [4]	118 [5]
Potassium	146 [4]	421 [4]
Sodium	50 [4]	37 [4]
Iodine, μg(mcg)	0,0009 [4]	0,075 [4]
Zinc	0,4 [4]	3,61
Phosphorus	-	90 [5]
Proteins	2,9 [4]	3,0 [5]
Carbohydrates	4,7 [4]	4,4 [5]
Mono- and disaccharides	4,7 [4]	-
β-glucan	-	0,60 [5]
Starch	-	53,7
Dietary fibre	-	8,0 [4]
Fat	3,5 [4]	0,3 [5]
Cholesterol	10,0 [4]	-
Organic acids	0,1 [4]	-
Vitamins, mg		
Vitamin B_1	0,04 [4]	0,47 [4]
Vitamin B_2	0,15 [4]	0,12 [4]
Vitamin B_4	23,6 [4]	-
Vitamin B_5	0,4 [4]	1,0 [4]
Vitamin B_6	0,5 [4]	0,26 [4]
Vitamin C	1,3 [4]	-
Vitamin E	0,1 [4]	1,4 [4]
Vitamins, μg (mcg)		
Retinol	0,13 [4]	-
β-carotene	-	0,02 [4]

The most accurate method is considered to be the desirability scale of Harrington, which has more accurate attributes, such as monotony, continuity, adequacy, effectiveness and statistical sensitivity. (Topol'nik, Ratushnyj, 2008; Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013) [11, 12, 13, 14]. To convert the absolute values of products quality into dimensionless ones, it is efficiently to use exponential dependence that is taken as the basis of desirability scale of Harrington:

$$D_i = \exp\left[-\exp(-Y_i)\right] \quad (1)$$

where Y_i is the code value of the quality indicator. Scale includes intervals from 1,00 to 0,00 (Figure 1):

- 1,00–0,80 – very good (excellent);
- 0,80–0,63 – good;
- 0,63–0,37 – satisfactory;
- 0,37–0,20 – bad;
- 0,20–0,00 – very bad.

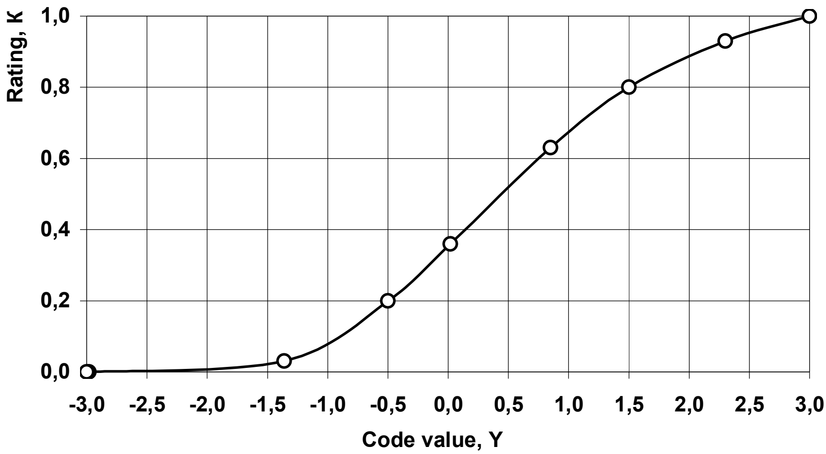

Figure 1. Schedule of estimates definition of the normed quality indicators of innovative hot sweet soufflé dessert

Results and discussion

It should be noted that at present in modern child's food allowance sweets prevail above other products, therefore flour, bakery and confectionery products are the main objects for improvement of recipe composition. Every year foreign market expands the range of sweet foods enriched with nutrients (J. Harrison, A. Bramlett et al, 2012; M, Marauska et al, 2013; Vilma Speiciene et al, 2015) [6,7,8]. The researches pay special attention is to the hot desserts because they are the most popular products among the guests of the restaurant industry. That is why the object of the improvement is the traditional recipe of "Chocolate soufflé"

Innovative product is enriched with β-glucan to enhance nutrition value and to reduce the food energy value. (Noora Mäkelä Ndegwa, H.Maina Päivi, et al, 2017;) [9, 10].

Recipe composition of control and innovative hot sweet soufflé dessert are given in tables 2 and 3.

Table 2

«Chocolate souffle»

No.	The name of the raw material	Mass of raw materials, g	
		Gross	Net
1	Egg	2,0	80,0
2	Sugar white crystalline	40,0	40,0
3	Cow's milk	40,0	40,0
4	Fancy white wheat flour	8,0	8,0
5	Butter	2,0	2,0
6	Vanilla	0,02	0,02
7	Dark chocolate	5,0	5,0

Table 3

The innovative dessert Soufflé

No.	The name of the raw material	Mass of raw materials, g	
		Gross	Net
1	Pumpkin	38,0	25,0
2	Grounded flax seeds	10,0	10,0
3	Tapioca starch	15,0	15,0
4	Banana	25,0	20,0
5	Oat broth	33,0	33,0
6	Cocoa powder	17,0	17,0
7	Fresh egg albumen	5,0	5,0

It was established that the addition of oat broth is quite pertinent, but it needs more detailed study. That is why in this case the quantitative evaluative method is selected for evaluation of innovative hot sweet soufflé dessert. Certain indicators of the product are determined for calculation of the quantitative evaluation of the quality of the dish. These indicators are categorized into: standard and original.

The standard indicators of soufflé quality include: the organoleptic, physical, chemical and microbiological indicators of safety (J.M. Regenstein CE Regenstein, 2017) [19].

The original indicators include contents of: protein, carbohydrates, fats, minerals and vitamins. (Azgaldov et al, 2015; Samantha Caesar et al, 2016; Jean-Louis Sébédio et al, 2017; Jean-Claude Moubarac et al, 2017; Kuzmin O., Ditrich I., et al 2017) [20-23].

At Figure 2 the hierarchical structure is represented by the standard and original indicators as the main components.

To calculate the comprehensive quality evaluation the arithmetic weighted average is used according to the formula 2:

$$K = \sum_{i=1}^{n} K_i \cdot m_i , \qquad (2)$$

The justification of the nodal values is given in Table 4. The standardized values are presented in the form of a relative quality index - Ki = 0.37 and highlighted in bold. (Topol'nik, Ratushnyj, 2008;Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013Topol'nik) [9, 10, 11, 12].

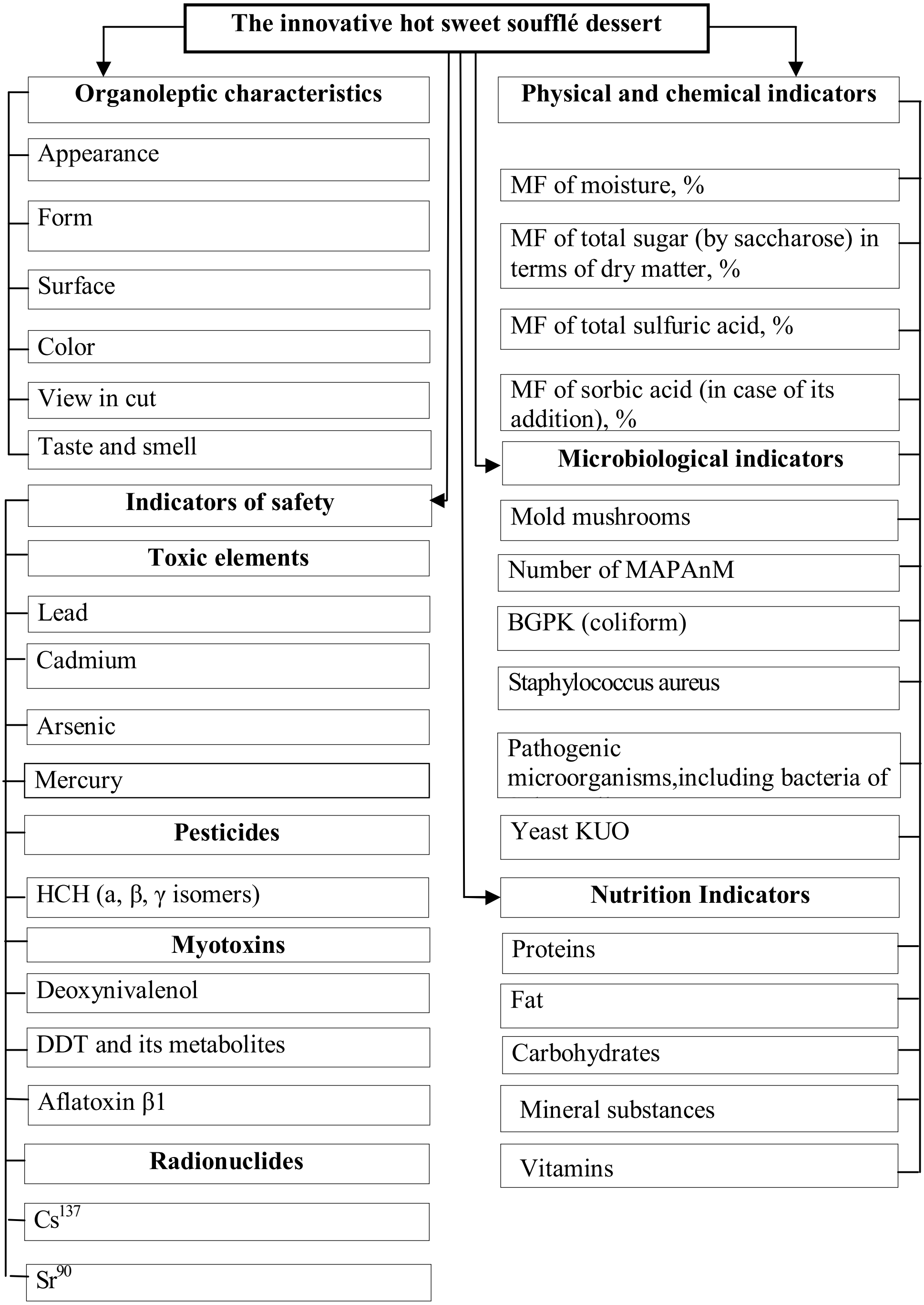

Figure 2. The hierarchical structure of innovative hot sweet dessert

Table 4
The scale of the nodal values of the quality indices of the innovative hot sweet soufflé dessert

Metric name, unit of measurement	Grade, K_i					
	1,00	0,80	0,65	0,37	0,20	0,00
	Coded values *in*					
	3,00	1,50	0,85	0,00	-0,50	-3,00
1	2	3	4	5	6	7
Organoleptic characteristics						
Appearance	5,0	4,0	3,0	2,0	1,5	1,0
Form	5,0	4,0	3,0	2,0	1,5	1,0
Surface	5,0	4,0	3,0	2,0	1,5	1,0
Color	5,0	4,0	3,0	2,0	1,5	1,0
View in cut	5,0	4,0	3,0	2,0	1,5	1,0
Taste and smell	5,0	4,0	3,0	2,0	1,5	1,0
Physical and chemical indicators						
MF of moisture, %	41,0	40,5	40,2	**40,0**	37,0	35,0
	41,0	42	43	**44,0**	46,0	50,0
MF of total sugar (by saccharose) in terms of dry matter, %	0,5	0,8	1,0	**1,5**	2,0	3,0
MF of total sulfuric acid, %	0,002	0,003	0,007	**0,04**	0,07	0,15
Indicators of safety						
Lead, mg / kg	0,01	0,05	0,1	**0,5**	1,4	3
Cadmium, mg / kg	0,005	0,01	0,05	**0,1**	0,7	1,5
Arsenic, mg / kg	0,001	0,005	0,01	**0,3**	1,0	1,6
Mercury, mg / kg	0,001	0,005	0,01	**0,02**	0,1	1,0
Myotoxins						
Deoxynivalenol	0,05	0,1	0,3	**0,7**	1,2	2,0
Aflatoxin β1	0,0005	0,001	0,002	**0,005**	0,01	0,02
Pesticides						
HCH (a, β, γ isomers)	0,007	0,05	0,1	**0,2**	0,7	1,2
DDT and its metabolites	0,001	0,005	0,01	**0,02**	0,09	0,2
Radionuclides						
Cs^{137}	1,0	20,0	50,0	**100,0**	200,0	300,0
Sr^{90}	15,0	80,0				
Microbiological indicators						
Number of MAPAnM	$1{\cdot}10^{2}$	$1{\cdot}10^{3}$	$1{\cdot}10^{4}$	$\mathbf{5{\cdot}10^{4}}$	$6{\cdot}10^{4}$	$8{\cdot}10^{4}$
BGPK (coliform)	0,001	0,005	0,008	**0,01**	0,07	0,2
Staphylococcus aureus in 1,0 g of product	0,001	0,005	0,01	**0,1**	0,7	1,3

continuation tab 4

1	2	3	4	5	6	7
Mold mushrooms in 1 g of product	2,0	20,0	50,0	**100,0**	200,0	300,0a
Pathogenic microorganisms,including bacteria of Salmonella genus	1,0	10,0	15,0	**25,0**	40,0	60,0
Yeast KUO, not more than 1 g of product	2,0	15,0	25,0	**50,0**	100,0	150,0
Macronutrients, g						
Proteins in 100 g of product	5,2	5,0	4,80	**4,60**	4,0	3,8
	5,2	5,40	5,60	**5,80**	6,0	6,2
Fat in 100 g of product	2,2	2,0	1,6	**1,20**	1,0	0,8
	2,2	2,40	2,60	**2,70**	2,80	3,00
Carbohydrates in100 g of product	26,0	27,0	34,0	**30,0**	10,0	5,0
	26,0	32,0	36,0	**38,0**	40,0	42,0
Mineral substances, mg						
Calcium in 100 g of product	820,0	815,0	810,0	**800,0**	780,0	770,0
	820,0	825,0	830,0	**840,0**	850,0	860,0
Potassium per 100 g of product	1380,0	1370,0	1360,0	**1350,0**	900,0	750,0
	1380,0	1400,0	1450,0	**1600,0**	1800,0	2100,0
Sodium in 100 g of product	330,0	325,0	320,0	**315,0**	260,0	200,0
	330,0	335,0	340,0	**350,0**	400,0	450,0
Mangan in 100 g of product	128,0	127,0	124,0	**130,0**	110,0	95,0
	128,0	133,0	137,0	**140,0**	155,0	170,0
Phosphorus in 100 g of product	810,0	806,0	802,0	**800,0**	780,0	770,0
	810,0	815,0	820,0	**825,0**	830,0	840,0
Iron in 100 g of product	11,5	11,0	10,5	**10,0**	75,0	64,0
	11,5	12,0	12,5	**13,0**	14,0	15,0
Iodine 100 g	100,0	95,0	94,0	**90,0**	75,0	70,0
	100,0	101,0	103,0	**104,0**	110,0	120,0
Vitamins, mg						
Vitamin B_1 100 g	0,96	0,94	0,90	**0,80**	0,4	0,3
	0,96	0,98	1,0	**1,20**	1,4	1,44
Vitamin B_2 100 g	1,08	1,06	1,04	**1,0**	0,7	0,65
	1,08	1,10	1,12	**1,14**	1,16	1,18
Vitamin B_5 per 100 g of product	3,6	3,40	3,20	**3,0**	2,8	2,7
	3,6	3,80	3,90	**4,0**	4,2	4,4
Vitamin C in 100 g of product	51,6	51,0	50,5	**50,0**	48,0	47,0
	51,5	52,0	52,5	**53,0**	54,0	55,0
Vitamins, µg						
β-carotene per 100 g of product	620,0	615,0	610,0	**600,0**	590,0	585,0
	620,0	625,0	630,0	**635,0**	640,0	645,0

Values of indicators with an estimate below 0,37 do not meet the requirements of foreign quality standards (Topol'nik, Ratushnyj, 2008; Azgaldov et al,, 2011; Koretska, 2013; Zinchenko, Niemirich A., Novosad O. 2013) [9, 10, 11, 12].

The normalized value is an indicator that has received an estimate of 0,37. To determine the weighting factors, the advantage method is used (Table 5).

Table 5

Determination of weight factor for innovative sweet soufflé dessert

Nutrition	Norm	Validity
Proteins	4,60	$m_{1\text{-}1} = 0,2$
Fat	1,20	$m_{1\text{-}2} = 0,4$
Carbohydrates	30,0	$m_{1\text{-}3} = 0,4$
Σ - energy substances	**149,2**	**Σ m = 1,0**
Ca	107,0	$m_{2\text{-}1} = 0,1$
K	380,0	$m_{2\text{-}2} = 0,1$
Na	32,0	$m_{2\text{-}3} = 0,1$
Zn	2,0	$m_{2\text{-}5} = 0,4$
Fe	6,0	$m_{2\text{-}6} = 0,3$
Σ-mineral substances	**527,0**	**Σ m = 1,0**
beta-carotene	0,66	$m_{3\text{-}1} = 0,2$
B_1	0,4	$m_{3\text{-}2} = 0,2$
B_2	0,2	$m_{3\text{-}3} = 0,2$
B_6	14,0	$m_{3\text{-}4} = 0,2$
C	12,0	$m_{3\text{-}5} = 0,2$
Σ- vitamins	**27,26**	**Σ m = 1,0**
Σ- all substances	**703,46**	

The Table shows that the highest value of the complex index (K0) is for: fats and carbohydrates – 0,4; zinc – 0,4; the minimum value is typical for calcium, potassium and sodium.

Conclusions

The benefits of innovative hot sweet soufflé dessert in comparison with the prototype were established by methods of qualimetric and mathematical quality analysis.

These methods have proved the expediency of using β-glucan in the recipe of dish to enhance nutrition value and to reduce the food energy value.Indicators of safety and microbiological indicators that are defined with the help of the Harrington's scale of desirability have confirmed the safety of a new type of soufflé.

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Impovement of some functional properties of cookies with added natural components of pumpkin and chia

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Abstract

Introduction. Conducted analytical and experimental studies to increase biological value the recipe of the shortbread cookie "Pumpkin", the choice of using pumpkin puree, pumpkin oil and chia seeds has been substantiated for creation a functional food product.

Materials and methods. The optimum balance of hydrolyzed pumpkin puree to sand sugar, pumpkin oil to butter and the required amount of chia seeds was determined was determined by mathematical modeling. Mass fraction of sugars was determined due to AOAC Method 10-52, moisture – AOAC 934.01, fat – AOAC 963.15. Ash test was carried out based on AOAC 923.03. Water absorption – AOAC 960.14.

Results and discussion. The results showed that the sample of cookie with addition of pumpkin puree 50% and pumpkin oil 20% of the initial laying of raw materials and chia seeds in the proportion of 1.5% of the wheat flour amount had the best indicators. Pumpkin puree addition to the sandy paste has affected the structure and consistency of the products. The introduction of puree to the cookie has caused more intensive taste and aroma, a golden color, and it has stabilized the shape and surface.

The usage of pumpkin puree has led to a change of the products' color from light yellow to light orange, due to the presence of beta-carotene. Reducing of the norm of sand sugar has led to a decrease of the energy value of finished goods from 467 to 402.5 kcal. The structure of the cookie has become more fragile and tender, which was noted by the tasters as a positive effect.

Organoleptic and physicochemical indicators (mass fraction of moisture –13,2%; ash – 0,1%; mass fraction of sugars 30%; mass fraction of fat – 3,4%; water absorption – 157%) confirm that the selected additives do not change the basic characteristics of the cookie.

Conclusion. Using a mixture of pumpkin puree, pumpkin oil and chia seeds in the production led to a reduction in the energy value of finished products by reducing the amount of sugar.

Introduction

Nowadays, the sharp increase in the number of chronic diseases in the countries of eastern Europe population is noticed. It is deeply connected with a violation of the food quality. Thus, everyday nutrition includes fats of animal origin and simple carbohydrates in a significant amount, while there is a scarcity of protein consumption, macro- and micro elements, dietary fibers, vitamins and other biologically active substances [1].

The analysis of the assortment structure, volumes of production and the level of consumption of confectionery products by the population of Eastern Europe allows to consider confectionery products made of flour as functional products, which can satisfy various consumer needs. Most of them are characterized by such criteria: attractive appearance, energy value that is high enough, and also, they include proteins, not only carbohydrates and fats [2].

Cookies are probably one of the most commonly used products made of flour by the confectionery industry. This is a favorite delicacy of millions of adults, as well as of children whose body needs nutrients inflow for normal development. Thus, the development of shortbread cookie recipe of increased biological value is one of the priority tasks for modern confectionery industry.

Excessive consumption of animal fats, that are usually present in large numbers in cookie recipes, leads to deterioration of human health and intensification of many diseases. Therefore, it is possible to increase the competitiveness of this group of products in modern conditions is possible by pumpkin oil usage, which contains a significant amount of essential polyunsaturated fatty acids ω-3 and ω-6. In addition to this, they are the source of essential substances for human bodies (phospholipids, fat-soluble vitamins, sterols, etc.), and this fact makes them indispensable components of nutrition [3].

For the development of the new type of cookie recipe of increased biological value as a source of useful substances, such ingredients were chosen: pumpkin puree, pumpkin oil and chia seeds. All these natural and physiological functional products contain a significant amount of dietary fibers, polyunsaturated fatty acids, vitamins (B, A, D, K, E, C, PP), macro- and microelements (potassium, calcium, magnesium, sodium, phosphorus), iron, boron, iodine, manganese, copper, selenium, zinc, etc.), which are essential for healthy life [1].

The purpose of the research is to determine the properties of the shortbread cookie "Pumpkin" with the adding of pumpkin puree, pumpkin seeds and chia seeds, and to determine it nutritional properties.

Analysis of recent research and publications

During the research of scientific works of Denisenko T.M., Kozlova A.V., Iorgacheva K.T., Sirokhman I.V. [2–5], devoted to the development of the shortbread cookie recipe with various additives, it was determined that the usage of pumpkin puree dietary fibers and its oil as functional components is the most expedient. They significantly improve the organoleptic properties of products and give an attractive yellow-orange color and harmonious fragrance.

Pumpkin is a kind of natural vitamin and mineral complex. It is widely grown, is unpretentious and well stored throughout the year Table 1 shows the nutritional content of pumpkin [4].

Table 1

Nutritional content of pumpkin [8]

Nutrients	**Content in 100g**
Protein, g	1.0
Fat, g	0.1
Carbohydrates, g	4.4
Food fibers, g	2.0
Ash, Mr.	0.6
Starch, g	0.2
Organic acids, g	0.1
Mono and disaccharides, g	4.2
Mineral substances, mg:	
Calcium	204.0
Magnesium	14.0
Sodium	4.0
Potassium	204.0
Phosphorus	25.0
Iron	0.4
Zinc	240
Copper	180
Vitamins, mg	
Vitamin B1	0.05
Vitamin B2	0.06
Vitamin B6	0.1
Vitamin B9, μg	14.0
Vitamin s	8.0
Vitamin a	1.5
Vitamin PP	0.5
Energy value, kJ	89.02

That is why the development of food products with pumpkin content is appropriate. It allows to create fundamentally new products with the perfect content of nutrients and excellent organoleptic properties. In addition, they have prophylactic and bio corrective effect [5].

Pumpkin was introduced into a new recipe in the form of pumpkin puree [6]. The chemical composition of used hydrolyzed pumpkin puree with a 10% of mass fraction of solid matter (MFHR) is given in Table 2.

Table 2

Chemical composition of hydrolyzed pumpkin puree [6]

Indicator's name	**HHP**
MFHR, %	10 ± 0.5
Active acidity, pH	3.2 ± 0.1
Total sugar content, %	7.5 ± 0.5
Content of water-soluble pectin, g/100 g	2.7 ± 0.1
Degree of pectin esterification	60 ± 2.0
Cellulose content, g / 100	2.1 ± 0.1

Due to the high content of dietary fiber, pectin and other nutrients, hydrolyzed vegetable raw material is selected for usage in order to improve the new type of confectionery product made of flour.

Pumpkin oil effects on the nervous system are widely known. It helps to get rid of sleep disturbances, migraine and headaches, chronic fatigue, stress, its light sedative effect restores calmness and calmness [5].

Chia, or Salvia Spanish (Lat. Salvia hispanica) is a species of flowering plant in the mint family, Lamiaceae. Its close related spicies Salvia columbariae is also often used. The native land of the plant is Central and South Mexico as well as Guatemala. Today chia is cultivated in many countries in South America and Australia [7]. According to the analysis of literary sources, chia seeds contain twice as much protein as eggs and seven times more than in milk. Also, in Chia there are 3 times more fat than in eggs, 4 times more than in fish, 5 times more than in meat and 15 times more than in milk. Content of ω-3 unsaturated fatty acids in chia seeds is 4 times greater than in the above-mentioned products (see Table 1). The content of mineral substances and vitamins in the seeds of chia is very high in comparison with products of animal origin, comparing the content of such elements as calcium, magnesium, phosphorus, iron, copper and vitamins B9 and C [8–9].

Materials and methods

According to the aim, the stages of the research were identified in such way: analysis of the chemical composition of new raw ingredients; identification of the optimal composition of the recipe, which could provide high sensory properties of the product; development of the shortbread cookie “Pumpkin” recipe of functional purpose; study of sensory, physical and chemical indicators of the obtained biscuits.

The optimum ratio of three kinds of meal composition was determined by mathematical modeling [9].

Production of research sample

Shortbread dough with the addition of the estimated number of meal and reference sample for recipe shortbread cookies was prepared according to the method of AACC [13] with some modifications in the recipe, technological card shown in Table 3 [10,11].

The recipes of samles of shortbread cookies "Pampkin" are shown in Table 3.

The cookies were cooked with usage of all the food ingredients: the butter was churned for 5-6 minutes. Other ingredients were added in such sequence: whole egg, sugar and vanilla powder, pumpkin puree and oil. They were churned well again, then flour and chia seeds were added into pastry and it was being churned for 1 min. The ready dough was transported into a piping bag and laid through a toothed nozzle of "tubules" with a diameter of 10-12 mm on a dish and baked for 14 minutes with temperature of 200 °C.

Sensory properties of cookies were determined using a twenty-member panelist. Participants were asked to evaluate the coded samples for smell, taste, color and form texture. Each sensory attribute was evaluated on a 5-point scale (1 = extremely disliked, and 5 = very much) and seems like polygon for best described results was made Figure 1. Shortbread profile was defined by calculation method [12].

Table 3

Recearched recipes of shortbread cookies "Pampkin" of a functional purpose

No. z/p	Name of raw materials	Calculation per 1 kg of finished goods (g)			
		Cookie	Sample № 1	Sample № 2	Sample № 3
1	Fancy white wheat flour	614	600	600	600
2	Butter	400	360	320	340
3	Powdered sugar	123	73.8	61.5	61.5
4	Whole egg	31	31	31	31
5	Vanilla powder	3.1	3.1	3.1	3.1
6	Pumpkin puree	-	49.2	61.5	61.5
7	Pumpkin oil	-	40	80	60
8	Chia seeds	-	15	15	15

Physical and chemical analysis

Mass fraction of sugars was made as directed in the AACC Method 10-52 [13].

Mass fraction of moisture was determined based on AOAC Method 934.01: Air Oven Method [14].

Mass fraction of fat was conducted based on AOAC Method 963.15: Soxhlet Extraction Method utilizing petroleum ether as solvent [14].

Ash test was carried out based on AOAC Method 923.03: Dry Ashing Method [14].

Water absorption was determined using standard AOAC Method 960.14: Adsorption Indicator Method [14].

The Calorie content level in a cookie "Pumpkin" placed be calculated by the method of determining the amount of energy released from chemical compounds that are part of the product in the process of biological oxidation of them in an organism used to provide physiological functions of the organism [15]. Method uses the average values of 4 Kcal/g for protein, 4 Kcal/g for carbohydrate, and 9 Kcal/g for fat.

Results and discussion

According to the results of the organoleptic evaluation of the shortbread cookies, a «profilogram» (Fig. 1) was constructed. It proofs that the best organoleptic quality indices are obtained in sample № 2 of cookie with addition of pumpkin puree 50% and pumpkin oil 20% of the initial laying of raw materials and chia seeds in the proportion of 1.5% of the wheat flour amount had the best indicators.

The addition of pumpkin puree to the shortbread dough has affected the structure and consistency of the products. The introduction of puree has caused an increase of cookie's taste and aroma, a golden color, a stabilization of the shape and surface.

The use of pumpkin puree has led to a change in the color of products: from light yellow to light orange, due to the presence of beta-carotene.

Reducing the norm of powdered sugar led to a decrease of the caloric value of finished goods.

The structure of the cookie has become more fragile and tender, which was noted by the tasters as a positive effect. Thus, a positive influence on the organoleptic parameters of finished goods is shown.

Regarding physical and chemical indicators, the results of the research revealed that all of them are situated within the norms presented for cookie requirements, shown in Table 4.

The caloric value of the cheque and enriched shortcut biscuit sample is shown in Table 5.

Based on the results of studying the caloric value indices, it is concluded that the cookie "Pumpkin" has a lower calorie content in comparison with a cheque sample of 78.0 kcal / 324.48 kJ.

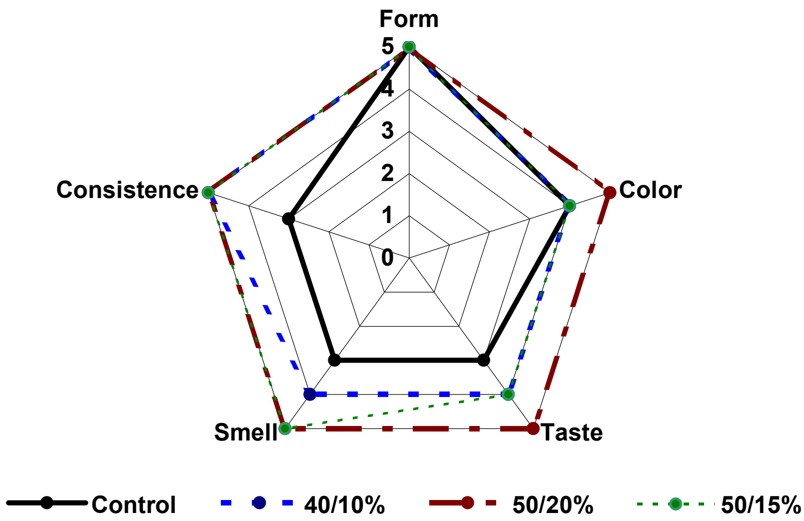

Figure 1. Aroma cookie cooker "Pumpkin"

Table 4

Results of studying the physical and chemical quality indicators of shortbread cookie of increased biological value

Indicator's name	Cookie requirements	Cookie "Pumpkin"
Mass fraction of moisture, %	Not more than 15.5	13.2 ± 0.4
Mass fraction of sugars (in terms of dry solids), %	Not less than 12,0	30 ± 1.1
Ash, %	Not more than 0,1	0,1 ± 0.1
Mass fraction of fat (in terms of dry solids), %	Not less than 2,3	3.4 ± 0.1
Water absorption, %	Not less than 110,0	157 ± 2.0

The obtained results of Table 3, confirmed that the selected additives do not affect the results of researches and do not change the basic characteristics of the cookie, because all are within the norm for conventional cookies.

Table 5

Caloric value of the cheque sample

Nutritional value	Cheque sample, 100 g	"Pumpkin" cookie's sample, 100g
Proteins, g	6.1	6.4
Fat, g	18.8	20
Carbohydrates, g	68.9	55
Caloric value, kcal / kJ	467 / 1942,7	402.5 / 1674

Using a mixture of pumpkin puree, pumpkin oil chia seeds in the production of "Pumpkin" cookies led to a reduction in the energy value of finished products from 467 to 402.5 kcal by reducing the amount of sugar.

Conclusions

A new type of cookie "Pumpkin" has the high biological value due to the introduction of raw materials of plant origin into its composition – hydrolysed pumpkin puree and pumpkin oil, chia seeds. Samples of a new product are made. The optimal concentration of pumpkin puree, pumpkin oil and chia seeds for harmonic taste and smell are established. Sensory, physical and chemical parameters are investigated.

According to the results of the study, the patent of Ukraine for the useful model of shortbread cookie "Pumpking" was received.

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Investigation of the yeast dough mixing process at different rotational frequency of the mixing blade

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Abstract

Introduction. It was considering consider the question of mixing the yeast dough with the variable speed of rotation of the working element and the different humidity of the dough.

Materials and methods. The research was carried out by measuring the power and other parameters of kneading and recording the results in the form of pharynograms. Flour, water, salt and yeast blend was placed in a stirring chamber and recorded the torque and the corresponding technological parameters. The mixing of the yeast dough took place for 20 minutes for the rotational speed of the working element from 20 to 140 turns per minute and at different humidity levels of the dough in the range from 40,3% to 44,3%.

Results and discussion. There have been stages of mixing the yeast dough investigated. The influence of reinforced mechanical processing on the yeast dough was studied. It has been established that with increasing the frequency of rotation, the time required for mixing the components decreases. At dampness of a dough 44,3% at any speed of a rotation, in a range from 20 to 140 rpm. After intensive mechanical treatment of the yeast dough with a rotational speed of 60 to 140 rpm, it is required on its own batch of dough at different humidity, ranging from 40 to 60 seconds. Time is required for the third stage of kneading (dough plasticization), for the dough humidity of 40,3-42,4% ranges from 160 to 180 seconds for the rotational speed of 60-80 revolutions per minute.

The required, fine-grained and uniformly distributed porosity (the number of portions of 4500-4800 pieces) is observed in the intensive process of mixing the yeast dough for the rotational speed of the working body of 60 revolutions per minute. The highest porosity indices in the finished product for the parameters of the technological process of the rotational speed (n = 60 rpm), the moisture content of the yeast dough (H = 44,3%) under the given conditions, the porosity of the finished product (P = 70%) reaches the maximum values.

Conclusions. The yeast dough mixing process should be carried out at relatively high turns of the working element 60-80 rpm, so the humidity in the specified ranges (40,3-44,3%) will not significantly affect the process, the gluten macromolecule under the influence of internal stresses, arising in the dough, are partially destroyed, but due to the internal restructuring of the structure are restored again, and the gluten turns out to be elastic.

Introduction

The dough kneading is an important technological operation. The duration of kneading for the wheat dough is from 1 to 20 minutes [1-3]. The purpose of kneading is to obtain a homogeneous dough mass with certain structural and mechanical properties [2].

There is the so-called two-stage model of mixing the dough, edited by the scientist Gaponyuka. There are two stages of the dough mixing: mixing components and plasticization. Bakers and chemistry specialists use the five-stage model of dough mixing edited by Kenneth J. Valence, Enrique Rothstein, R. Paul Singh [5].

To facilitate the analysis of the regularity of the mixing process and to identify the progressive rational parameters of its provision, O. Lisovenko proposed a three-stage model of the dough mixing (mixing of components, actually baking and plasticization), which is also based on modern developments of HD Cheshner, N. Kwenda and others [8, 10].

The dough formation during batching occurs as a result of a number of processes, of which the most important are: physical-mechanical, colloidal and biochemical processes. All these processes take place simultaneously, mutually affect each other and depend on the duration of batching, temperature and the quantity and quality of the raw materials used in batch testing [17–18].

Physic mechanical processes occur during kneading under the influence of a kneading element that mixes flour particles, water, yeast and additional raw materials, ensuring the interaction of all the constituent components [20].

Colloidal processes are connected with the main components of flour – proteins and starch. Proteins of wheat flour, absorbing moisture, sharply increase in volume and form a glutinous skeleton, inside of which there are swollen grains of starch and shell particles. As a result, Sticking of particles into a continuous mass leads to the formation of a test [3].

The physical dough properties are mainly determined by the specific features of its protein part. They determine the elasticity, ductility and viscosity of the wheat dough. However, excessive batching can cause destruction of the already formed dough structure, which can lead to a deterioration in the quality of bread [3–7].

During the batch of the dough, biochemical processes, caused by the action of enzymes of flour and yeast, also occur. The main biochemical processes are the hydrolytic decomposition of proteins under the action of proteolytic enzymes (proteolysis) and starch under the action of amylolytic enzymes (amylolysis). As a result of these processes, the amount of substances capable of transitioning to the liquid phase of the test increases, which leads to a change in its structural and mechanical properties [10].

One way to intensify the maturation of the dough is to increase the mechanical processing of the dough [20].

The purpose of the scientific study of mixing the yeast dough is to set the time limits of the mixing yeast dough stages length with different humidity (40,3%, 42,4%, 44,3%), depending on the rotation frequency of the working parts.

Materials and methods.

The process of kneading of wheat yeast dough was reseached.

The research was carried out on FARINOGRAPH®-AT, produced by German company BRABENDER®, the next generation of high-precision instruments for the flour quality and the dough behavior study during its mixing determining, depending on the dipping time and the rotation frequency of the mixing blade.

Fill your flour sample into the preheated and temperature controlled measuring mixer. At the start the program the mixer blades loosen up the flour and a minute later the water will be injected into the mixer. A dough develops, which is subjected to a defined mechanical stress by the rotating mixer blades which are driven by a motor, carried in a pendulum bearing. The resistance of the dough against the blades, which depends on the viscosity of the dough, causes an opposite deflection of the motor housing. This deflection is measured as torque and recorded and plotted online as a function of time in a clear color diagram.

To assess the porosity of the finished products wiring was cutting, and photographed via "ImageJ". Then porosity of the finished product were calculated through the found and counting the number of pores. "ImageJ – the image processing software, which can calculate the area and degree of image details, user-defined election statistic, measure distances and angles, a histogram density and line profile plots.

Result and discusion

After 1–2 minutes dough mixing, the curve reaches a certain maximum. This characterizes the transition of the mixing raw material to the condition of the bound mass and shows the duration of the 1st stage of the components mixing process (Figure 1). During the subsequent mixing process the dough mass acquires a certain elasticity. This is due owing to swelling processes and action of hydrolytic enzymes. The curve reaches a second maximum that characterizes the duration of the 2nd stage of the process (Figure 2). This process is called the actual metaphase. The next stage is plasticization (Figure 3), during which the effective viscosity of the test decreases. The total duration of the first and second stages is called the dough formation process. During this period, processes of swelling dominate. As a result of deepening processes of enzymatic and mechanical disaggregation of proteins, there is a gradual dilution of the consistency of the dough.

We investigated the first stage (Figure 1) of yeast dough components stirring. The graph shows that the first stage is linear. As the rotation frequency increases, the time required for components mixing decreases. On the moisture content of the dough 44,3% at any rotation speed, in the range from 20 rpm to 140 rpm. The regularity of the effect of humidity on the yeast dough mixing process is due to the fact that when more water is added, contact with bulk substances takes place in a much shorter time (50-60 seconds) and there is a qualitative mixing of the components.

The second stage of mixing, actually the dough dipping (Figure 3), depending on the rotational frequency and the different dough humidity, is of a power character and is inversely proportional to the first stage in duration. This process is explained by the fact that 40,3% of the dough humidity contains up to a relatively less amount of water and, thus, the dough framework is formed more quickly. With increased machining by working parts from 60 rpm to 140 rpm, the time required for the actual dough mix at a different humidity is 40-60 seconds.

It was investigated that the physical properties of the yeast dough during mixing are continuously changed as a result of a number of processes that occur when kneading the dough. The time is required for the third stage of the dough plastification with the humidity 40,3-42,4% is 160-180 seconds at a rotational speed of 60-80 rpm.

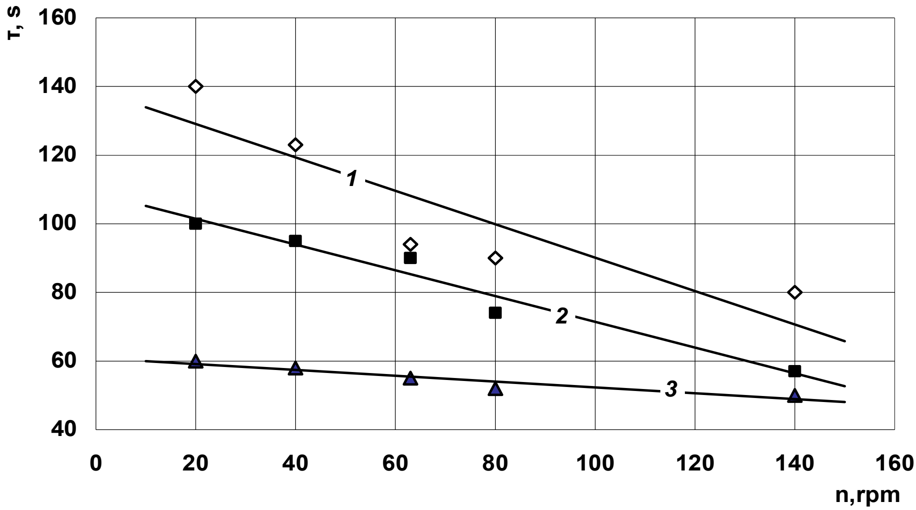

Figure 1. The first mixing stage duration, depending on the frequency of rotation and the different humidity: 1–40,3%; 2–42,4%; 3–44,3%

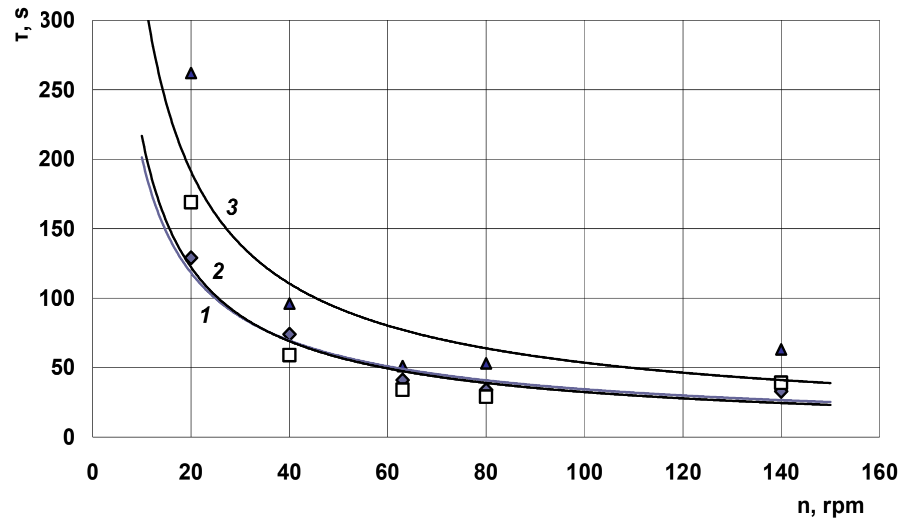

Figure 2. The second stage of mixing duration depending on the frequency of rotation and the different humidity: 1–40,3%; 2–42,4%; 3–44,3%

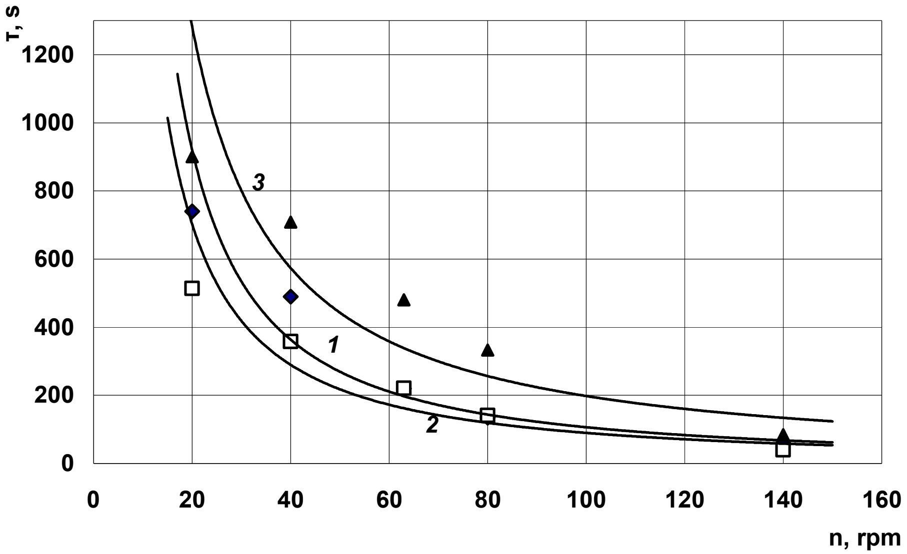

Figure 3. Duration of mixing the third stage, depending on the rotational speed and humidity: 1–40,3%; 2–42,4%; 3–44,3%

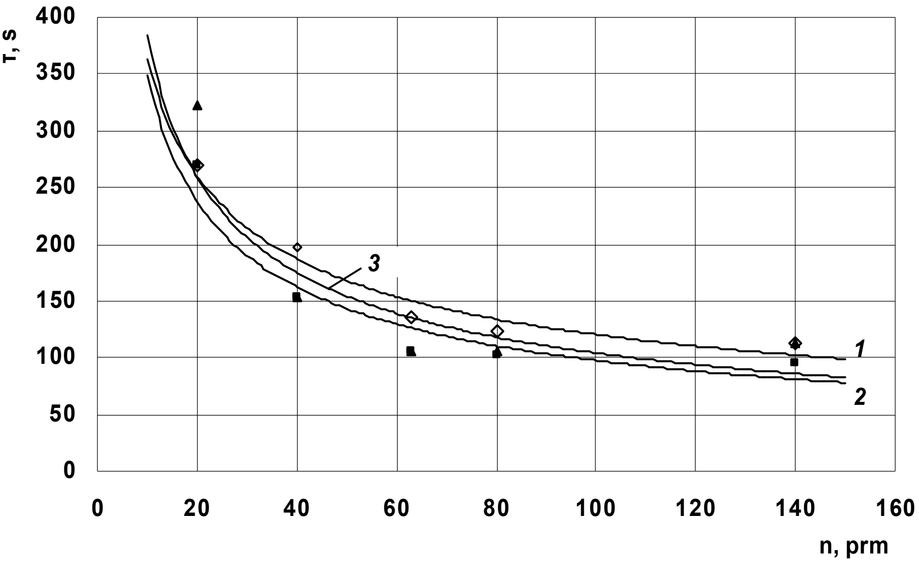

Figure 4. The dough formation time with different humidity (1–40,3%; 2–42,4%; 3–44,3%) and rotation frequency

The time of dough formation at different humidity and speed of rotation is shown on Figure 4, the lines have a degree of power. Dependence analysis of the duration of the dough formation indicates that the determining factor in the dough formation is the intensity of mechanical treatment, thus increasing the rotational speed of the working element reduces the time required for the dough formation.

The dependence of the duration of the dough formation, depending on the frequency of rotation, shows that with a rotational speed of the working element of 140 rpm, the duration of the dough formation will be the smallest, the same indicators of 100 seconds of time required for the dough formation are observed and with a rotational speed of 60-120 rpm. Rapid dough formation is due to the fact that the intensity of mixing at such rotations of the working organ is high. After analyzing the results, it is advisable to mix the yeast dough at the rotational speed of the working element of 50-60 rpm, increase the rotational speed of the working element above the parameters is not meaningful, since the time will be the same but the energy required for the batch, will be used more.

Mechanical processing of the dough during batching and transportation is one of the main ways of regulating its rheological properties. To mix the bread dough different types of machines are used with different working elements, which depending on the type of flour, formulation composition and assortment features carry out a different mechanical effect on the dough.

We have been conducting studies of torque change over time by mixing the yeast dough with different humidity (40,3%, 42,4%, 44,3%) for different working element rotation (from 20 rpm to 140 rpm). The torque was automatically detected by means of sensors in real time.

The yeast dough was added to Farinograph for 20 minutes. The results of a series of studies were given in the form of three diagrams (Figure 5,6,7).

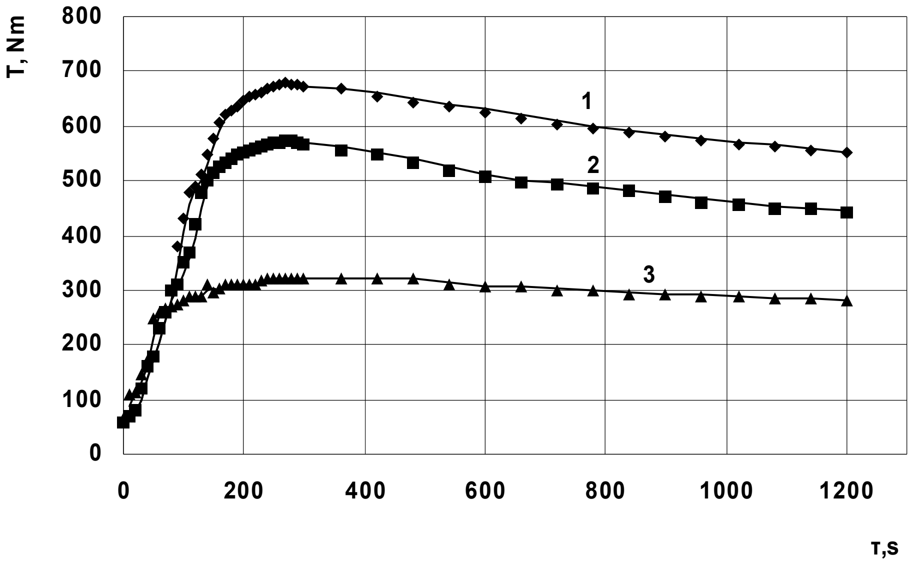

Figure 5. Dependence of torque on humidity in time (1-40,3%; 2-42.4%; 3-44,3%) at constant speed (20 rpm)

The obtained dependence (Figure 5) shows that the yeast dough has a different formation time at a different humidity at a constant rotational speed (20 rpm). High figures (690 Nm) of torque are observed when kneading the yeast dough, humidity 40,3% for a 300 second pickup, where we observe the second stage of mixing – kneading. The mixing of the yeast dough with a humidity of 44,3% proceeds for the indicators of the torque of the working element at the limit of 300 Nm, thus the electricity consumption significantly reduces and the drive works in a stable load. On the graph (Figure 5) it is seen that the torque increase reaches its maximum values at the second stage of mixing, and then gradually decreases.

At the rotational speed of the working element, 60 rpm, the torque dependence (Figure 6) for the different moisture content of the yeast dough, the following dependence is observed: at the first stage (mixing of the components), the torque increases, after which the second stage (the actual batch) begins to reach the maximum on the graph. After that the torque decreases and the third stage (plasticization) of the kneading of the yeast dough occurs. An interesting feature for the rotational speed (60 rpm) of the working element is that the torque is the same when the humidity is 40,3–42,4% after 650 seconds.

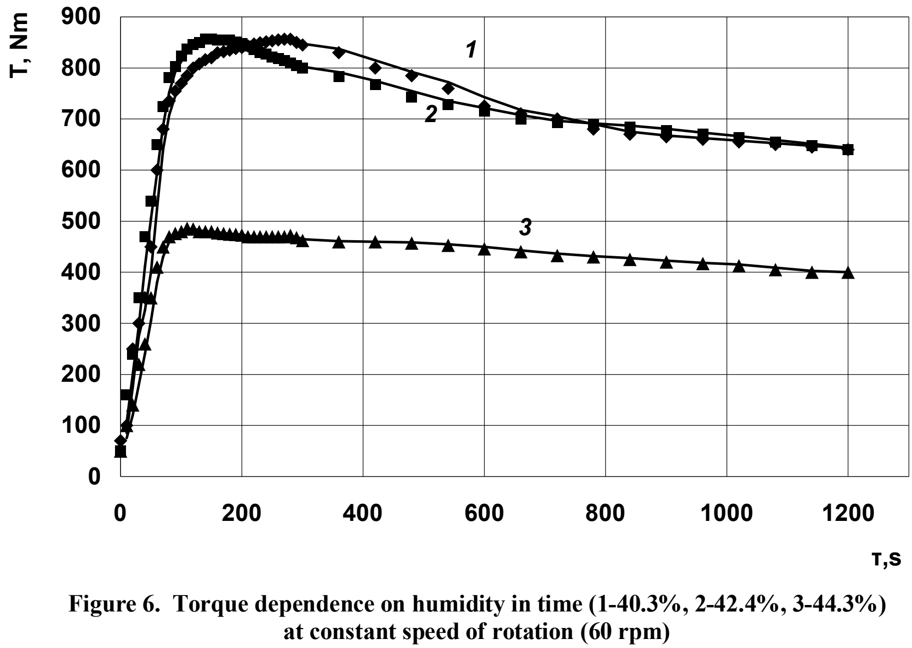

Figure 6. Torque dependence on humidity in time (1-40.3%, 2-42.4%, 3-44.3%) at constant speed of rotation (60 rpm)

The highest torque (Figure 7) is observed when mixing a yeast dough with a rotational speed of the working element of 140 rpm and a test dough of 40,3% of the torque value reaching 1180 Nm, thus the most load on the working element occurs and the result is consumed according to these parameters more electricity.

The maximum torque at a humidity of 42,4% is observed at 980 Nm, and then rapidly falls at the stage of plasticization. The process of mixing the yeast dough at a humidity of 44,3% rises to a mark of 430 Nm and then goes very slowly down to the 395 Nm mark.

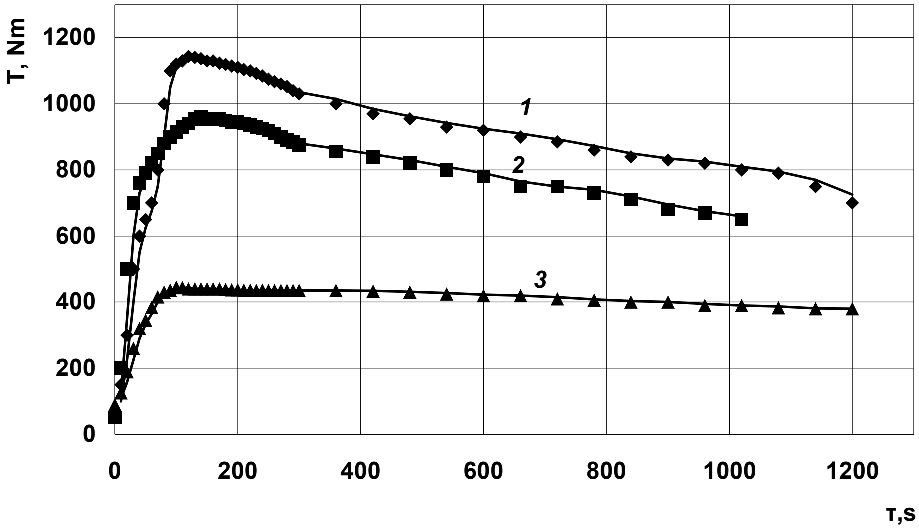

Figure 7. Torque dependence on humidity in time (1-40,3%; 2-42,4%; 3-44,3%) at constant speed (140 rpm)

The process of yeast dough mixing at the rotational speed of the working element of 140 rpm is not feasible, as high torque values are observed, which in turn increases the cost of electricity. For the rotational speed of the working element of 20 rpm, the process of kneading the yeast dough proceeds slowly. The speed of rotation of 60 rpm is rational at a given speed of rotation, but comparatively low torque is observed, but at the same time

The porosity of the finished product (Figure 8) is the volume of pores, expressed as a percentage of the total volume of crumb of bread. Bread with uniform fine porosity, well loosened is better impregnated with digestive juices and therefore is better absorbed.

Good, fine-grained and uniformly distributed porosity (the number of portions of 4500-4800 pieces) is observed in the intensive process of mixing the yeast dough for the rotational speed of the working element of 60 rpm. At rotational speeds of 20 rpm, in some places large pores are formed that occupy a large area in the volume of the finished product and thus interfere with the formation of a fine-grained structure of porosity (the number of portions is 2990-3120 pieces). The nature of the distribution of porosity in the finished product for the rotational speed of the working element 140 rpm and 40,3% moisture content is not accompanied by a uniform distribution of porosity (the number of portions of 2600 pieces), due to the fact that during intensive yeast dough mixing at a relatively low humidity the gluten-free dough frame collapses. At a rotational speed of 140 rpm and a moisture content of 42,4-44,3% of yeast dough, uniform fine grained porosity is observed (the number of pores is 3080-3089 pieces).

The amount of pores of the finished product (Figure 9) characterizes an important quality parameter of the bread property. Low porosity is usually inherent in bread from poorly mixed dough. The porosity of wheat bread is 50-70%, depending on the type of bread and the way it is baked. We determine the porosity using the "ImageJ" software package.

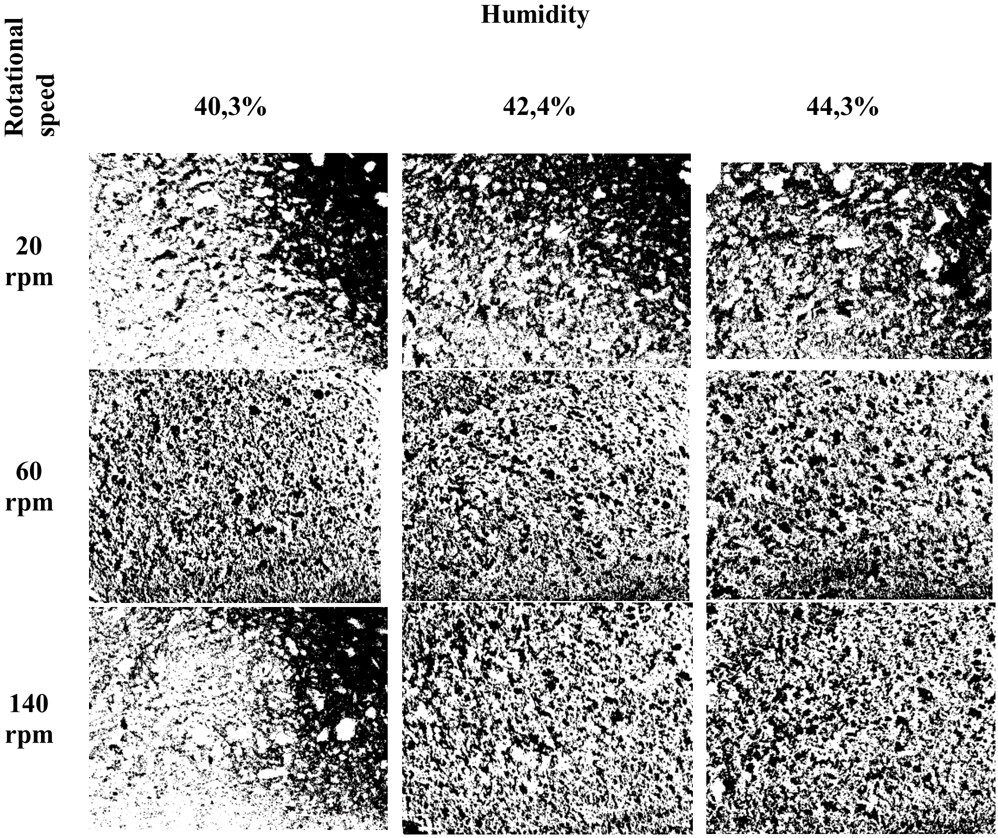

Figure 8. Digital image of the porosity of the finished product at different rotational speed and dough moisture humidity

The best porosity indicators in the finished product for the parameters of the technological process are the rotation frequency (n = 60 rpm), humidity of the yeast dough (H = 44,3%), under these conditions, the porosity of the finished product (P = 70%) reaches the maximum values. Good indicators of porosity of the finished product (P = 50% and P = 64%) and humidity of the yeast dough 40,3-42,4% for the rotational speed of the working element 60 rpm. At the rotational speed of the working element of 20 rpm with different moisture content of the yeast dough, porosity values reach 46-50%. For the rotation frequency of the working element 140 rpm at different moisture content of the yeast dough, the porosity reaches 41-52%.

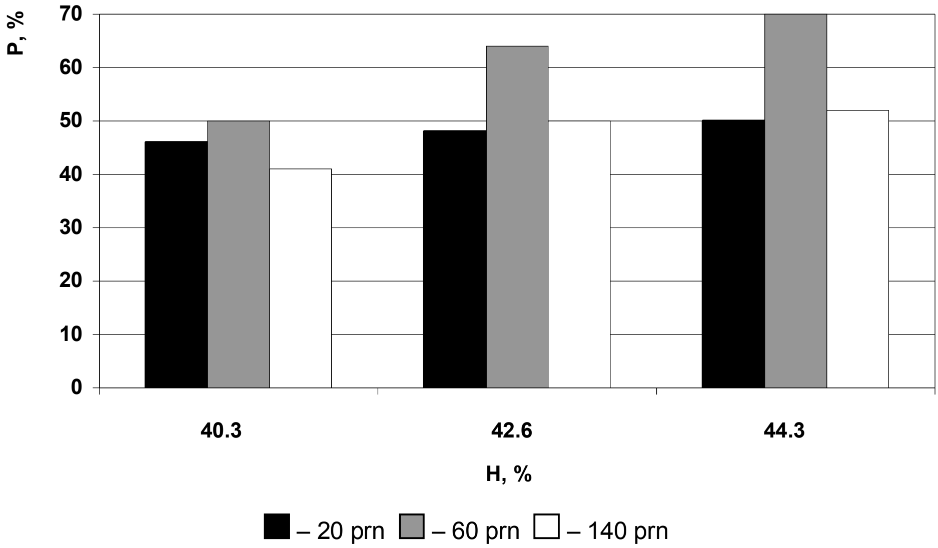

Figure 9. Finished product porosity, depending on the humidity and rotation frequency of the working element

Conclusion

The yeast dough mixing process of should be carried out at relatively high turns of the working part 60-80 rpm, so the humidity in the specified ranges (40,3-44,3%) will not significantly affect the process, the gluten macromolecule under the influence of internal stresses appear in the dough, partially destroyed, but due to the internal restructuring of is restored again, and gluten turns out to be elastic. Under these conditions high porosity of the finished product is maintained P = 70%.

By working element rotation frequency of 60 rpm there recommended indicators for torque drive is not overloaded and reduced energy costs.

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Energy effective drying modes of soy-vegetable compositions

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Abstract

Introduction. It was carried out the research for determining the optimal drying conditions of soybean and vegetable mixtures that provide the least drying time and maximally preserve the biologically active substances of the dried material.

Materials and methods. It was researched the colloidal capillary-porous materials on the basis of soy, carrots, spinach and soy-carrot, soy-spinach mixture. For the study of the drying process it was used an experimental stand with automatic temperature controllers was used which is a system of isolated pipelines with devices for heat treatment and circulation of coolant, drying chambers, measuring circuits and instruments for controlling the process parameters and measuring the values characterizing the process of drying.

Results and discussion. Researched the kinetics of the soybean-carrot mixture drying process at a temperature of the coolant temperature of 70 ºC, 100 ºC, with a constant drying rate v=2.5 m/s, as well as mode steps of 100/70 ºC with constant drying rate v=2.5 m/s. The process of drying the binary mixture takes place in the second period. With the deepening of the evaporation zone inside the material, the temperature of its surface increases, and the rate of moisture content decreases. It has been established that drying with a temperature of the coolant temperature of 100 ºC results in an inadmissible melaidine reaction, while the 100/70 ºC step mode prevents such reactions due to the fact that the material does not warm up above 70 degrees throughout the drying period.

Researched the kinetics of the soybean-spinach mixture drying process at a temperature of 60 ºC, as well as mode steps of 100/60 ºC, a constant drying rate v=2.5 m/s. In the chemical composition of spinach contains folic acid, which is destroyed during the heat treatment of products at a temperature of 100 ºC for 20 minutes. When drying the mixture with a 100/60 ºC degree of temperature, the material under investigation at a temperature of the heat carrier is 100 ºC for 4 minutes, and then the temperature of the coolant is reduced, after 20 minutes of drying the temperature of the coolant 80 ºC, this prevents significant losses of folic acid, after 40 minutes of drying, the temperature of the coolant is 60 ºC, during the whole process of drying the surface temperature and in the thickness did not exceed 60 ºC.

Conclusions. The drying time of the material in the mode of the heat carrier 100/60 ºC and 100/70 ºC is less in comparison with the duration of the process at 60 and 70 ºC, which reduces energy expenses by 30–40% for the drying process.

Introduction

Processes of drying vegetable raw materials are an important issue for preserving food [1], in which water removal minimize many of the moisture-driven deterioration reactions impacting the bioproduct quality. Dried fruits and vegetables and their application in powder form have gained interest in the food industry. Drying and grinding conditions during powder processing greatly influence the quality attributes of biological materials. It implies not only nutritional changes but also physical, textural, sensorial and functional changes [2]. It is known that the main mechanism for removing moisture is the diffusion of fluid. This mechanism is complex due to the diversity of the chemical composition and physical structure of the material [3].

Knowledge of thermodynamic properties during the process of drying of plant materials allows designing drying equipment, calculating the energy required in the process, studying the properties of the adsorbed liquid, assessing the microstructure of food products, and studying the physical phenomena occurring on the material surface [3]. Due to the lack of research in the literature that provides information on changes in moisture in soybean-carrots and soy-spinach mixtures, this work is aimed at studying the process of drying soybean plants to achieve the energy efficiency of the process.

Soybeans are rich in nutrients and biologically active substances. Soya is associated with the reduction of some diseases such as heart disease, hypertension, breast cancer and cholesterol [4]. The use of soy ingredients in foods is receiving significant attention from the food industry and consumers because of their role as a functional food. The functionality of food can be addressed from the perspective of food components. Despite the rich health benefits of soy ingredients and affordability, their use in widely consumed dairy products needs further study [5].

Carotenoids are colourful compounds, present in fruits and vegetables, synthesised by plants andmicro-organisms. About 10% of these are important dietary precursors of vitamin A. Carotenoidsact as antioxidants and possibly decrease in-vivo lipid oxidation. Lipid oxidation is known to be arisk factor for atherosclerosis [6].

In soy-carotene-containing powders, high lipid content up to 40% [7]. Carotenoids, in the process of storing soy-vegetable compositions, help to stabilize and prevent the process of oxidation of soy proteins.

Materials and methods

Materials

To develop energy-efficient drying modes of soybean and vegetable compositions the research was carried out on plant material, such as: pre-hydrothermal processing soybean [8], carrots and spinach, as well as mixtures-soy-spinach and soybean-carrot.

Chemical composition of soy

Generally soybean seeds content 5,6-11.5% of water, ranges for crude protein is from 32 to 43,6%, for fat from 15.5 to 24.7%, for crude ash from 4.5 to 6.4%, for neutral detergent fiber (NDF) from 10 to14,9%, acid detergent fiber (ADF) from 9 to 11,1%, carbohydrates content from 31.7 to 31.85% on a dry matter basis [9].

Soybean meal is the best vegetable protein source considering on quantity as well its quality. From among legume seeds, the soybean seeds content the most of crude protein and the best of amino acid composition. Content of crude fiber (about 6%) is lower in comparison to another vegetable high protein feeds [9].

Soybean seeds contain to 40% of crude protein and about 20% of fat, and soybean meal characterized higher content of crude protein – about 40–49%. The protein of soybean contains the considerable quantity of lysine (6.2g/16gN), but value of protein is limited by methionine and cystine content (2.9g/16gN) [9].

The nutritive value of soybean is limiting mainly by trypsin and chymotrypsin inhibitors, pectins and the protein about immunology activity. The most important there are the trypsin inhibitors – the Kunitz inhibitors and the Bowman-Birk inhibitors. Protease inhibitors (the Kunitz inhibitor and Bowman-Birk inhibitor) are active against trypsin and chymotrypsin. These inhibitors interfere with the digestion of proteins. Activity of trypsin inhibitor range from 100 to 184 TUI/ mg of protein. The limit of activity for soy products is to 0.4 urease units. Thacker & Kirkwood report a range for trypsin inhibitors of 21.1 to 31.1 mg/g. The activity of these inhibitors in soybean products may be decrease by toasted or heated processes. The right warming up of soybean and its products eliminate above 90% of antitrypsin activity [9].

Chemical composition of carrot

The moisture content of carrot varies from 86 to 89%. Carrots are a good source of carbohydrates and minerals like Ca, p, Fe and Mg. Gopalan have reported the chemical constituents of carrot as moisture (86%), protein (0.9%), fat (0.2%), carbohydrate (10.6%), crude fiber (1.2%), total ash (1.1%), Ca (80 mg/100 g), Fe (2.2 mg/100 g) and p (53 mg/100 g) whereas, the values reported by Holland for most of these parameters are different i.e. moisture (88.8%), protein (0.7%), fat (0.5%), carbohydrate (6%), total sugars (5.6%), crude fiber (2.4%), Ca (34 mg/100 g), Fe (0.4 mg/100 g), p (25 mg/100 g), Na (40 mg/100 g), K (240 mg/100 g), Mg (9 mg/100 g), Cu (0.02 mg/100 g), Zn (0.2 mg/100 g), carotenes (5.33 mg/100 g), thiamine (0.04 mg/100 g), riboflavin (0.02 mg/100 g), niacin (0.2 mg/100 g), vitamin C (4 mg/100 g) and energy value (126 kJ/100 g) [10]. The edible portion of carrots contains about 10% carbohydrates having soluble carbohydrates ranging from 6.6 to 7.7 g/100 g and protein from 0.8 to 1.1 g/100 g in 4 carrot cultivars. Kaur have reported 1.67–3.35% reducing sugars, 1.02–1.18% non-reducing sugars and 2.71–4.53% total sugars in 6 cultivars of carrot. Simon and Lindsay reported that reducing sugars accounted for 6–32% of free sugars in 4 hybrid varieties of carrot [10]. The free sugars identified are sucrose, glucose, xylose and fructose. The crude fiber in carrot roots consist of 71.7, 13.0 and 15.2% cellulose, hemicllulose and lignin, respectively. The cellulose content in 4 carrot varieties varied from 35 to 48%. The average nitrate and nitrite content in fresh carrot have been 40 and 0.41 mg/100 g, respectively. The taste of carrots is mainly due to the presence of glutamic acid and the buffering action of free amino acids [10]. Trace amounts of succinic acid, α-ketoglutaric acid, lactic acid and glycolic acid have also been reported. Caffeic acid is the predominant phenolic acid in carrots. Thiamin, riboflavin, niacin, folic acid and vitamin C are present in appreciable amounts in carrot roots. The anthocyanins content in roots may vary from trace amounts in pink cultivars to 1,750 mg/kg in black carrots. The major anthocyanins have been identified as cyanidin 3-(2-xylosylgalactoside), cyanidin 3-xylosylglucosylgalactoside and cyanidin 3-ferulylxyloglucosyl galactoside [10].

Chemical composition of spinach

Spinach is one of the most important antioxidative vegetables, usually consumed after boiling either fresh or frozen leaves. Freshly cut spinach leaves contain approximately 1,000 mg of total flavonoids per kilogram. The possible presence of flavonoid-like compounds in spinach was first reported in 1943 but nearly 20 yr elapsed before the structure of the flavonol isolated from spinach leaves was established as patuletin and the presence of spinacetin was confirmed [11]. In addition, the existence of several flavonol glycosides in a methanolic extract of spinach leaves was reported. The occurrence of at least 10 flavonoid glycosides has now been reported in spinach [11]. These are glucuronides and acylated di-and triglycosides of methylated and methylene dioxide derivatives of 6-oxygenated flavonols [11]. Glucuronides are more water-soluble than glycosides and acylated compounds that remain in the tissue after cooking in boiling water. Flavonoids and other phenolic constituents act as antioxidants by the free-radical scavenging properties of their hydroxyl groups. Extensive conjugation across the flavonoid structure and numerous hydroxyl groups enhance their antioxidative properties, allowing them to act as reducing agents, hydrogen-orelectron-donatingagents, orsinglet-oxygen scavengers. Results from the in vitro oxygen radical absorbance capacity (ORAC) assay have shown that, among various fruit and vegetable extracts, foods with the highest ORAC activity include spinach, strawberries, and blueberries [11]. The antioxidant capacity of spinach flavonoidshasbeendeterminedbythefree-radicalscavenging assay using DPPH radical and was compared with that of Trolox, a synthetic analogue of vitamin E. The most active products were those derived from patuletin with a 3,4 -dihydroxyl group [11]. The incorporation of a feruloyl residue increased the free-radical scavenging activity. During storage of spinach leaves, a decrease in the total antioxidant activity was observed. Boilingof fresh-cut spinach leaves extracted approximately 50% of the total flavonoids and 60% of the vitamin C in cooking water; however, flavonoid glucuronides were extracted more than other glycosides [11].

Experimental stand

Investigation of convective drying processes was carried out on an experimental stand, the principal scheme of which is depicted in Figure 1 [14].

The experimental stand consists [12] of a system of isolated air ducts with devices for heating and circulation of coolant, drying chambers, measuring circuits and instruments for controlling the process parameters and measuring the quantities characterizing the process of drying the test material.

The drying chamber 1 is a rectangular sheet of iron with a manhole for the introduction of samples of the material. The chamber has lateral clear hatches, through which you can observe the state of the material during the drying process. The design of the stand allows conducting the study of the drying process by weight, using the scales connected to the computer.

The heat-training section of air (2) is made in the form of a rectangular box, which contains electric heaters, which allow to maintain in the automatic mode the temperature of air in a wide range. The automatic temperature control system consists of (8), PID controller with interface (7), opto-thyristor of symmetrical and electric heaters (2). The air movement is carried out by means of a centrifugal fan (3) of medium pressure on the system of air ducts.

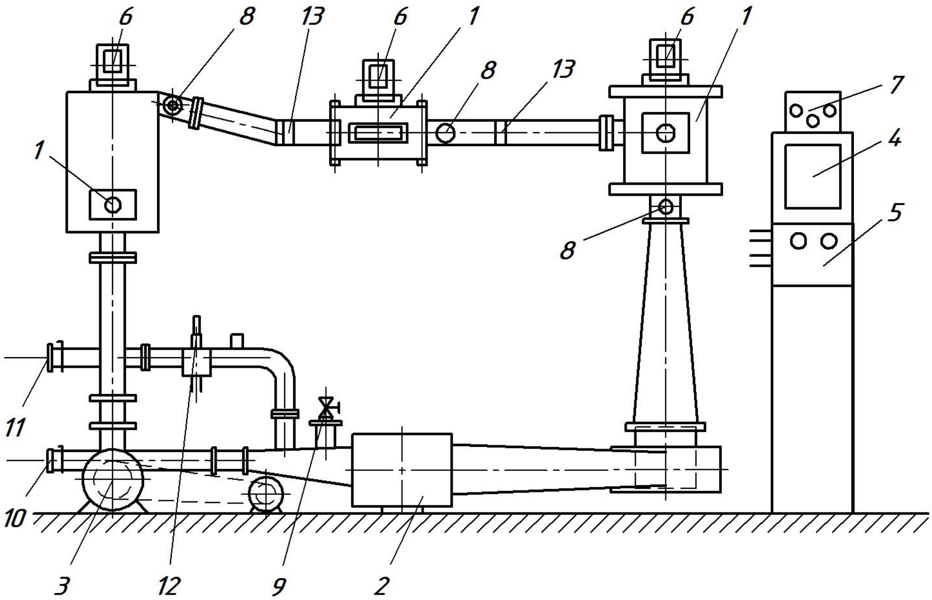

Figure 1. Scheme of the experimental stand:
1 – drying chambers; 2 – heater; 3 – fan; 4 – potentiometer; 5 – control panel; 6, 7 – automatic temperature control system; 8 – resistance thermometers; 9, 10, 11 – pipe fittings; 12 – psychrometer, 13 – special lattices.

The change in the velocity of the heat carrier is achieved by controlling the number of revolutions of the fan's working wheel by means of the frequency controller, the ratio between the spent and fresh air can be adjusted with the help of shibers on the nozzles (9, 10, 11).

The air temperature in the drying chamber is recorded using a chromole-copulative thermoelectric converter with a diameter of 0.2 mm, located above the samples under study. During the drying process, the temperature of the surface of the sample and its central part was measured using specially made probes with a diameter of 1.2 mm with thermoelectric chromed-coplanar converters mounted in them.

Results and discussion

Investigation of the kinetics of the drying process of soybean - vegetable compositions

In the processing of plant material with prolonged storage there is a partial destruction of biologically active components (BAC) and a decrease in the functional value of the final product [7]. Therefore, it is advisable to study the kinetics of drying of soybean and vegetable components for the further development of energy-efficient drying regimes and prevention of losses of the BAC under the influence of temperature of the coolant. The subject of the study is hygrothermically processed soy [8], carrot and spinach, as well as compositions – soybean-spinach and soy-carrot.

Experimental studies were carried out on the drying of a soybean-carrot mixture with temperatures of the heat-coolant 70 and 100 ºC, the results of which are shown in Figure 2. The process of drying the binary mixture takes place in the second period. With the deepening of the evaporation zone inside the material, the temperature of its surface increases, and the rate of moisture decreases. The rates of drying curves show that with the increase of coolant, the intensity of dehydration increases. However, the use of a high-temperature drying regime at 100 º C results in an undesirable melayidine reaction, which results in the burnout of biologically active substances, changing qualitative characteristics of the raw material, with a significant highlighting of the color of the raw material.

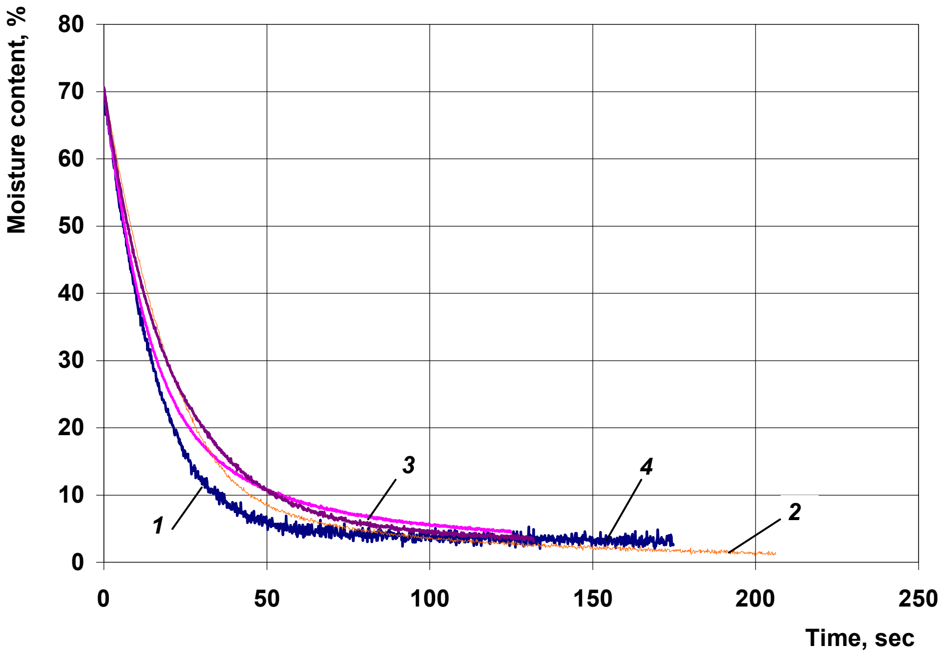

Figure 2. Curves of drying of soybean-carrot mixture according to step-by-step regimes δ=10 mm, $W_к^с$=4 %; V=2,5 m/sec; d=10 g/kg dry pr.: 1 – carrot 70 ºC, 2 – soybean-carrot 70 ºC, 3 – soybean-carrot 100/70 ºC, 4 – soybean 70 ºC

For the study of phytoestrogenic raw materials, a combination of soy was selected – spinach treated with hygrothermically. Folic acid (vitamin B9) is widespread in nature, but its content in products is very small. Folic acid is easily destroyed by heat treatment at 100 ºC for 20 minutes. Its name (folium-sheet) – vitamin received because it was first found in spinach. The shelf life of spinach at a storage temperature of 0–1 ºC, relative humidity of 90–95% for only 2 days. To prolong the shelf life spinach must be preserved, one of the ways to preserve is drying. Before drying spinach, according to the literature data, it is necessary to soak [13]. Experimental studies were carried out on the drying of soy-spinach composition at temperatures of 60 ºC, 100 ºC and 100º/60 ºC. The combined analysis of the data showed that the drying process of the binary mixture takes place in the second period. As the evaporation zone deepens in the middle of the material, the temperature of its surface increases, and the rate of moisture decreases.

At the beginning of the process (Figure 3), The temperature of the heat-coolant is equal to 100 ºC. After 5–10 minutes the drying temperature of the heat-coolant is reduced to 60 ºC (curve 2 in Figure3). For comparison, the curves of drying soy-spinach mixture at 60 ºC (curve 1) are shown in Figure 4. The dried mixture according to the regimes (curves 1,2) has a green color, with the taste of the original raw material.

Heat - mass transfer in the process of drying of soy-vegetable composition

The use of a high-temperature carrier to intensify the process is limited by the specifics of the material being studied. Generalization of the curves of drying kinetics in a semi logarithmic coordinate system following the technique of Krasnikova V. allowed to determine the critical moisture content of binary mixtures. The first critical moisture content is 45–60, and the second 18–25% moisture content of the material and depends on the conditions of the experiment.

After the kinetics results, the moisture content is easily transferred to the calculation of the kinetics of heat exchange of binary mixtures in order to determine the optimum drying regimes. The method of graphical differentiation – curves t-W is used to calculate the temperature coefficient of drying, and the Rebinder number. In addition, dependencies are built. The nature of their variation by different drying regimes turned out to be similar (Figure 5).

When the critical moisture content is reached W=45–55%, the number Rb begins to increase, indicating that most of the heat is lost in heating the material, rather than evaporating moisture out of it. This circumstance proves the necessity of lowering the temperature of the coolant when the material reaches a critical moisture content W=45–60%. So, it makes no sense to maintain the heat of the heat-coolant at the last stage of the dehydration process. The processing of the experimental data has proved that the number of the Rebinder does not depend on the velocity and moisture content of the heat-coolant, but is determined only by the thermal regime of drying.

Nutrition powders with carotene

Drying was carried out to a final moisture content of 4% to obtain a powder. Powders can be used as semi-finished products in various industries of the food industry. On the basis of carotene-containing powders of soy-carrot and soy-spinach mixtures, you can produce the final product. To this end, the technology of obtaining a quick-cooking soup spinach soup has been developed. Dry carotene-containing mixtures of fast-food products have a number of features and benefits.

The process of dosing powder-like components is provided with high accuracy and allows you to create puree-like mixtures with different content of dry substances in products. Fast food products are of high biological value.

Due to its chemical composition, these compositions enhance the physiological functions of the body. They are recommended for medical and preventive and infant nutrition that enrich the diet with vitamins and trace elements, improve the functioning of the digestive system. Natural food fibers actively remove slags and toxins, restore microflora of the stomach and normalize its work.

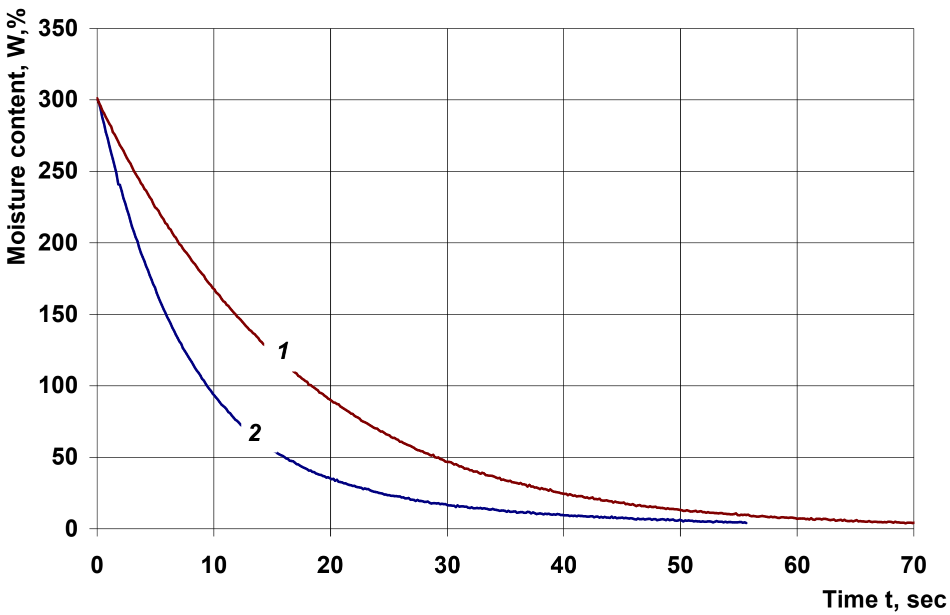

Figure 3. Curves of drying of soy-spinach mixture according to step-by-step regimes δ=10 mm, $W_к^c$=4 %; V=2,5 m/sec; d=10 g/kg dry pr.:
1 – soy-spinach 60 °C; 2 – soy-spinach 100/60 °C

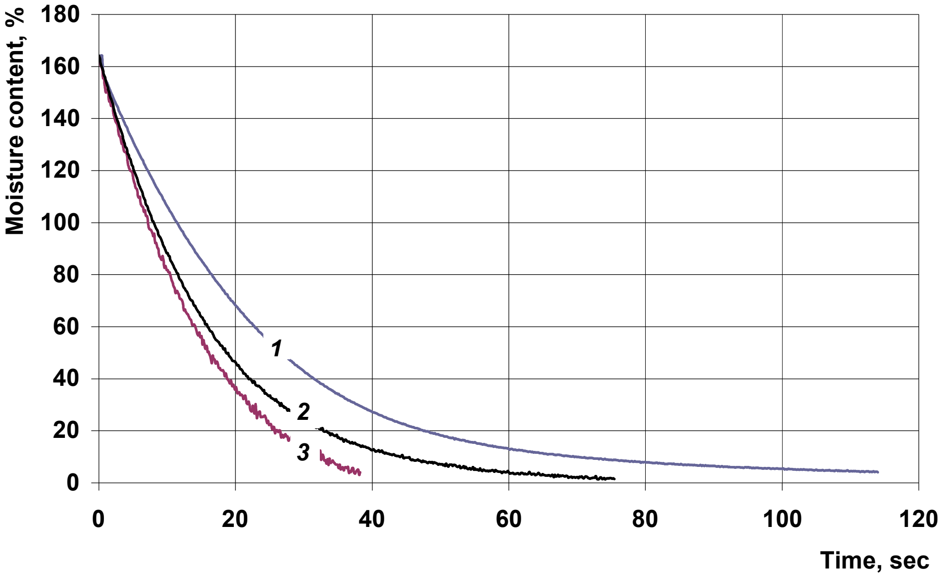

Figure 4. Effect of heat carrier temperature on soybean-spinach mixture drying process δ=10 mm, $W_к^c$=4%; V=2,5 m/sec; d=10 g/kg dry pr., t= 60 ºC:

1 – soy; 2 – soy-spinach; 3 – spinach

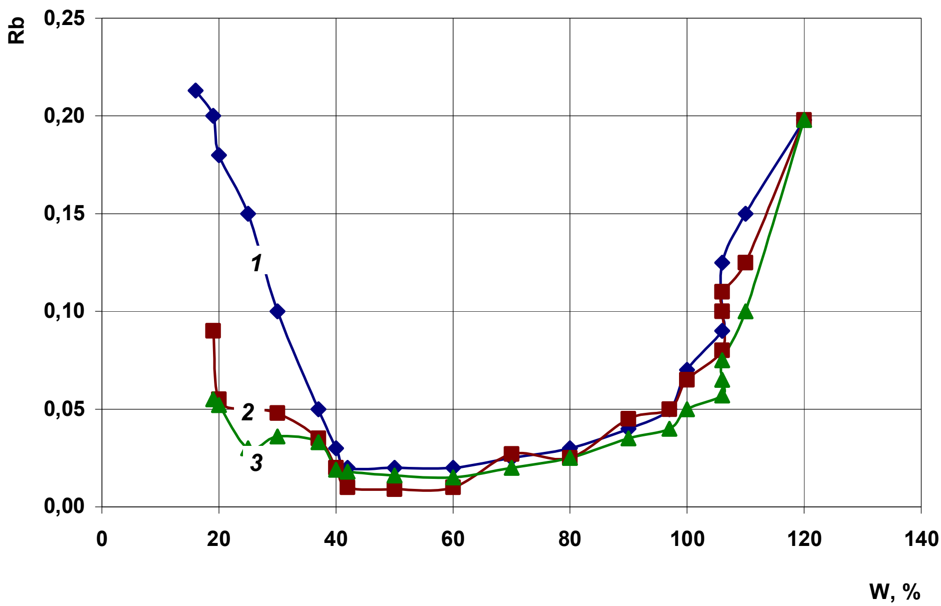

Figure 5. Change in the number of Rebinder in the process of dehydration of soybean-carrot mixture: V= 2 m/s; d=10 g/kg dry pr.; granule size 10 x 10 x 65 mm; soybean and carrot ratio 1:1; heat-coolant temperature t, °C:
1 – 120; 2 – 100; 3 – 80.

On the basis of the research conducted, a recipe for soya-pumpkin porridge of quick preparation, in which the soy-pumpkin powder is used, was developed. This allows you to remove dry milk from the formulation, enrich the product with vegetable proteins, increase the shelf life of the dry mixture (Table 1).

Table 1

The chemical composition of soy-pumpkin porridge

№	Indexes	Composition	
		%	mg, %
1	Total sugars	49,7	-
2	Pectin	1,8	-
3	Cellulose	8,2	-
4	Mineral substances	2,1	-
5	Organic acids	0,4	-
6	Protein	11,0	-
7	Fats	9,0	-
8	Starch	15,5	-
9	Nitrogenous substances	2,3	-
10	Carotenoids	-	2,8-3,5

Soy-pumpkin porridge enriched with sugar, starch contains all the components that are typical of raw pumpkin and soy. Soy protein effectively improves the total amount of food protein of the product, contains all vital essential amino acids: arginine, histidine, lysine, tryptophan, phenylalanine, methionine, threonine, leucine, isoleucine, valine. Soy-carotene concentrates have a high content of phosphatides – lecithin and cephalin.

The structure of mineral elements includes salts of potassium, phosphorus, magnesium, calcium, copper, iron, manganese, zinc, cobalt and nickel, vitamins A, B, B2, D, E, C, K. Soy-carotene products have high dietetic properties, have antihypo-toxic, hypocholesteromic and hypothermic activity, stimulate the human nervous system, are used in the treatment of diabetes and radiation sickness.

Conclusion

The carried out researches give the chance to draw a conclusion, that the optimum mode of drying should be the regime, after which the temperature of the material does not exceed 70–80 ºC. As the moisture content decreases, the Rebinder value (Rb) decreases, that is, the heat during drying is more expended on evaporation of moisture from the material than on its heating.

The necessity of lowering the coolant temperature at the final stage of the drying process is confirmed, this certainly positively affects the quality of the dried material.

The results of the conducted studies have developed step-by-step regimes for drying the soybean-carrot and soybean-spinace mixture, in which the temperature of the heat-coolant changes during drying, which reduces the energy costs of drying, shortens the drying time and, as a result, preserves the quality of the mix composition, with high long-term storage properties. Also, for the proposed step-by-step regimes, a technology for producing soya-spinach soup with bistro preparations was developed.

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Level assessment of good practice in food industry of Ukraine

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Abstract

Introduction. The business practices of corporate food industry enterprises of Ukraine are examined in order to assess accordance to the requirements of EU corporate social responsibility.

Materials and methods. The subject of study is business practices oligopolistic companies oil and fat industry of Ukraine. For the purpose of the study was the approach, built on the method of individual interviews and questionnaires trainees postgraduate education of the industry, the association of experts, scientists and leading experts of the industry. Total surveyed 33 companies participated, of which 9 or 25% belong to the oil and fat industry.

Results. The lawmakers admit the differences between the practice and standards at all stages of market economy. A lot of scientists consider oligopolistic market to be very closed and difficult for getting reliable information by the system. The system of clannish interests still does not allow to introduce real reforms. Having analyzed the existing and declared corporate practices of leading companies in the sphere of oil-fat production, we have noticed a tendency to ignore the guidelines of the European community while conscious and voluntary stick to corporate responsible behavior. The process of negative business practices is characterized by fluctuations: corruption and manipulation. It is noteworthy that observance of internal and international legislative directions is of more formal character.

Conclusion. The level of owner and management behavior in corporate environment may be defined as opportunistic and almost manipulative. That's why it is necessary to find reasonable balance between the requirements of business decisions, control over their orientation and social counterbalance and legal norms of EU.

Introduction

The market developed world has got two systems of influence on the components of internal and external society: financial and sociological market regulator with the USA and Europe as its samples correspondingly. The impact of oligopolistic form of the market was traditionally considered by the scientists from the point of view of ensuring the equal possibilities to compete. E. Chemberlin [1] and J. Robinson [2] have studied the fundamentals of the theories of imperfect competition. Modern researches consider the possibility of blocking the mechanisms of self-regulation of the market to be the main disadvantage of oligopolistic market [3]. The new approaches to the role of the social responsibility of business were analyzed in the researches of M. Porter and P. Druker [4] . Degree, aspects and areas of responsibility of business are often discussed in scientific publications.

The scientists consider the methods of corporate social responsibility to be the means of improvement of competitiveness of national economy [5] . The scientists pay attention in their researches to the necessity of development of relations between business partners. The social responsibility is studied at the level of enterprise and public policy, though there are the differences in interpretation. In recent years the most significant researches belong to Y.M. Pakhomov [6], M. Zveryakov [7], Kh.R. Gal'chak [8], I. Burakovskiy [9].

A concept "respectable business practice" was almost not investigated in national economic literature (the concept "ethics" is often substituted by the concept "etiquette") [10]. This term is used in jurisprudence as analogue of restrictive business practice in the course of competition regulation and development of antitrust laws [11, 12]. Meanwhile the current economic situation, national market development and lack of correspondence between business practice and requirements of developed markets induce business environment to formalize this area. Yes, The National Bank of Ukraine has prepared the project of The Behavior Code and business practice for participants of the interbank foreign exchange market of Ukraine [13].

Ukraine aims at European integration. That's why it is necessary to study the impact evaluation and social direction of corporate sector in the context of compliance of national practices with the requirements of the EU to the activity of corporate sector. A lot of EU-countries consider corporate social responsibility to be a part of main policies and principles of state administration, for example in Denmark, Finland, Sweden and France, and some countries rely on bona fide activity of the companies, for example in Slovenia, Greece, Ireland and the Netherlands.

Materials and methods

The subject of research is business practices oligopolistic companies oil and fat industry of Ukraine.

For the purpose of the study was the approach, built on the method of individual interviews and questionnaires trainees postgraduate education of the industry, the association of experts, scientists and leading experts of the industry [9].

Total surveyed 33 companies participated, of which 9 or 25% belong to the oil and fat industry.

Result and discussion

A lot of scientists consider oligopolistic market to be very closed and difficult for getting reliable information by the system. That's why quantitative and qualitative approaches were used for applied stage of analysis. The implementation of the conception of social responsibility requires the introduction into everyday activity of the company a wide range of the aspects of responsible management organization, observance of human rights during the activity of the company, improvement of socially responsible labor relations, management of fair operational activity, protection of environment, observance and development of the system of consumer rights protection, support of local communities development and cooperation with them.

To this purpose it was used the method of direct measuring with the use of IFC methodology into the corrected example [14].

Table 1

Total public effect of responsible activity (thousand, UAH)

Oligopolistic core	Social effect	Corporate effect	Public effect	Total
Enterprise "K"	67696,0	1011532,0	437525,9	437525,9
Enterprise "D"	23678,2	731562,0	49289,3	804529,5
Enterprise "V"	29462,1	607605,0	200534,0	837601,1
Total	120836,3	8934799,0	687349,2	3158884,5

Quantitative approach was based on the identification of market condition, its corporate structure, applied strategies, basic economic and productive descriptions of its participants taking into account the behavior features of oligopolistic core.

Table 2

Estimation of the effect from the responsible activity of oligopolistic core, %

Oligopolistic core	Social effect	Corporate effect	Public effect	Total
Enterprise "K"	4,5	66,7	28,8	48,0
Enterprise "D"	2,9	90,9	6,1	25,5
Enterprise "V"	3,5	72,5	23,9	26,5
Total	3,8	74,4	21,8	100

The use of quantitative estimations does not allow understanding the level of impact and responsibility concerning company assets and its load on the use of society resources: the top priority task of OECD and European commission consists in harmonization of surveys in non-European countries. Some another approach was applied for the purposes of this research: the method of individual interviews and questionnaires of visitors of postgraduate courses for employees, experts of corresponding association, scientists and leading specialists of this industry.

Relative comparison proves that the effect of the activity is mainly concentrated in corporate sector, and the social effect is quite insignificant.

Table 3

Internal policies and business practices of oil-fat companies

Companies	Area of business practices	Compliance with the EU principles, points
Enterprise "K"	Tendency to implement and support fair business practice	12
	To introduce positive practices into the activity of new companies. To bring general and short-term strategies up to the standard of farm enterprises and procurement departments. There is a special training "smart farm" for this purpose. It helps to prepare raw materials independently.	
	To publish information about insider agreements, assigned auditor, incentive system, list of shareholders with more than 5% of total amount of votes, dividend charge and changes of share prices, periodicity of meetings, trade rules.	
	To publish financial report, GRI–requirements are not implemented.	
	There is no information about joint enterprises on the web-sites.	
Enterprise "D"	The code of conduct includes ethics and responsibility: reputation based on observance of legality, fair and ethic competition, anticorruption behavior, true accounting, fulfillment of obligations, prevention of conflict of interests, financial information is distinguished by the kinds of activity (including the credit rating for the last 5 years), information about business practices is characterized by trade and industrial features.	10
	Cooperation: scientific assistance to the partners and professional assessment, cooperation with the partners, that adhere to the CRS-requirements.	
	The report is not presented.	
	The policy of the company enterprises is not itemized.	
Enterprise "V"	There is no business policy of the company on the web-site, but there is a financial report. The policy of the company enterprises is not itemized and it is not structured in accordance with the types of company activity.	8
	There is 1 web-site of the company for advertising purposes.	

The first empirical research of business responsibility degree was carried out in 2002 by the Charity fund "Intellectual prospects" on the request of UNICEF in Ukraine. The next survey was conducted by the Consortium for Enhancement of Ukrainian Management

Education and by the Center of Innovations and Development in 2004. In 2006 the corporate social responsibility (CSR) was studied by the Carpathian foundation for the study of stimuli and obstacles during the introduction of the social responsibility of business (SRB). In 2010 OECD and UNO assisted in assessment of the social responsibility of business in order to create a platform for the dialogue between business and government. In 2013 The Institute of Industrial Economics of NAS of Ukraine has revealed the results of the expert survey among the scientific specialists and teachers of Ukraine on the problems of social responsibility of individuals, society, business and state. The Center for the development of CSR in Kyiv plays a significant role in spreading of CSR. And, finally, in 2014 the National University of Food Technologies started the cycle of researches for the estimation of the state, typical problems and monitoring of corporate social and public responsibility degree in food industry.

Having analyzed the existing and declared corporate practices of leading companies in the sphere of oil-fat production, we have noticed a tendency to ignore the guidelines of the European community while conscious and voluntary stick to corporate responsible behavior. The fulfillment of this requirement mostly remains stagnated and is more cosmetic tool that makes internal processes better.

Table 4

Assessment of negative business practices (corruption) in the sphere of oil-fat production, %

Index	Bribe or corruption is necessary		Hope on judicial or state protection	
	2013	2014	2013	2014
Company self-rating				
Companies within oligopolistic core	63	75	37	29
Large-scale enterprises	56	65	33	20
Medium-sized enterprises	60	60	23	15
Small enterprises	59	58	10	15
Expert review				
Corporate sector	70	80	18	10

*Composed by the author. Based on the results of expert reviews and interview answers

The process of negative business practices is characterized by fluctuations: corruption and manipulation. This is because of the first years of market economy in the country, when the first business processes were defined by speculative and corrigible relations of internal and external character. They were promoted during tax optimization by the leading international advisory organizations.

Pooling of state and business interests may lead to propagation of anticompetitive practices and its application by powerful market participants. The period of fast establishment of effective owner and the period, when business wanted to become a part of international business market may be associated with the start of pooling of state and business interests.

Table 5

Anticompetitive practices (power pressure, raiding, management reserves, lobbying), %

Index	2006-2009	2010-2012	2013	2014
Companies within oligopolistic core	80	60	40	90
Large-scale enterprises	29	25	18	27
Medium-sized enterprises	10	-	-	12
Small enterprises	-	-	-	-
Expert review	27	19	19	32

*Composed by the author. Based on the results of expert reviews and interview answers

Table 6

Importance of informal relations between business and state, %

Index	2007-2009	2010-01.01.2014
Tax administration	51,7	30,7
Municipal authority	50,0	26,1
State authority (ministries, Verkhovna Rada of Ukraine)	49,3	24,0
Ministry of Internal Affairs	46,5	26,6
Local authorities	43,9	26,4
Total	57,0	31,7

*Composed by the author. Based on the results of individual interviews with boards of governors, management and experts

Table 7

Distribution of business expectations in accordance with the changes of business environment, %

Main business expectations	Percentage
Cease-fire	76
Productive lawmaking work of the Parliament in order to normalize business environment	41
Anti-corruption campaign	40
State run public authorities must make transparent decisions	26,3
Tax pressure minimization	24,4
Public purchases without protectionism	23,7
Improvement of public economic policy and administration	21,8
Judicial reform	20,0
Economic development as a priority for state development programs	17,0
Clear economic policy	9,6
Negative expectations	9,3

*Composed by the author. Based on the results of surveys and data [15]

The data of above mentioned table partly proves the previous opinion. That's why it is possible to say, that there are particular factors that help to maintain internal competitiveness of oligopolistic core within the sphere of oil-fat production. These factors are: to possess advantages in costs, to use extensively administrative resources, to use rent model for own benefit, to pool the interests of oligopolists and authorities. Further, it is shown that the main business expectations don't belong to the economic sphere.

It is noteworthy that observance of internal and international legislative directions is of more formal character. That's why it is possible to detect not only gap in law but also break in law. That's why the requirements of European society to introduce the reforms into this sphere are reasonable.

Table 8

Observance of national and international laws of corporate sector within the sphere of oil-fat production

Companies	Characteristic of social practices	Compliance with the EU principles, %
Enterprise "K"	The observance of all legal regulations, international standards, national laws and internal directives is announced	60
	Observance of international labor legislation	
	Jobs and production processes completely comply with the health protection and labor safety standards and requirements	
Enterprise "D"	Law-abiding business process, observance of the safety standards at foodstuff production and environmental protection	70
	Observance of international labor safety standards	
	No information	0

* Composed by the author. Based on the results of reviews

The interview results confirm the existence of great differences: companies under complete foreign control possess too formalized management. Certainly this fact reduces the risks but deteriorates efficiency and situational decision making. However management of Ukrainian companies faces the unformalized absence to permit decision making. Additional disputes between employers and among workers are caused by uncertain regulations.

Not only the conflict between shareholders (owners) and management and the conflict between the minority and majority of shareholders is not typical for the national corporate sector, but it is typical in the corporate practice in the USA and Europe correspondingly, but also conflict between institutional components: between all the interests of the society and consolidated interests of the corporate sector and state administration.

Table 9

Expert rating of management opportunism in the sphere of oil-fat production

Companies	Oligopolistic	Large-scale	Medium-sized	Small
Closed sale of shares	-	partly	mainly	-
Legal procedure due to breach of the contract	partly	partly	partly	-
Malpractice regarding clients	partly	partly	mainly	partly
Breach of the strategy	partly	partly	mainly	-
Conflict situations among the employees	partly	mainly	mainly	-
Non-transparent management	partly	yes	yes	yes

* Composed by the author. Based on the results of personal interviews with management and experts

The index of revealed information about business agreements was suggested by the owner and manager in order to rate their manipulative and opportunistic behavior.

The above mentioned index consists of five components. These components were modified and adapted to the national business terms by the author. As a result the rating scale was suggested in order to rate manipulative and opportunistic behavior of the owner and/or manager of corporate enterprise of food industry.

Table 10

Manipulative and opportunistic behavior of the owner of oligopolistic core within the sphere of oil-fat production, (points)

Index	Oligopolistic core		
	Enterprise "K"	Enterprise "D"	Enterprise "V"
The presence of corporate body, that licenses the agreements of property assets sale, withdrawal of the assets from circulation, restructuring and merging	2	2	1
The necessity to reveal information to the society about agreements concluded by shareholders, regulating authority	1	1	1
The presence of request to publish information about agreements	1	1	1
The presence of request to inform the board of governors or supervisory board about conflict of interests	0	0	1
The necessity to involve external auditor in order to pre-inspect the agreement	0	0	0
Total	4	4	4
Compliance with the standards (10), %	40	40	40

*Composed by the author. Based on the results of interviews and expert reviews

The level of owner and management behavior in corporate environment may be defined as opportunistic and almost manipulative. That's why it is necessary to find reasonable balance between the requirements of business decisions, control over their orientation and social counterbalance and legal norms. For solving this problem it is necessary to determine the limits and forms of the responsibility of the participants of regulation process. The system of Codes is the means of implementation of this direction in Europe and in the world.

Conclusions

The lawmakers admit the differences between the practice and standards at all stages of market economy. The system of clannish interests still does not allow to introduce real reforms. The lack of correspondence between economic policy, directions of regulatory influences and real requirements of national business environment and requirements of developed continental markets endangers European integration way of the nation.

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Gastronomy tourism potential of Sinop (Turkey) destination

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Abstract

Introduction. The investigation of traditional food heritage of Sinop and reuse of it as a touristic product in tourism market is aimed in this article.

Materials and methods. In this study, the kitchen literatures related to Sinop and personal experiences from people living in the region had been complied. Made an inference about the current and future gastronomy tourism situation of Sinop by the identifying with oral interviews technique.

Results and discussion. Tourism is a multi-dimensional phenomenon, interested in all natural and cultural entities and cases. In this context, nourishment as very important components of tourism sector besides some of the tourists travel due to gastronomic experiences. Sinop province is little-known as gastronomic tourism in Turkey. Sinop City is on the Peninsula of the northern part of the province. The city derived from Iron Age and colonized by Miletus in 8th century before as a part of Greek Culture.

Sinop has been a little and undevelopment fishing town during the republic period. That's why, the town wasn't impressed by the effects of industrialization. Besides the natural beauty of Sinop it is also reflected in the kitchen with the accumulation of the effects of different civilization. In Sinop cuisine mainly fish dishes is located in the kitchen culture due to the Sinop is peninsula, are also incorporates many flavors previously mentioned. It is being referred to the touristic point of the sea and the natural beauty of Sinop, unable to so much prominence local cuisine. With the caught season staring in 15 September, tourists from near the city of Sinop to eat fish are the most important element of gastronomic tourism. Traditional foods are important part of cultural heritage of Sinop province, however, today their presentation / announcements are not done sufficiently.

Conclusion. It can be suggested to destination planners to use local cuisines as a part of tourism marketing. Particularly with the growing tourism potential of Sinop region, introduction of regional cuisine and related activities should be accelerated.

Introduction

The whole tourism activities require any kind of attractiveness in destinations. To have more attractiveness is the first necessity to gain more tourist for all touristic destinations. Tourists are interested in different spaces and activities. But all tourists who travels for anything, need food and beverage in every destination in every time and case. That's why offering food and beverage is very important part of tourism sector. Moreover, cuisines of touristic destinations can be attractiveness for some tourists by itself. If the visiting case of except cuisines, tourist mostly taste native foods and beverages. So, cuisines of destinations are interested in all tourists.

Before as the authors stated [1], people are increasingly interested in exploring local cuisines or tasting famous chefs' meals, unique destinations with different destinations and local cuisine. . While the concept of travel for food has gained a new meaning with the beginning of the spice trade, voyagers still carry with dried vegetables for their diets [1]. In tourism industry of Turkey food and beverage form the largest portion of revenues. Food and beverage spending is more than hospitality and the share of total income is between 20-25 percent. A total of incoming of Turkey from tourism industry at 2004 was about 17 billion dollars which 3.1 billion of them was related to food and beverage. After 11 years this amounts have been doubled. In other words, total revenue reached to 34.3 billion which 6 billion 523 million dollar of them are for food and beverage. By the end of 2014, the expenditure done by tourists for food are 19-20 percent of total expenditure. This indicates that 1/5 of incomings from tourism are concern to eating and drinking. According to the survey done by TUIK [2] in Turkey in 2014, 157 dollar in average was spent on food and beverage by each tourist [2].

According to the report of TURSAB Gastronomic Tourism [3]; *"88.2 percent of tourists in the world says that "the food is a very important factor when they choose destination. Food related events make the major part of gastronomic tourism activities. About 80 percent of the world companies operating in this field, usually state their food products for food events. In the United States 17.879 people are working in various tourism community such as restaurant, cooking schools, travel agencies, hotels and other related fields. In this ranking system Turkey with 94 various communities stands in 23rd place".* Tourism depends on two main bases. They contain all kinds of touristic attractiveness. They are natural and cultural issues. Food and beverage concepts are the extension both of them. Disperse of the traditional foods in the world is mostly related geographical factors [4]. Those factors derived nature also cultural structure derives nature. But cultural issues are also related with interactions of another cultures. Those kind of cultural transfers is also seen in nourishment. Immigrations effect the disperse of food and beverage in the space.

The nutritional needs within its physical needs are one of the essential requriements of tourism varieties all over the world. Ardabili et al. [5] reported as food impresses other aspects such as travel agencies' culinary program, final price of hotels, culture assimilation and many other components.

Moreever, diversity of traditional foods are very important component of culturel tourism. To supply of traditional cuisine to tourism market also ensure to sustain traditional foods. Otherwise, those kind of foods will not kept by next generations and be forgotten. It could be said another side of traditional foods in tourism for the side of producing them from the field. In this approach is related with agrotourism as a part of ecotourism. Ecotourism is not only a nature sensibility recreation model but know and keep natural and traditional process [6]. It also contains agricultural and basic homemade foods (Figure 1). It can be accepted first step of traditional foods using in tourism market. Process of producing traditional foods is not familiar to youth members of the modern societies. Some of them, mostly educated and sensible for the natural and cultural heritage is volunteer to participate that kind of activities as a tourist. Turkey can offer many alternatives for them. Those activities starts from harvest on fields or wine yards to participate all process of producing foods and the eat them. Tourism market in Turkey is not good enough in this compartment.

For the foods; “traditional” means proven usage on the Community market for a time period showing transmission between generations; this time period should be the one generally ascribed to one human generation, at least 25 years [7]. In 2007, European Commission [8] gave the following definition of “traditional foods”: traditional food is food with a specific feature or features that distinguishes it clearly from other similar foods in terms of the use of “traditional ingredients”, “traditional composition” and “traditional type of production and/or processing methods”.

To participate the ecotourist to production of homemade traditional foods in rural settlements and farms is one side of using of traditional foods in tourism. The other side is using them in touristic kitchens.

Industrialization radically changed to preparation of foods [9]. Traditional foods are against to negative results of modern nourishment. All cultural components are become global by modernism. One of the result of this globalization is lacking of traditional foods. To use them in tourism results to be known in the future.

Another importance using traditional agricultural production, homemade food production and offer traditional foods in touristic management are creating economic value both tourism sector and traditional producers. According to Demirer [10], consumptors can pay more 18 percent for regional agricultural productions. Traditional agricultural and food production is mostly sustained for local agricultural, villages, hunters, cook etc. To use traditional productions in tourism sector is developed those people of rural societies. This part of the society is mostly poorer the other part of the society. To use their product is both sustain traditional cultural components and keep them in their homeland. So it is the barrier of immigration which causes social disasters. Among the reasons why European consumers prefer traditional foods are chosen weight control, convenience, familiarity, healthiness and natural content [11].

Methodology

In this study, the kitchen studies related to Sinop and personal experiences from people living in the region had been complied. The scope is to discuss the role of traditional food and beverage in Sinop, Turkey. The following research questions were adopted from Okech [12] and used for this reason.

Sinop province is little-known as gastronomic tourism in Turkey. The purpose of this research, to make an inference about the current and future gastronomy tourism situation of Sinop by the identifying with oral interviews technique. In according with the basic purpose, it will try to reveal the status of gastronomic tourism in the province.

Research questions

- What are the touristic supply of traditional foods in Sinop?
- Why is culinary tourism important for Sinop?
- What is the role of gastronomy tourism in Sinop cultural heritage and on economy?

Study area

Sinop is one of the small provinces in Turkey. It is on the northern part of Turkey. Northern board of the province is nearly 175 km coast next to Black Sea. Kastamonu Province is the western, Çankırı Province is the southern and Samsun Province is the eastern and southeastern neighbors of Sinop Province. The area of the province is 5862 kilometer square, 0.8 percent of Turkey [13]. The topography of the province is mostly rough, nearly 75 percent consist of mountains [14]. The Northern Anatolia mountain line which is on the west-east direction divides the province not only physical but cultural conditions. The northern part of the mountain range is by the effect of sea, both climatic, floristic and cultural structure. The southern part of the mountain range has terresterial landscapes and culture. There is no big river in the province. The important river of the province is Gökırmak, which is the branch of the longest river of Turkey, Kızılırmak. Ayancık Stream, Karasu Stream and Kabalı Stream are some important rivers of the province.

The province has loosen population due to employment problems. The population of the province is 204.133 in 2015 [2]. This population has ethnic diversity which influences the kitchen diversity of the province. The center of the province is Sinop city, also the biggest city in the province. Sinop City is on the Peninsula of the northern part of the province. The city derived from Iron Age and colonized by Miletus in 8th century before as a part of Greek Culture. Miletus rebuilt the castle and Sinop became an important harbor city. The importance of the city comes it has two harbors one is on the north the other is on the south. All coasts of the northern part or Turkey sees the north. But Sinop is the only one city in Black Sea coast of Turkey sees to south. Also Sinop is the only one natural harbor on Black Sea costs of Turkey [16].

Turkish army first conquered Sinop in eleventh century. Seljukian Turks had the town again in 1214 and they built the first Turkish shipyard of Seljukian State in Anatolia. Sinop had become an important shipyard center of Turkish navy in Seljukian and Ottoman Period. Sinop also had been an important harbor town until Russian attack from the sea. Russian navy bombed fired the town in 1853. After the Crimean war that happened in 1853-56, Paris Convention signed in 1856. Sinop military shipyard was closed according to convention. It collapsed the economy of Sinop.

Russia exiled Muslim Caucasian people in the second half of nineteenth century. Most of the Muslim Caucasian people immigrated to Ottoman also Sinop. They brought their cultures. That’s why, Caucasian cuisine is very common in Sinop. Sinop has been a little and undevelopment fishing town during the republic period. That’s why, the town wasn’t impressed by the effects of industrialization.

Results and discussion

Potential of Touristic Supply of Traditional Foods in Sinop

Sinop kitchen has a great diversity due to diversity of both natural conditions and cultural structure. Long coasts, abundant plains, wetlands, plateaus, forests, orchards etc. are the one source of this diversity. Sinop province has both coastal ecosystems, mountain ecosystems and terrestrial ecosystems. This diversity ensures to product different agricultural yields. Sinop is also a developed fishing center. Sea foods are another richness of the province. Plant and animal diversity gives many materials for kitchen. Those material richness was supported by cultural diversity. Lots of immigrants have been come from the other coastal cities of Northern Anatolia, Caucassia and Crimea. Native Sinopians, other Black Sea people of Northern Anatolia, different Caucassian nations and Crimeans mixed in coastal Sinop. They all added their traditional foods to Sinop kitchen. On the other hand, on the southern part of the mountains culture is different from the coastal culture. This terrestrial culture in inner part of Sinop had created own kitchen which give richness to Sinop kitchen. Both natural and cultural diversity has shaped Sinop kitchen.

Turkey is a peninsula with its three sides surrounded by the sea. People who are living in the north part of this country mostly occupy fishing to livelihood. By starting the fishing season in 15th September, number of domestic tourists and subsequently fish consumption shows an increase. One of the most important food served in provinces' restaurants for domestic or foreign tourists is "Manti" which natives call it "Kulak Hamuru" (Figure 1a). Sinop's Nokul (Figure 1b) presented with minced meat, potatoes, walnuts, walnut/raisin and spinach is another production of this region that attract the attention of tourists. Sinop salted fish (Figure 1c), Sinop chestnuts, Sinop solid sour apple molasses (Figure 1d), corn Keshkek, fresh/dried wild mushroom species (Figure 1 e, f), are among delicacies purchased by native and foreign tourists. Dried/frozen "Kulak hamuru" are available in the stated restaurants, various types of "nokul" are sold in confectionaries and mobile vendors, fishmongers sell different types of salted fishes in plastic jars, also Sinop chestnuts, don molasses, corn Keshkek, fresh/dried wild mushroom species are available in the village markets.

Seafood consist important part of Sinop kitchen. Black Sea has a great fish diversity. These fishes and other seafood has used to food since ancient era. Turan et al. [17] and Kocatepe and Turan [17] searched some of them. Bonito, anchovy, whiting, horse-mackerel etc. are some important fishes of Sinop. Sinop is covered on three sides, and the livelihood source of majority of Sinop people is fishing. It is said that the most and the best fresh seafood consumed in Sinop. It is inevitable that, the diversity of fish dishes are more in the city earn their live hood from the sea [19]. The usage of fish and especially anchovy are quite a lot in season and out of season in Sinop kitchen. They were cooked in different styles. Anchovy is the most known and consumed fish in Black Sea coast of Turkey. In Turkish black sea culture, anchovy is not a fish, just an anchovy. Sinop is the most important center of anchovy fishing in Turkey. Turkish people on Black Sea coast have been using anchovy in every kind of food as fries, grilled, pickled, with vegetable, with rice etc. Anchovy rice is very preferred food for Black Sea Coast in anchovy season. But it is nearly impossible to find this unique taste in touristic management (Figure 2).

Figure 1. ***a*** **– Kulak Hamuru;** ***b*** **– Nokul,** ***c*** **– Salted bonito;** ***d*** **– Apple Molasses;**
e **–Dried mushroom (*****Boletus edulis*****) fried mushroom (*****Boletus edulis*****)**
(Photos: D. Kocatepe).

Figure 2. Anchovy rice (Photos: A. Tırıl).

Why is culinary tourism important for Sinop?

Nowadays, many countries develop their interests and plans to gastronomic tourism. Protection of cultural properties in the ever-evolving world is of great importance for nations. Eating habits are gradually changing with globalization and are going to be unhealthy, for instance, rapid consumption patterns are increasing. All the generations are affected by rapid consumption culture brought by fast food. Being host for many civilizations, Sinop is a city that inspired with different cultures in its cuisine. Traditional delicacies made by native people during centuries though lost its value by passing the days, rural areas and restaurants with local cuisine maintain its vitality. Uncovering these almost forgotten values will be positive for both natives and visitors. Thus, as well as many other countries some programs such as competitions, festivals, etc. can be arranged in this region to introduce the local tastes.

For example, in Taiwan in 2010 the Council for Economic Planning and Development launched the "Gourmet Taiwan International Action Program"- an Action Plan for the internationalization of Taiwanese cuisine. The objectives of this program were to boost the global competitiveness of Taiwanese restaurant industry, to flourish the Taiwan tourism and ultimately to increase the tourism destination attraction [20]. The world famous International Gourmet Festival in Portugal in 2013, 10th Malaysia International Gourmet

Festival in 2010 were organized. These festivals, celebrations or contests are spectacular, so, gastronomic tourists increase in these dates. To be host for different gastronomic delicacies beside to natural and cultural beauties of Sinop province, cause to increasing its attractiveness for tourists.

It's possible to eat fresh Black Sea fishes in one of ship-restaurants at the seaside, tirit or kulak hamuru in historical madrasa (theological school) and also it's common to enjoy smell of Sinop nokul in tea gardens of Sinop. Sinop local delicacies are sold from these businesses provide the livelihood for many families. To increase the stability of both the local flavor in mind as well as cultural heritage stands out.

Traditional foods are important part of cultural heritage of Sinop province, however, today their presentation / announcements are not done sufficiently. Additionally, the number of brochures, books and publications concern to traditional foods and meals of Sinop is quite low. Among these studies are Karataş et al. [21], Turan et al. [17-19], Kocatepe and Turan [22, 23].

What is the role of gastronomy tourism in Sinop cultural heritage and on economy?

There are many tourists who travel for reasons of seeking culinary experience. Tourism activity related to food has been labeled such as food tourism, gourmet tourism, cuisine tourism, culinary tourism, or gastronomy tourism. This distinction between food tourism and food as a part of the travel experience is evident in research that has classified tourists based on the importance of food in the overall trip decision making process [24, 25]. Many researchers revealed that tourists spend almost 40 percent or one-third of their budget on food when travelling [26, 27]

Hall and Mitchell [28] defined food tourism as, "*visitation to primary and secondary food producers, food festivals, restaurants and specific locations for which food and tasting and/or experiencing the attributes of a specialist food production region are the primary motivating factors for travel*".

Food is one of our basic needs, so it is not surprising that it is also one of the most widespread markets of identity. Given the strong relationship between food and identity, we understand why food came become an important marketing tool in tourism promotion and gastronomy tourism, specifically, an effective tool for regional development. One of the basic reasons for this phenomenon is the strong relationship between certain localities and special types of food. Food can also be used as a mean for guiding tourists around regions or countries. The close association of gastronomy to local, regional and national identity is apparently threatened by the process of globalization. However, lately it is believed recently by many that "Local has become a treasure": Especially in rural destinations, we can seek for comparative and competitive advantages in their diversified gastronomy traditions [29].

Besides the natural beauty of Sinop it is also reflected in the kitchen with the accumulation of the effects of different civilization. In Sinop cuisine mainly fish dishes is located in the kitchen culture due to the Sinop peninsula, are also incorporates many flavors previously mentioned. It is being referred to the touristic point of the sea and the natural beauty of Sinop, unable to so much prominence local cuisine. With the caught season staring in 15 September, tourists from near the city of Sinop to eat fish are the most important element of gastronomic tourism.

Fresh seafood in beach resorts, traditional cookery, the famous restaurants in expensive hotels, on the cruise liners or in the major commercial centers all and all are built for this purpose. In fact, all the countries and even cities expand their unique culinary attractions to engage more travelers. Food Tourists, compared to other tourist groups, have been the most faithful group to destination. In their decision making for selecting the destination of travel, local meals perform a crucial role [25].

Sinop is the "happiest city" in Turkey according to the TUIK report about "Turkey 2013, Provincial-level life satisfaction". It is also the second province in the same year was the highest satisfaction by rendering public security services [13]. These factors make it attractive for Sinop tourism.

Conclusion

In this paper, local kitchens and traditional foods were evaluated by tourism sector in Sinop case. It is necessity both to sustain traditional cultures and to increase market rate of tourism. Tourism professionals have to work on this concept more. One of the main and important way of developing tourism market is creating attractiveness which are new and interested in more people in the market. Food and beverage are not only interested in tourists but all people. Due to they are the most important part of main life activities of all people, also a pleasure and desiring elements of most of the tourists. So, as gastronomy tourism is the specific one in tourism species, and it is the component of all tourism species and activities. This reality is an important argument to destination which have extra ordinary cuisine. It was suggested to destination planners to use local cuisines as a part of tourism marketing. Particularly with the growing tourism potential of Sinop region, introduction of regional cuisine and related activities should be accelerated. For this purpose, local product promotion fairs, workshops, competitions, etc. should be organized with special supports. It will be ensure both developing tourism and conserving local cultures and tastes.

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Анотації

Харчові технології

Залежність показників безпечності та якості м'яса птиці механічно відокремленого,від виду сировини і її температури при здійсненні сепарування

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Вступ. Проведені дослідження з метою визначення впливу технологічних факторів і основних властивостей різних видів сировини на визначальні показники якості та харчової безпечності м'яса птиці механічно відокремленого.

Матеріали і методи. Використовували м'ясо птиці механічно відокремлене: тушки курчат-бройлерів і курей, шиї курей і спинки тушок курчат-бройлерів. Температура сировини – від мінус 4 °С до 6 °С. Дослідження проводили на прес-сепараторі «Lima» шнекового типу та на прес-сепараторі «Baader» стрічкового типу.

Результати і обговорення. Кожному з досліджених видів сировини відповідає певний діапазон найбільш прийнятних значень температури, за яких вдається отримати м'ясо птиці механічно відокремлене з безпечною кількістю кісткових включень за достатньо високого виходу готового продукту. Так, для жорсткого відокремлення на шнекових сепараторах таким діапазоном температури, практично для всіх представлених видів сировини є діапазон від 0 °С до 2 °С. Зниження вмісту кісткових включень прослідковується, починаючи з температурної межі мінус 2 °С. Дещо нижчий вихід продукту компенсується якістю одержаної маси – низьким вмістом у ній кісткових включень. Для шиї курчат-бройлерів і курей найбільш прийнятним є діапазон від 4 °С до 6°С. Аналогічна залежність простежується для м'якого відокремлення на стрічкових сепараторах. Відомо, що для сепараторів останнього типу, зазвичай, підморожена сировина не застосовується – переважно через швидкий знос притискувальної стрічки сепарувального вузла та меншого, порівняно зі шнековими сепарувальними пристроями, тиску, який діє на сировину. Підморожену сировину за температури мінус 2 °С, у випадку використання її для виробництва на стрічкових сепараторах, попередньо подрібнюють на вовчках з крупною решіткою.

Сепаруванню у м'якому режимі притаманний менший (в середньому на 9–10 %), порівняно із сепаруванням у жорсткому режимі, вихід м'яса птиці механічно відокремленого, проте м'якому режимові відповідає менший майже на 40 % середній відсоток масової частки кісткових включень. Найбільш прийнятний, з технологічної та безпекової точки зору, діапазон температури сировини – від 2 °С до 6 °С. Використання сировини з температурою нижче мінус 2 °С не є доцільним. Особливо зазначене стосується шиї курей, оскільки для цього виду сировини зі зменшенням температури різко збільшується кількість кісткових включень у готовому продукті.

Висновки. Дослідження дають змогу отримати м'ясо птиці механічно відокремлене з мінімальним вмістом кісткових включень за високих значень виходу готового продукту.

Ключові слова: *температура, кістка, м'ясо, птиця.*

Отримання та дослідження впливу ліпосомного розчину екстракту фолікулярних яєць курячих на якість хлібних виробів

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Вступ. Досліджено процес бродіння дріжджових клітин у ліпосомному розчині ліпідного спиртового екстракту з вмістом чистого фосфатидилхоліну (ФХ) та суміші фосфатидилєтаноламіну і фосфатидилхоліну (ФЕ+ФХ).

Матеріали і методи. Застосовували методи мікробіологічних досліджень та пробне лабораторне випікання хліба. При проведенні мікробіологічного експерименту використовували: поживне середовище, дріжджі Saccharomizces cerevisiae, дріжджову суспензію чистої культури, ліпосомні розчини. Для дослідження впливу ліпосомних екстрактів на якість хліба проводили його випікання.

Результати і обговорення. Під час проведення мікробіологічних дослідів на 36 години був зафіксований найбільш ефективний процес бродіння у ліпосомній рідині з вмістом чистого фосфатидилхоліну та суміші фосфатидилхоліну та фосфатидилєтаноламіну з вмістом фосфоліпідів у кількості 3,24 гр. У зразках, які містили менш 2 гр фосфоліпідів у ліпосомних розчинах, процес бродіння гальмувався. При кількості фосфоліпідів менше 0,1 гр у ліпосомних розчинах процес бродіння не починався. Оскільки приготування ліпідної рідини з сумішшю ФХ та ФЕ має технологічні й економічні переваги порівняно з отриманням рідини з вмістом чистого ФХ, то для випікання хлібобулочних зразків використовували ліпідні екстракти фолікулярних яєць курей з сумішшю ФХ і ФЕ. Ліпосомний екстракт вводили у кількості 2,5 мл, 5, 10, 15, 20, 30 мл. Отримані зразки хліба після остигання через 24 години аналізували за встановленими методологічними показниками: питомий об'єм, формостійкість подового хліба Н/D, органолептичні оцінки якості хліба, показник кислотності.

Висновки. При випіканні хліба з використанням ліпосомних розчинів ліпідного спиртового екстракту були отримані зразки з високими споживчими властивостями, які повністю відповідають стандартам якості.

Ключові слова: фосфатидилетаноламін, фосфатидилхолін, дріжджі, хліб, яйце.

Аспекти мокрого очищення вовни

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Вступ. Актуальною проблемою первинної обробки вовни є ощадне використання водних і енергетичних ресурсів.

Матеріали і методи. У статті виконано оптимізацію параметрів замочування вовни за запланованим експериментом із використанням латинських квадратів. Визначили технологічні умови мокрого очищення вовни. Серед факторів, які вливають на очищення вовни під час замочування, досліджували гідромодуль (співвідношення вода : суха вовна), температуру, тривалість. Відгуком на зміну факторів обрали показник заломлення *n*, значення pH відпрацьованої води.

Результати і обговорення. На першому етапі визначали вплив гідромодуля у діапазоні 10–100, температури 20–50 °C і тривалості 5–25 хв. Для порівняння впливу досліджених факторів значення рівнів факторів нормалізували. З представлених рівнянь видно, що чим менший гідромодуль замочування, тим у воді більше екстрактивних речовин.

На другому етапі визначали вплив гідромодуля у діапазоні 10–90, температури 10–30 °C і тривалості 2–10 хв. Зі збільшенням співвідношення вода : вовна зменшується вміст екстрактивних речовин у відпрацьованій воді. Також виявлено прямопропорційну лінійну залежність вмісту екстрактивних речовин у відпрацьованій воді після замочування від температури. Чим вища температура, тим більше екстрактивних речовин вилучається з вовни у відпрацьовану воду.

Виконано ранжування факторів за їхнім впливом на процес замочування вовни. Найвпливовішим фактором на вилучення екстрактивних речовин є гідромодуль. Також впливовим фактором є температура. Раціональними умовами для вилучення гідрофільних екстрактивних речовин вовни є гідромодуль 60, температура 42 °C і тривалість 6 хв.

Висновок. Раціональним режимом для вилучення гідрофільних екстрактивних речовин вовни є гідромодуль 60, температура 42 °C і тривалість 6 хв.

Ключові слова: *вовна, замочування, екстракт, ранжування.*

Дослідження процесу екстрагування пряно-ароматичної сировини при виробництві гірких настоянок

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Вступ. Проведено дослідження з метою визначення впливу параметрів процесу екстрагування на вилучення цільових компонентів із пряно-ароматичної сировини задля його інтенсифікації та визначено здатність кардамону, імбиру та перцю червоного гіркого до накопичення іонів важких металів.

Матеріали і методи. Дослідження зміни вмісту вітаміну С та фенольних сполук в екстрактах проводилося титрометричним і спектрофотометричним методами. Визначення здатності накопичувати пряно-ароматичною сировиною іони важких металів здійснювалося за схемами комплексоутворення іонів важких металів з функціонально-активними угрупованнями.

Результати і обговорення. Оптимальні значення гідромодуля й тривалості процесу екстрагування склали, відповідно, для кардамону 14,5 та 83 хв; для імбиру – 13 та 70 хв; для перцю гіркого 17 та 92 хв при умові проведення процесу екстрагування водою як екстрагентом при температурі 40 °C задля збереження вітаміну С та постійному перемішуванні, що пояснюється хімічним складом пряно-ароматичної сировини.

Здатність до накопичення іонів металів Hg^{2+}, Pb^{2+} та Cd^{2+} для кардамону становить 94%, 66,52% та 72,57%, для імбиру – 92%, 38,84% та 35,16%, для перцю червоного гіркого – 94%, 24,11% та 20,19% відповідно. Високу здатність до накопичення важких металів проявляє кардамон, трохи нижчі імбир і перець червоний гіркий. Це пояснюється наявністю в їхньому складі значної кількості вуглеводів, вітамінів, амінокислот і пектинових речовин.

Висновки. Результати досліджень можна ефективно застосувати в лікеро-горілчаній промисловості для розроблення рецептур напоїв, які б характеризувалися високою біологічною цінністю, та технологічних чи апаратурно-технологічних схем.

Ключові слова: *екстрагування, гідромодуль, тривалість, кардамон, імбир, перець гіркий.*

Визначення факторного простору процесу шприцювання ковбасних виробів

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Вступ. Проведені аналітичні дослідження з метою наукового обґрунтування основних чинників і визначення факторного простору процесу шприцювання ковбасного фаршу.

Матеріали і методи. Методи дослідження: теоретичні – вивчення та узагальнення апріорної інформації щодо умов шприцювання ковбасних виробів; кваліметричні. Для об’єднання показників якості в узагальнений (комплексний) показник використано адитивну математичну модель як найбільш розповсюджену в кваліметрії.

Результати і обговорення. Одним із основних процесів формування ковбасних виробів, що гарантує отримання високоякісної продукції, є наповнення (шприцювання) оболонки ковбасним фаршем.

Встановлено основні чинники процесу шприцювання ковбасного фаршу: тиск шприцювання; температура фаршу; тиск вакуумування. Визначено, що величина тиску шприцювання залежить від виду оболонки, типу виробу, його складу, фізико-механічних і реологічних властивостей, яка складає 0,30–2,00 МПа. Температура фаршу впливає на стабільність емульсії, тому при шприцюванні в ковбасну оболонку повинна бути у діапазоні від +8 до +18 ºС. Вакуумування позитивно впливає на зменшення об'єму повітряних порожнеч; колір; текстуру; дозрівання продукту; терміни його зберігання; зниження окислювальних процесів у жирової тканині, бактеріальне обсіменіння; покращення реологічних характеристик продукту; вологоутримувальну здатність (ВУЗ); поліпшення щільності батона. Міра вакуумування для окремих видів фаршу індивідуальна та може складати до –0,09 МПа.

Розраховано коефіцієнти регресії та величину довірчого інтервалу Δb_i=0,004 (α=0,2; f=8). Перевірено коефіцієнти регресії на значущість з довірчим інтервалом: b_0=0,654>±0,004; b_1=0,041>±0,004; b_2=0,06>±0,004; b_3=-0,021>±0,004; b_{12}=-0,008>±0,004, b_{13}=0,006>±0,004, b_{23}=0,018>±0,004, b_{123}=-0,051>±0,004. Встановлено, що на комплексний показник якості статистично значущо впливають усі варійовані фактори.

Висновки. Проведено узагальнення літературних даних, що дає змогу визначити основні чинники в процесі шприцювання ковбасного фаршу, які залежать від виду оболонки, типу виробу, його складу, фізико-механічних і реологічних властивостей. Для збільшення комплексного показника якості необхідно збільшувати тиск продукту, що подається (x_1) до 2,25 МПа, граничний залишковий тиск (x_2) до - 0,8 МПа та зменшувати температуру фаршу (x_3) до 275 К.

Ключові слова: *шприцювання, тиск, температура, вакуумування, ковбасний фарш.*

Оптимізація рецептури зубної пасти шляхом введення карагінану

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Вступ. Досліджено фізико-хімічні властивості зубної пасти з доданням карагінану з метою оптимізації структури зубної пасти.

Матеріали і методи. Виготовили три зразки пасти з вмістом карагінану від 1% до маси до 3% до маси та зразок із доданням 1% до маси натрійкарбоксиметилцелюлози (NaКМЦ). Реологічні параметри зразків визначено за допомогою ротаційного віскозиметра. Органолептична оцінка якості зубних паст здійснена за допомогою дескрипторно-профільного методу.

Результати і обговорення. Запропоновано перелік органолептичних показників, а саме: консистенція, колір, запах, смак та введено 5-бальну шкалу оцінок. Проведено профілювання показників якості за цією шкалою. За консистенцію найбільш придатним для зубної пасти є зразок із вмістом карагінану 2% до маси, за кольором найвищу оцінку отримали зразки зубної пасти з 1% та 2% вмістом карагінану. Запах і смак задовільний для всіх зразків зубної пасти. Найкращу загальну оцінку за органолептичними показниками якості отримали зразки зубної пасти з вмістом NaКМЦ 1% і карагінану 2% та 3% до маси. Згідно з органолептичними показниками, найбільш доцільним є введення карагінану в кількості 2% до маси. За реологічними параметрами показники найбільшої в'язкості системи з практично не зруйнованою структурою (η_m=76,16 Па•с) та найменшої в'язкості системи з практично зруйнованою структурою (η_0= 86,37 Па•с) є оптимальними. При цьому завдяки доданому карагінану утворюється гелеподібна консистенція зубної пасти. Щодо розрахованих реологічних параметрів цього зразка пасти, що характеризують міцність структурних зв'язків ($P_{к1}/P_{к2}$=1,68) і діапазон напружень ($P_m/P_{к1}$=8,87), в яких відбувається руйнування структури, то вони також є задовільними.

Висновки. Отримана зубна паста з 2-відсотковим вмістом карагінану має гелеву структуру. Введення добавки оптимізує властивості компонентів зубної пасти та сприяє раціональному впливу на фізіологічні особливості ротової порожнини.

Ключові слова: *зубна паста, рецептура, карагінан, реологія, органолептика.*

Структурно-механічні властивості желе з йоштою

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Вступ. Досліджено використання йошти – нового виду ягідної пектиновмістної сировини з підвищеним вмістом біологічно-активних речовини, розроблено структуровані страви (желе) для профілактичного харчування.

Матеріали і методи. Використані такі матеріали: желе, ягоди сімейства агрусових – йошта. Проводився аналіз літератури з метою обґрунтування підбору структуроутворювачів у розробці желейних страв з сировиною Північного-чорноморського регіону – йоштою. Структурну міцність желе визначали методом пенетраці. Адгезійну міцність желейних мас визначали шляхом вимірювання питомої сили відриву пластини, яка характеризує поверхню форми, від желейної маси.

Результати і обговорення. Як драглеутворюючу сировину для виробництва желейних страв з підвищеною харчовою цінністю доцільно використовувати нову ягідну сировину Північного-чорноморського регіону – йошту. Ягоди йошти характеризуються високим вмістом біологічно-активних речовин, а також пектину (0,8–1,5 г на 100 г сирої речовини). Завдяки високому вмісту пектину йошта є перспективною сировиною для виготовлення структурованих солодких страв, зокрема желе.

При додаванні йошти в желе можна частково виключити з рецептури желатин без суттєвих змін реологічних характеристик продукту й отримати желе з необхідними структурними властивостями. Так, значення показників густини – 1,037 кг/м^3 та граничної напруги зсуву – $30 \cdot 10^3$ кПа зразків желе з йошти із 50% вмістом желатину від рецептурної кількості відповідають вимогам. Зниження масового вмісту желатину в желе з йошти до 50% рецептурної кількості дає змогу знизити в 1,2–1,3 раза адгезійну напругу порівняно з контрольними зразками. Встановлено, що найменша адгезійна міцність желейної маси спостерігається при її контакті із селіконовою поверхнею. Міцність взаємодії підвищується в 1,2 раза при використанні керамічної і в 1,6 раза – сталевої поверхні.

Висновки. Обґрунтована рецептурна композиція інгредієнтів структурованих страв з підвищеною харчовою цінністю для підприємств ресторанного господарства за рахунок використання нової пектиновміщуючої сировини – йошти.

Ключові слова: *йошта, желе, пектин, структура, адгезія.*

Вплив їстівного покриття на якість житнього і житньо-пшеничного хліба

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Вступ. Проведені дослідження впливу їстівного покриття на якість житнього і житньо-пшеничного хліба з метою збереження свіжості виробів і підвищення харчової цінності.

Матеріали і методи. Зразки покриття для хліба виготовлені з картопляного крохмалю, желатину, карбаміду, лляної олії та води. Утворену емульсію наносили на хліб шляхом глазурування. Контрольний зразок виробів зберігали в стрейч-плівці (житній) і в пакеті із синтетичних полімерних матеріалів (житньо-пшеничний). Дослідження зміни характеристик хліба було зроблено впродовж строку зберігання довше на 24 год. Досліджено органолептичні показники, кришкуватість, кількість води, що поглинає м’якушка, та структурно-механічні характеристики хлібної м’якушки.

Результати і обговорення. Покриття не впливає на форму виробів, вирівнює поверхню та робить її блискучою, надає жовтуватого відтінку, не впливає на смак, оскільки саме покриття має нейтральний смак, легко розжовується, запах також залишається без змін. Їстівне покриття є дієвим пакувальним матеріалом, оскільки вологість виробів зменшується повільно. Збереження вологості виробів в їстівному покритті можна пояснити показником паропроникності покриття, який становить 4,77 мг/(м·год·кПа). на одному рівні із синтетичними пакувальними матеріалами. Товщина покриття становить 0,540±0,005 мм. Товщина матеріалу, з якого виготовлені пакети для хлібних виробів, становить 0,030 мм. Здатність поглинати воду м'якушкою хліба, що зберігається в синтетичному матеріалі, дещо вища. Хліб, який зберігався в їстівному покритті, має таку ж крихкуватість, як і хліб, що зберігався в синтетичному пакуванні. Свіжість виробів у їстівному покритті при 48 год зберігання вища на 3% порівняно з виробами у синтетичному пакуванні, наприкінці зберігання (72 год) – більша на 2% у виробів у синтетичному пакуванні. Вміст вологи покриття становить 72 %, а після висихання та формування на поверхні хліба вологість покриття становить 5 %.

Висновки. Їстівне покриття є повноцінною екологічною заміною синтетичного пакування для житнього та житньо-пшеничного хліба.

Ключові слова: *хліб, покриття, пакування, зберігання.*

Комплексна оцінка якості гарячої солодкої страви суфле

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Вступ. Метою досліджень є оцінка якості інноваційної гарячої солодкої страви суфле з позиції фізіологічних потреб організму дитини дошкільного віку методами кваліметрії.

Матеріали і методи. Основу дослідження склали методи теоретичного узагальнення, наукової індукції та дедукції, методи системного, структурного, кваліметричного та математичного аналізу якості страви.

Результати. Враховуючи норми фізіологічної потреби дитини віком 4–6 років, розроблена інноваційна гаряча солодка страва суфле та надано її комплексну оцінку якості, яка показала переваги вдосконаленої рецептури над традиційною Удосконалена ієрархічна структура системи показників якості виробу, на основі якої створена шкала вузлових значень показників якості, що характеризують критичні точки даної страви.

Коефіцієнт вагомості (m) інноваційної гарячої солодкої страви суфле становить для: білків – 0,20; жирів – 0,40; вуглеводів – 0,40; натрію – 0,10; калію – 0,10; цинку – 0,40; кальцію – 0,10; заліза – 0,30; β-каротину – 0,20; тіаміну – 0,20; рибофлавіну – 0,20; піродоксину – 0,20; аскорбінової кислоти – 0,20.

Найбільше значення комплексного показника (K_0) становить для: жирів і вуглеводів – 0,4; цинку – 0,4; мінімальне значення – характерно для кальцію, калію, натрію.

Висновки. Встановлено переваги інноваційної гарячої солодкої страви суфле над прототипом методом кваліметричного та математичного аналізу якості. Доведено доцільність використання β-глюкану в рецептурі страви для підвищення харчової та зниження енергетичної цінності виробу.

Ключові слова: *страва, суфле, кваліметрія, якість.*

Удосконалення окремих функціональних властивостей пісочного печива з додаванням натуральних компонентів гарбуза і чіа

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Вступ. Проведено аналітичні та експериментальні дослідження з метою підвищення біологічної цінності пісочного печива «Гарбузинка» за рахунок додавання гарбузового пюре, гарбузової олії та насіння чіа для створення функціонального харчового продукту.

Матеріали і методи. Математичним моделюванням визначено оптимальний баланс гідролізованого гарбузового пюре до цукру-піску, гарбузового масла до вершкового масла та необхідну кількість насіння чіа. Масову частка цукрів визначено відповідно до методу AACC 10-52, вологості – 934,01 AOAC, жиру – AOAC 963,15. Тест на зольність проводився на основі методу 923,03 АОАК. Поглинання води – AOAC 960,14.

Результати і обговорення. Пісочне печиво з дозуванням гарбузового пюре (50%) і гарбузовою олією (20%) від первісної закладки сировини та насіння чіа у кількості 1,5% від закладки борошна пшеничного мало найкращі показники. Додавання гарбузового пюре в пісочне тісто вплинуло на структуру і консистенцію виробів. Після внесення пюре печиво мало більш виражений смак і аромат, золотистий колір, форма і поверхня стабілізувалися.

Використання гарбузового пюре призвело до зміни кольору виробів від світло-жовтого до світло-оранжевого, що пояснюється наявністю бета-каротину. Зменшення норми закладки цукру-піску призвело до зниження енергетичної цінності готової продукції з 467 до 402,5 ккал. Структура печива стає більш розсипчастою і тендітною, що було відзначено дегустаторами як позитивний ефект.

Органолептичні та фізико-хімічні показники (масова частка вологи – 13,2%, зола – 0,1%, масова частка цукрів 30%, масова частка жиру – 3,4%, водопоглинання – 157%) підтверджують, що вибрані добавки не змінюють основних характеристик печива.

Висновки. Використання суміші гарбузового пюре, гарбузової олії та насіння чіа у виробництві призвело до зниження енергетичної цінності готової продукції шляхом зменшення кількості цукру.

Ключові слова: *печиво, гарбуз, насіння чіа, біологічна цінність.*

Дослідження процесу замішування дріжджового тіста за різної частоти обертання місильної лопати

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Вступ. Досліджено питання замішування дріжджового тіста за змінної частоти обертання робочого органу та різної вологості тіста.

Матеріали і методи. Дослідження проводилися методом вимірювання потужності та інших параметрів замішування й реєстрації результатів у вигляді фаринограм. Замішування дріжджового тіста проходило протягом 20 хв за частоти обертання робочого органу від 20 до 140 обертів за хвилину та за різної вологості

тіста в межах від 40,3% до 44,3%. Дані отримували у вигляді кольорової фаринограми в режимі реального часу.

Результати і обговорення. Досліджено стадії замішування дріжджового тіста та вплив посиленої механічної обробки на дріжджове тісто. Встановлено, що зі збільшенням частоти обертання зменшується час, необхідний на перемішування компонентів, – за вологості тіста 44,3% при будь-якій швидкості обертання в діапазоні від 20 до 140 об/хв. За посиленої механічної обробки дріжджового тіста з частотою обертання робочих органів від 60 до 140 об/хв час, необхідний на заміс тіста за різної вологості, становить від 40 до 60 секунд. Час, необхідний на третю стадію – замішування (пластифікацію тіста), при вологості тіста 40,3–42,4% коливається в межах від 160 до 180 с за частоти обертання 60–80 обертів за хвилину.

Необхідна, дрібнозерниста та рівномірно розподілена пористість (кількість пор 4500–4800 штук) спостерігається при інтенсивному процесі замішування дріжджового тіста за частоти обертання робочого органу 60 обертів за хвилину. Найкращі показники пористості у готовому виробі такі: частота обертання –n=60 об/хв, вологість дріжджового тіста – Н=44,3%. За таких умов пористість готового виробу (Р=70%) досягає максимальних показників.

Висновки. Процес замішування дріжджового тіста слід проводити при відносно високих обертах робочого органу (60-80 об/хв.). Вологість у вказаних діапазонах(40,3-44,3%) не буде суттєво впливати на хід технологічного процесу, макромолекули клейковини під дією внутрішніх напружень, що виникають в тісті, частково руйнуються, але внаслідок внутрішньої перебудови структури знову відновлюються, і клейковина виходить еластичною.

Ключові слова: *замішування, дріжджі, тісто, обертання, вологість.*

Енергоефективні режими сушіння соєво-овочевих композицій

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Вступ. Проведені дослідження з метою визначення оптимальних режимів сушіння соєво-овочевих сумішей, що забезпечують найменшу тривалість сушіння та максимальне збереження біологічно активних речовин висушеного матеріалу.

Матеріали і методи. Досліджено колоїдні капілярно-пористі матеріали на основі сої, моркви, шпинату та соєво-морквяної і соєво-шпинатної сумішей. Для досліджень використано експериментальний стенд з автоматичними регуляторами температури, який є системою ізольованих провітропроводів з пристроями для тепловологої обробки та циркуляції теплоносія, сушильних камер, вимірювальних схем і приладів для контролю параметрів процесу та вимірювання значень, що характеризують процес сушіння.

Результати і обговорення. Досліджено кінетику процесу сушіння соєво-морквяної суміші при температурі теплоносія 70 ºС, 100 ºС з постійною швидкістю сушіння v=2,5 м/с, а також ступеневий режим 100/70 ºС з постійною швидкістю сушіння v=2,5 м/с. Процес сушіння бінарної суміші проходить у другому періоді. З поглибленням зони випаровування всередину матеріалу температура його поверхні підвищується, а швидкість вологовіддачі зменшується. Сушіння з температурою теплоносія 100 ºС призводить до недопустимої мелаїдинової реакції, в той час як ступеневий режим 100/70 ºС запобігає таким реакціям у зв'язку з тим, що матеріал не прогрівається вище 70 ºС протягом усього періоду сушіння.

Досліджено кінетику процесу сушіння соєво-шпинатної суміші при температурі теплоносія 60 ºС, а також ступеневий режим 100/60 ºС з постійними швидкостями сушіння v=2,5 м/с. У хімічному складі шпинату міститься фолієва кислота, що руйнується при термічній обробці продуктів при температурі 100 ºС протягом 20 хвилин. При сушінні суміші ступеневим режимом 100/60 ºС досліджуваний матеріал сушиться при температурі теплоносія 100 ºС протягом 4 хв і далі температура теплоносія знижується. Після 20 хв сушіння температура теплоносія 80 ºС, це запобігає суттєвим втратам фолієвої кислоти. Після 40 хв сушіння температура теплоносія 60 ºС. Протягом усього процесу сушіння температура поверхні і в шарі не перевищувала 60 ºС.

Висновки. Час сушіння матеріалу в режимі теплоносія 100/60 ºС та 100/70 ºС менший порівняно з тривалістю процесу при 60 ºС та 70 ºС, що зменшує енергетичні витрати на 30–40%.

Ключові слова: *сушіння, вологовіддача, соя, шпинат, морква, теплоносій.*

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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.

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2. (2013), *Svitovi naukovometrychni bazy*, available at: http://www1.nas.gov.ua/publications/q_a/Pages/scopus.aspx

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