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TECHNOLOGY OF FRUIT SAUCES FOR HEALTH PURPOSES

Among the wide range of culinary products, an important place is occupied by sauces, which have a high consumption quality. By combining products and sauces, you can expand the range of culinary products, regulate nutritional and biological value, caloric content, cost price, product price, and production profitability. In order to increase the biological and nutritional value, we investigated the possibility of developing the technology of fruit sauces based on vegetable hydrocolloids, calcium lactate, protein and fat additives. The most problematic issue in the technology of sauces is ensuring their colloid stability, which is determined, first of all, by the effectiveness of the structure-forming agents of low- or high-molecular substances and their complexes. Of particular interest are high-molecular structure-formers represented by proteins of plant origin and polysaccharides. Mathematical methods based on the physicochemical parameters of the chemical composition of sauces determined the rational ratio of protein and fat additives, dietary fibers Fibregum and Litesse, pectin and calcium lactate as 5:3:3:2:2. Analysis of the chemical composition of control and test samples of sauces shows an increase in protein content by 8.5 and 6 times, fats by 1.1 g, dietary fibers by 6.8 and 7.8 times compared to the control. The mineral composition improved by increasing the content of potassium by 95% and 155%, calcium by 33 and 21 times, magnesium by 3.8 times, phosphorus by 5.2 and 4.2 times, iron by 74% and 293%, respectively. The content of vitamins increased significantly: B1 – 6.7 and 7 times, B2 – by 76.5% and 167%, PP – 40% and 14 times, C – 40% and 17.5%, respectively. The developed quince and persimmon sauces have a better biological value, and in terms of organoleptic indicators, they are close to the control samples. Based on the physiological properties of the studied raw materials, the developed products can be recommended for inclusion in the diets of workers working in hazardous industries, people living in polluted areas and for all age groups of the population.

Keywords: sauces, vegetable hydrocolloids, protein-fat additive, gum arabic, food fibers, biotechnology, technology.

АНТОНЕНКО АРТЕМ, БАЛЬ-ПРИЛИПКО ЛАРИСА
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ТЕХНОЛОГІЯ ФРУКТОВИХ СОУСІВ ОЗДОРОВЧОГО ПРИЗНАЧЕННЯ

Серед широкого асортименту кулінарної продукції важливе місце займають соуси, які мають високі споживні якості. Комбінуючи продукти і соуси, можна розширити асортимент кулінарної продукції, регулювати харчову і біологічну цінність, калорійність, собівартість, ціну продукції, рентабельність виробництва. З метою підвищення біологічної та харчової цінності нами досліджено можливість розробки технології фруктових соусів на основі рослинних гідроколоїдів, лактату кальцію, білково-жирових добавок. Найбільш проблемним питанням у технології соусів є забезпечення їх колоїдної стабільності, яка визначається, насамперед, ефективністю структуроутворювачів низько- або високомолекулярних речовин та їх комплексів. Особливий інтерес представляють високомолекулярні структуроутворювачі, представлені білками рослинного походження та полісахаридами. Математичними методами на основі фізико-хімічних показників хімічного складу соусів визначено раціональне співвідношення білково-жирових добавок, харчових волокон Fibregum та Litesse, пектину та лактату кальцію як 5:3:3:2:2. Аналіз хімічного складу контрольних та дослідних зразків соусів показує збільшення вмісту білків у 8,5 та 6 разів, жирів на 1,1 г, харчових волокон у 6,8 та 7,8 разів порівняно з контролем. Мінеральний склад покращився за рахунок збільшення вмісту калію на 95 і 155 %, кальцію в 33 і 21 рази, магнію в 3,8 рази, фосфору в 5,2 і 4,2 рази, заліза відповідно на 74 і 293 %. Значно збільшився вміст вітамінів: В1 – у 6,7 і 7 разів, В2 – на 76,5% і 167%, РР – на 40% і в 14 разів, С – на 40% і 17,5% відповідно. Розроблені соуси з айви та хурми мають кращу біологічну цінність, а за органолептичними показниками наближаються до контрольних зразків. Виходячи з фізіологічних властивостей досліджуваної сировини, розроблені продукти можна рекомендувати для включення в раціон працівників шкідливих виробництв, осіб, які проживають на забруднених територіях, а також для всіх вікових груп населення.

Ключові слова: соуси, рослинні гідроколоїди, білково-жирова добавка, гуміарабік, харчові волокна, біотехнологія, технологія.

Formulation of the problem

The worldwide trend towards healthy nutrition has led to the development of the production of products with a functional purpose, which, due to the presence of bioactive components in their composition, are able to support human health and increase the body's resistance to adverse environmental factors. Taking into account modern environmental conditions, the diet should contain a sufficient amount of natural biologically active substances: essential amino acids, polyunsaturated fatty acids, macro- and microelements, vitamins, dietary fibers, which are able to increase the resistance of the human body to the influence of negative environmental factors. The works of scientists: M.I. Peresichnoh, M.F. Kravchenko, V.N. Korzuna, L.P. Malyuk, G.B. Rudavska, T.I. Kostenko are devoted to the problem of using the above-mentioned substances in the production of food products. etc.

Among the wide range of culinary products, sauces, which have high consumption properties due to a specific emulsion structure and the presence of valuable nutrients, occupy an important place. Qualitatively prepared and correctly selected sauces stimulate the appetite, activate digestion processes, diversify the taste and appearance of many dishes, and increase their nutritional value. The subject of our scientific research is the newest technologies of sauce products based on dietary supplements of plant origin.

The most problematic issue in the technology of sauces is ensuring their colloid stability, which is determined, first of all, by the effectiveness of structure-forming agents (emulsifiers, stabilizers): low- or high-molecular substances and their complexes. Of particular interest are high-molecular structure-formers represented by proteins (of animal and plant origin) and polysaccharides.

Analysis of recent sources

Considering modern environmental conditions, the human diet should contain a sufficient amount of natural biologically active substances (BAR): essential amino acids, polyunsaturated fatty acids, macro- and microelements, vitamins, dietary fibers, which are able to increase the body's resistance to the influence of negative environmental factors. The work of scientists M. I. Peresichny, M. F. Kravchenko, P. O. Karpenko, A. B. Horalchuk, P. P. Pyvovarov [2], V. N. Korzun, O. M. Grigorenko [3] and others.

The purpose of the research is the scientific justification and development of the latest technologies of fruit sauces using protein-fat additives, Fibregum and Litesse dietary fibers, GRINDSTED YF 738 pectin and calcium lactate.

The object of research is the technology of fruit sauces for health purposes.

The subject of the study is Fibregum, Litesse, pectin, calcium lactate, protein-fat additive, sauces for health purposes.

The mass fraction of protein by the Kjeldahl method (GOST 17444–76), fat (GOST 30004.2–93), dietary fiber (GOST 13496.2–91) was studied; content of Calcium, Magnesium - (GOST 26428-85); Phosphorus - (GOST 17289); Sodium, Potassium, Ferrum - (DSTU ISO 6332–2003), Lead (GOST 26932–86), Cadmium (GOST 26933–86), Arsenic (GOST 26930–86), Mercury (GOST 26927–86), Copper (GOST 26931 –86), Zinc (GOST 26934–86); mycotoxins (GOST 28038–89); pesticides (DSTU EN 12955–2001); of radionuclides [9]. The content of toxic elements and radionuclides compared with the maximum permissible level (MRL).

The obtained data were processed by methods of mathematical statistics and correlation analysis using MathCad software.

Presenting main material

An important source of vegetable proteins is soy. Soy proteins have a high emulsifying capacity and biological value due to the content of essential amino acids [1]. In the technology of sauces, it is advisable to use a protein-fat additive from soy. The peculiarity of the IR-processed soybean product under the ESO trademark is that it has a high nutritional value: an increased amount of protein, polyunsaturated fatty acids, vitamins and minerals. Treatment of soybeans with IR irradiation significantly affects protein, carbohydrate and lipid complexes, which become more bioavailable to the action of proteolytic enzymes and are better absorbed by the human body.

The use of polysaccharides, in particular hydrocolloids, for the formation and stabilization of emulsions is due to their functional properties: surface activity, high viscosity when interacting with a solvent, thixotropy, etc. [2,3].

Polysaccharides also include gums, the assortment of which is represented on the domestic market by xanthan, guar, locust bean gum, fibergam, and they are widely used in low-fat food emulsion technologies [5,6]. The use of complex carbohydrates in the technology of sauces, namely soluble dietary fibers, is due, first of all, to their complex-forming ability. Dietary fibers are capable of chemical exchange with hydrogen and calcium ions, the formation of gelatinous structures that affect the release of the stomach, the speed of absorption of substances in the small intestine and the duration of transit through the gastrointestinal tract, are able to remove exo- and endogenous toxins, heavy metals, adsorb bile acids and, thus, affect their distribution in the gastrointestinal tract and reabsorption, which significantly affects the loss of steroids and cholesterol metabolism.

Soluble dietary fibers include fibergum (FIBREGUM™), a bioactive dietary fiber extracted from acacia resin (Leguminosae). Fibregam is a low-calorie (2 kcal/g), highly soluble supplement (up to 90% of dietary fiber in the dry extract), resistant to acidic environments and heat treatment. Due to its low viscosity and lack of taste and smell, fibergam can be added to food products without impairing their organoleptic properties. Fibregam solutions can reach a concentration of up to 50%. Fibregam is a dietary fiber that has prebiotic properties. It has a positive effect on human physiology: it reduces the content of glucose and cholesterol in the blood; stimulates microflora, participates in regulation of energy metabolism of cells.

Polysaccharides include litesse - this is a polysaccharide (polydextrose) obtained from glucose. It is a prebiotic and affects the reduction of the glycemic index. Litesse has a number of technological properties that allow it to be used in the production of confectionery, chocolate, fruit fillings, drinks, ice cream and fermented milk products.

Pectin substances are high-molecular heteropolysaccharides of plant origin, which consist of polymers of D-galactopyranosyl-uronic acid, some of the carboxyl groups of which are esterified with methyl alcohol or substituted with metals. Pectins gained special significance in recent decades, when information appeared about their ability to remove heavy metals from the human body, as well as absorb metabolic products, as well as cholesterol, bile acids, urea, etc. Pectin is a surface-active substance, has the properties of an emulsifier, foaming agent, thickener, stabilizer, structure former, moisture-retaining and gelling agent in emulsions and suspensions [6]. Based on the assortment and technological properties, GRINDSTED YF 738 pectin was chosen for research.

Calcium lactate E327 is one of the calcium-containing fortifiers of food products. Calcium lactate is a source of dietary calcium and performs technological functions, it is easily assimilated in the body and, unlike calcium chloride, does not irritate the mucous membrane of the stomach, it dissolves well in water. The strontium isotope is a chemical analog of calcium, but these cations differ significantly in their biological properties: strontium binds to

proteins and other macromolecules much weaker than calcium. Under the influence of an additional amount of Ca, the discrimination of Sr90 with respect to Ca in the processes of their assimilation in the intestine is strengthened. This, in turn, leads to calcium deficiency, which is accompanied by chronic strontium poisoning. A decrease in the retention of strontium in the body and a decrease in its level in blood serum is observed with the additional introduction of calcium, which is an important condition for weakening the effect of strontium on the metabolism of vitamin D and reducing the rachitogenic effect of this element. The interaction of these factors in the body ensures the protective role of calcium in the development of Sr-toxicosis.

Mathematical methods based on the physico-chemical parameters of the chemical composition of the sauces determined the rational ratio in the composite mixtures of the "Super" ESO grain product, Fibregum and Litesse dietary fibers, GRINDSTED YF 738 pectin and calcium lactate as 5:3:3:2:2. The composite mixture can be used in the technology of fruit and sweet sauces of various thicknesses.

By replacing starch (100%) with a composite mixture in the experimental samples, it was established that the rational concentration of the composite mixture should not exceed 15% of the mass of the sauce; if it is exceeded, the sauces acquire a too thick consistency and the aftertaste of soy is felt.

The technology of fruit sauces using dietary supplements is proposed (Fig. 1).

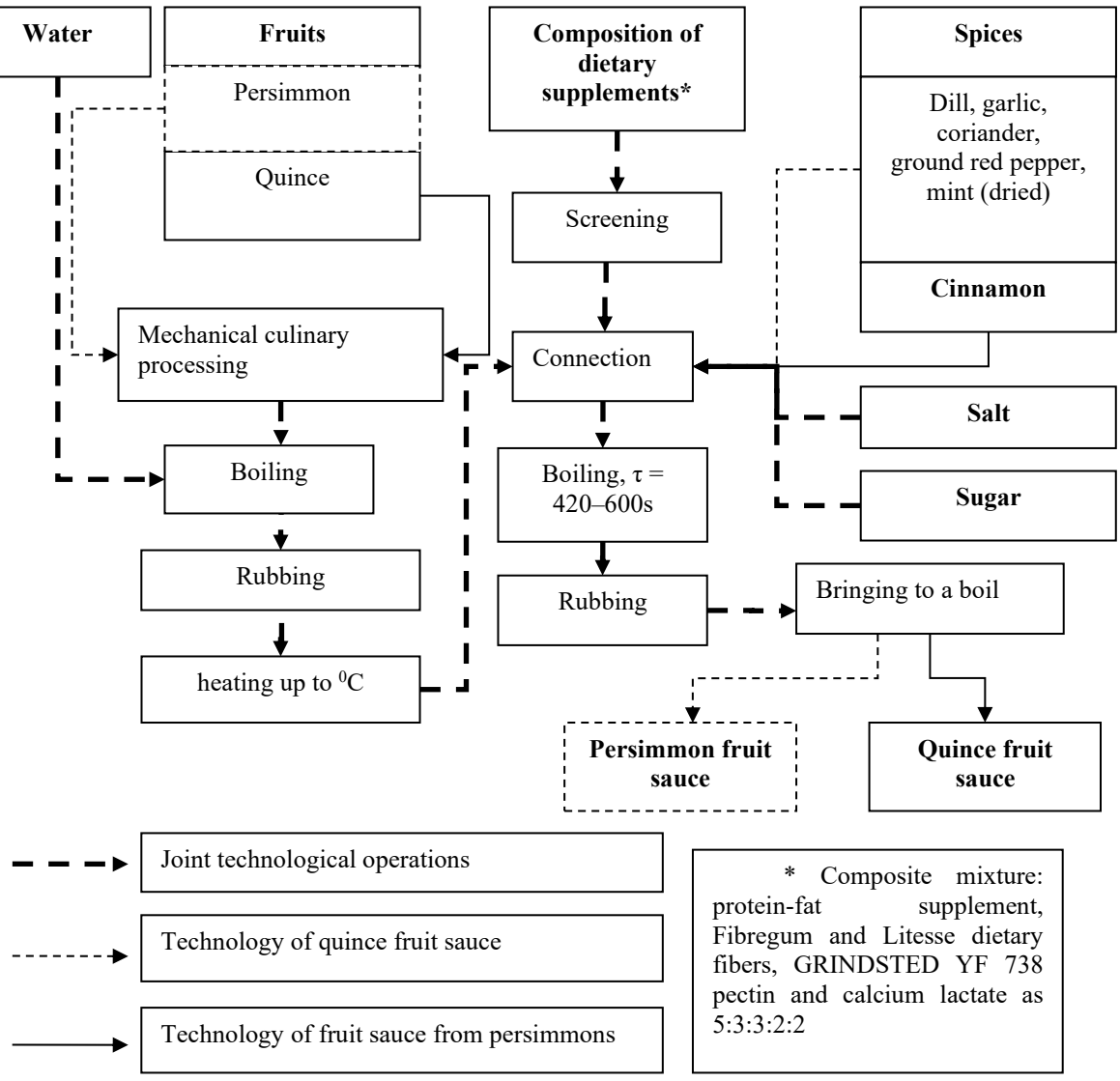

Fig. 1. Technological scheme of production of sauces using dietary supplements

The chemical composition of control and test samples of quince and persimmon sauces was studied (table 1).

Analysis of the chemical composition of control and test samples of sauces shows an increase in protein content by 8.5 and 6 times, fats by 1.1 g, dietary fibers by 6.8 and 7.8 times compared to the control. The mineral composition improved by increasing the content of potassium by 95% and 155%, calcium by 33 and 21 times, magnesium by 3.8 times, phosphorus by 5.2 and 4.2 times, iron by 74% and 293%, respectively. The content of vitamins increased significantly: B1 – 6.7 and 7 times, B2 – by 76.5% and 167%, PP – 40% and 14 times, C – 40% and 17.5%, respectively.

Table 1

Comparative chemical composition of quince and persimmon sauces (per 100g)

Indicator	Units of measurement	**Quince fruit sauce** (control)	**Quince fruit sauce** (experiment)	Difference, %	**Persimmon fruit sauce** (control)	**Persimmon fruit sauce** (experiment)	Difference, %
Squirrels	%	0,25	2,36	844,00	0,42	2,53	502,38
Fats	%	0,01	1,1	$10,9 \times 10^3$	0,01	1,1	$10,9 \times 10^3$
Food fibers	%	1,26	8,64	581,10	1,275	8,68	678,43
Mineral substances:							
Na,	mg/100g	1,87	2,19	17,11	1,27	1,6	125,98
K	mg/100g	89,25	174,4	95,41	153	238,2	155,69
Ca	mg/100g	8,5	286,9	3 275,29	14,45	292,8	2 026,30
Mg	mg/100g	4,25	16,25	282,35	6,8	18,8	276,47
P	mg/100g	7,65	39,65	418,30	14,45	46,45	321,45
Fe	mg/100g	1,1	1,91	73,64	0,42	1,23	292,86
Vitamins:							
C	mg/100g	3.15	4.40	40.0	7.20	8.45	17.5
Folic acid	µg/100 g	0,1	11	$10,9 \times 10^3$	0,1	11	$10,9 \times 10^3$
B1	µg/100 g	0,009	0,06	566,67	0,01	0,06	600,00
B2	µg/100 g	0,017	0,03	76,47	0,03	0,05	166,67
PP	µg/100 g	0,3	0,42	40,00	0,042	0,55	1 309,52
E	µg/100 g	0,1	1,01	$10,9 \times 10^3$	0,1	1,01	$10,9 \times 10^3$
β-carotene	µg/100 g	0,001	0,005	400	0,08	0,09	112,50

To compare new samples of sauces with the standard, quality profiles were constructed (Fig. 2, Fig. 3). A standard food product with a content of macro- and microelements, minerals, vitamins and dietary fibers of 25% of the daily requirement, which meets the requirements for functional food products, is taken as the standard.

The developed quince and persimmon sauces have a better biological value, and in terms of organoleptic indicators, they are close to the control samples.

Conclusions

The technology of sauces with increased biological value and meeting safety requirements for food products has been scientifically substantiated and developed. The developed food products received a positive conclusion of the state sanitary-epidemiological examination.

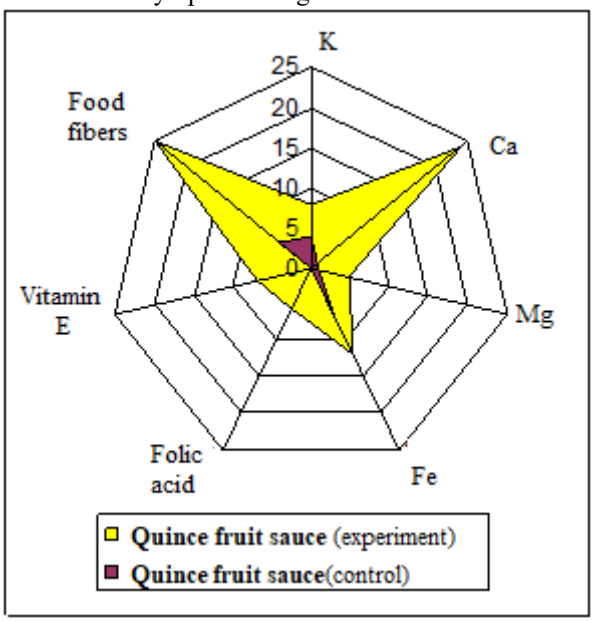

Fig. 2 Quality profile of the persimmon fruit sauce, %

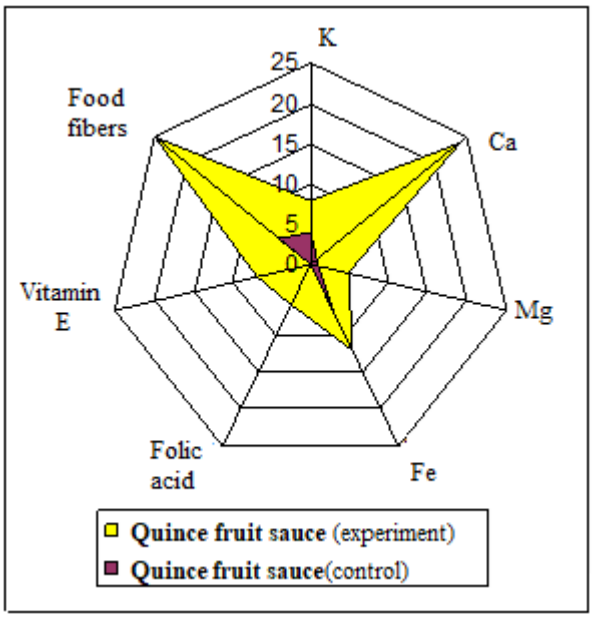

Fig. 3. Quality profile of the quince fruit sauce, %

Nutrition is the main factor in ensuring optimal growth and development of the human body, its efficiency,

adaptation to the harmful effects of environmental factors. Based on the physiological properties of the studied raw materials, the developed products can be recommended for inclusion in the diets of workers working in hazardous industries, people living in polluted areas and for all age groups of the population.

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