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STUDY OF FUNCTIONAL AND TECHNOLOGICAL PROPERTIES OF PLANT POWDERS FOR USE IN CONFECTIONERY INDUSTRY

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Summary. The article is devoted to research of functional and technological properties of powders from banana, carrots, strawberry, apple, spinach and orange received by cold spray drying. Expediency of vegetable and fruit powders use in the confectionery industry, including their addition during production of confectionery semi-finished products has been proved. Organoleptic properties of powders have been defined, namely: appearance and consistence, taste, smell and color, results are presented in the table. By the microscopic method dispersion of powders from banana, carrots, strawberry, apple, spinach, orange has been studied, results of researches are presented by charts. Also technological indicators of plant powders have been investigated, namely: the ability to bind moisture, water absorption coefficient, the emulsifying ability and ability to hold fat.

Keywords: vegetable powders, cold spray drying, dispersion, functional and technological properties, water absorption coefficient, ability to hold fat.

ДОСЛІДЖЕННЯ ФУНКЦІОНАЛЬНО-ТЕХНОЛОГІЧНИХ ВЛАСТИВОСТЕЙ РОСЛИННИХ ПОРОШКІВ ДЛЯ ВИКОРИСТАННЯ У КОНДИТЕРСЬКІЙ ПРОМИСЛОВОСТІ

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Анотація. Статтю присвячено дослідженню функціонально-технологічних властивостей порошків з банану, моркви, полуниці, яблука, шпинату та апельсину отриманих холодним розпилювальним сушінням. Обґрунтовано доцільність використання овочевих та фруктових порошків у кондитерській промисловості, зокрема додавання їх під час виробництва кондитерських напівфабрикатів. Визначено органолептичні властивості порошків, а саме: зовнішній вигляд та консистенцію, смак, запах і колір. Мікроскопічним методом досліджено дисперсність порошків з банану, моркви, полуниці, яблука, шпинату, апельсину. Досліджено технологічні показники рослинних порошків, а саме: вологозв'язувальна здатність, коефіцієнт водопоглинання, емульгувальна та жироутримувальна здатності.

Ключові слова: рослинні порошки, холодне розпилювальне сушіння, дисперсність, функціонально-технологічні властивості, коефіцієнт водопоглинання, жироутримувальна здатність.

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Introduction

Due to the adverse ecological situation which developed in Ukraine, the actual problem is creation a new types of foodstuff, including confectionery, with increased nutrition and biological value. Confectionery consumption plays a significant role in the balanced diet of different age groupes of the population, especially children. Primary groups of products in this field occupy flour confectionery. For their design use various glazes, fondant masses, creams. Therefore increasing the nutritional value of finishing semifinished products is reasonable

For decrease the energy value and increase biological usefulness of finishing semifinished products is reasonable using of plant powders which

are a source of food fibers, pectinaceous substances and organic acids. Additionally powders play a role of natural dyes that considerably expands the range of using semifinished product and makes ready-made products more attractive for consumption.

Formulation of the problem

New technologies based on using of physiologically functional ingredients of a natural origin allow to fill shortage of irreplaceable nutrients and expand the range of confectionery products and finishing semifinished products.

High content of moisture in vegetable raw materials is the reason of their instability in case of storage, as a result of bacterial, enzymatic and chemical spoil. Drying at low temperatures is the most rational method of conservation, because in dried products microbiological processes are slowed down, and the composition of nutritious and biologically valuable substances remains close to natural [1]. Therefore for enrichment of confectionery semifinished products are reasonable and necessary using of fruit and vegetable powders that is a concentrate of biologically active connections.

Definition of functional and technological properties of powders from banana, carrots, strawberry, apple, spinach and orange received by cold spray drying was a purpose of the research.

Literature review

The satisfaction of physiological need in irreplaceable components can't be based only on the known technology solutions, search of the new approaches directed to product development of healthy food, pre-optimized on micronutrients is actually [2].

Scientific institutions and workers of confectionery production solve this problem, applying various, nonconventional to an industry, phytogenesis raw materials. The main attention is paid to protective properties of products, enhancement of bioengineering procedures of conversion of agricultural raw materials, receipt of qualitatively new foodstuff of a general and special purpose with directed altered chemical composition, products of treatment-and-prophylactic appointment for prevention of various diseases and strengthening of protective functions of an organism.

Recently at production of confectionery use various sugar substitutes (natural and artificial), as a rule, they have a number of shortcomings. Employees of Voronezh state university of engineering technologies (VSUET) Oleynikov A.Ya. and Magomedov G.A. received a powdery semi-finished product from sugar beet on the special technology allowing to keep not only sucrose, but also all substances, useful to the person. When using this semi-finished product replacing icing sugar the power value of products decreases by 15 %, it is also established that the replacement increases the degree of satisfaction of daily need for food fibers, mineral substances and food fibers [3].

Candidate of Technical Sciences Gavva A. and professor Dorokhovich A. (NUFT) have well covered the topic of use of berry powder in one of types of confectionery. Use of high-disperse berry powder allows to increase an initial mass fraction of moisture of candies without deterioration in technological stages of formation and structure. The dosage of 2,0 % of berry powder to the mass of sugar gives to products of pleasant red-violet color and distinctive berry taste [4].

Skvyria M.A. scientifically and experimentally proved feasibility and efficiency of applying leaves of walnut and aqueous-alcoholic extract from walnut leaves in case of production sugar and dairy fondant confectionery. It showed positive influence of these raw materials on structural mechanical properties of fondant mass and quality of finished goods, found positive influence of the brought additives on consumer properties of finished products, including nutrition value, organoleptic, physical and chemical indicators, and also influence on quality of fondant products during storage [5].

At department VSUET under the leadership of Magomedov M. and Labosovoi M. was received a powdery semifinished product from Jerusalem artichoke root crops on the technology allowing to keep almost all useful substances of a Jerusalem artichoke: proteins (7 %), fats (0,3 – 0,65 %), polysaccharides (80 – 82 %), pectin substances (to 10 %), group B vitamins, vitamin C, organic acids (apple, lemon, amber). With the introduction of this powder on replacement to icing sugar effective viscosity of mass of a praline changes – with increase in a dosage it increases. Such process leads to growth of a capability to hold a weight form when forming [6].

Based on the conducted researches of the chemical composition of powder and aqueous-alcoholic extract from leaves of walnut it was established that they are valuable raw materials for production of sugar confectionery of functional purpose, despite the high content of proteins (7,8 – 8,7 %), vitamins, and also iodine (1120 and 92 mkg/kg) that plays an important role as a part of foodstuff of functional purpose [7].

As shows the analysis of modern publications, today investigate confectionery semi-finished products, enrich them with berry, fruit, vegetable purees, powders and extracts. For decrease the energy value and increase the biological usefulness of confectionery semi-finished products is expedient using of plant powders which are a source of food fibers, pectin substances and organic acids. The new technologies based on use of physiologically functional ingredients of a natural origin allow to fill shortage of irreplaceable nutrients and to expand the range of confectionery production. Therefore, it is reasonable to determine of technological indicators dried plant raw materials.

Main part

Methods of researches. Definitions of dispersion plant powders carried out by calculation particle size of powders using an eyepiece micrometer and an optical microscope at increase by 400 times. Making preparation was carried out by drawing dry samples on a glass slide.

For the purpose to predict the behavior of the researched plant powders in multicomponent food systems their main technological properties are determined: the ability to bind moisture,water absorption coefficient, the emulsifying ability and ability to hold fat. The principle of a method of determination of ability to hold fat consists that under certain conditions to plant powder oil is added and after centrifugation the quantity free oils is determined. Emulsifying ability of powders determined by the maximum quantity of oil, it is entered into colloidal system of proteins to achievement of a koatservation under certain conditions. In case of a research of the water connecting capability of powders used a weight method. Water absorption was determined by a centrifugation method [8].

Research of functional and technological properties of plant powders. According to the described problem,have been studied functional and technological properties of powders from banana, carrots, strawberry, apple, spinach and orange received by cold spray drying (CSD) of Naturex AG, Switzerland

It is obvious that introduction of powder will cause emergence in a ready-made product of a peculiar color, aroma and taste. Therefore, special attention needs to be paid to a research of organoleptic properties of these powders.

Table 1 – Organoleptic indicators of plant powders CSD

Indicators	Powder from banana	Powder from carrot	Powder from strawberries	Powder from apple	Powder from spinach	Powder from orange
Appearance and texture	Fine powder, homogeneous throughout the mass, without visible inclusions and impurities, without lumps, granular texture					
Taste and smell	Pleasant, pure, with a light smell and notable taste of banana	Pleasant, without notable particles of powder, with smack and a smell of fresh carrots	Pleasant, with a smell and taste of fresh berry, with notable sweetish smack	With hardly notable smell and pleasant taste of fresh apple, with sourish smack.	Pleasant, pure with a light smell and saturated taste of spinach	With notable taste and a smell of orange, has sweetish and sour smack
Color	Light yellow, uniform for all weight.	Expressed orange, uniform for all weight.	Pink, uniform for all weight	Light green, with yellowish shade, uniform	Intense green color	Light orange, uniform for all weight

With introduction of powder in confectionery semi-finished product it is expedient to use powders with a size of particles up to 15 microns and the content of this fraction not less than 75 – 80 %. Justification of the specified parameters is that particles with sizes more than 20 – 25 microns are felt as organoleptic. Therefore we have investigated by a microscopic method dispersion of powder from banana (fig. 1), carrots (fig. 2), strawberries (fig. 3), apples (fig. 4), spinach (fig. 5), orange (fig. 6). Numbers of fraction and the size of particles is presented in tab. 2.

Table 2 – Numbers of fractions and particle size, micron

Number of fractions	1	2	3	4	5	6	7	8	9
Dispersion of powder, micron	1 – 5	5 – 10	10 – 15	15 – 20	20 – 40	40 – 60	60 – 80	80 – 90	90 – 100

As seen from these the figures, the largest volume of particles with sizes up to 20 microns is presented in powders from strawberry – 83 % and orange – 83 %, this fraction in powder from banana contains in the volume of 81 %, apples – 79%, carrots – 78 and spinach – 77 %.

As shown in the tab. 3, studied vegetable and fruit powders have ability to absorb moisture in 2,3 – 2,9 times to own masses that testifies about their high the rehydration ability caused by existence in given raw materials of a large amount of pectin substances. Value of the ability to bind moisture is at one level 43 – 54 %, except for powder from oranges (63 %) that it is possible to explain with the chemical composition and, respectively, high porosity of powder.

Ability to hold fat and emulsifying ability of the studied powders are in the return proportionality to the water connecting ability that causes technological aspect of their use in food systems with the low content of fat

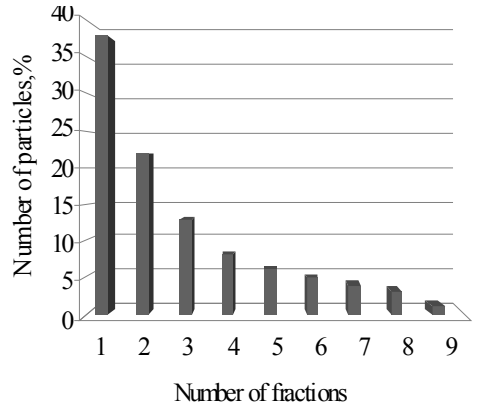

Fig.1. Dispersion of powder from banana

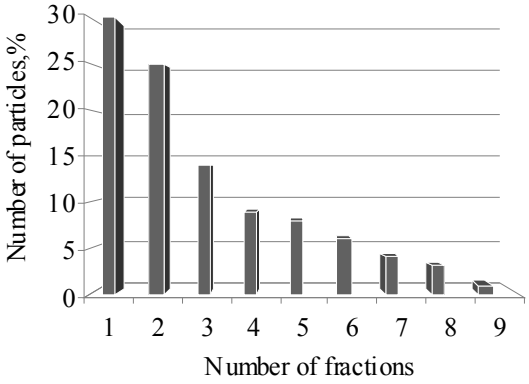

Fig. 2. Dispersion of powder from carrots

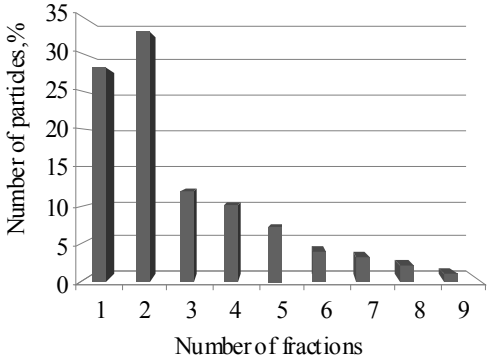

Fig.3. Dispersion of powder from strawberry

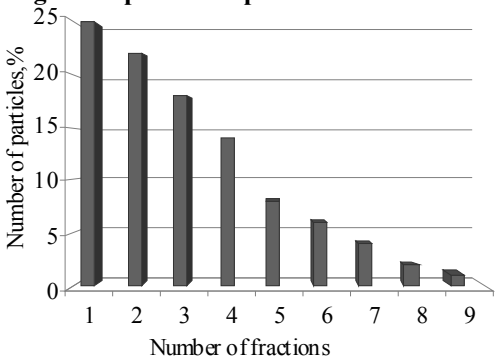

Fig. 4. Dispersion of powder from apples

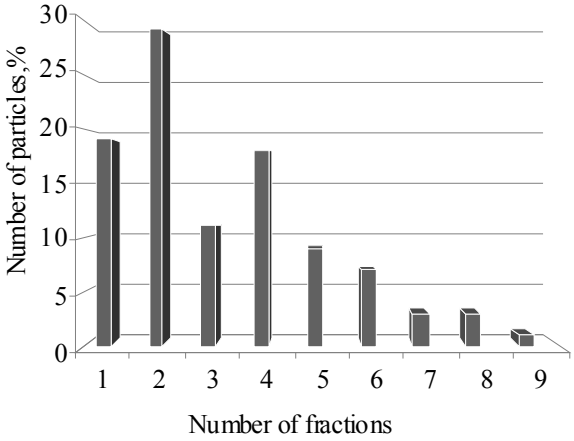

Fig. 5. Dispersion of powder from spinach

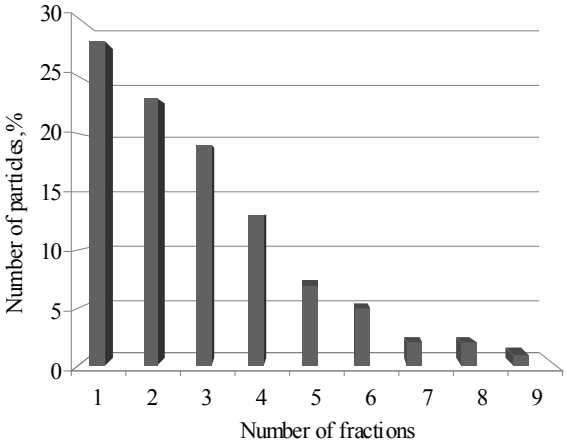

Fig. 6. Dispersion of powder from orange

The research results of technological properties of plant powders presented in table 3.

Table 3 – Research technological properties of plant powders

Indicators	Powder from banana	Powder from carrot	Powder from strawberries	Powder from apple	Powder from spinach	Powder from orange
Water absorption co-efficient, kg/kg	2,9±0,1	2,4±0,5	2,3±0,6	2,9±0,5	2,8±0,2	2,9±0,2
Ability to bind moisture, %	43,3±0,5	49,3±0,8	50,8±0,2	53,6±0,6	44,3±0,7	63,1±0,9
Ability to hold fat, ml/g	0,9±0,05	0,9±0,05	0,7±0,02	0,7±0,01	0,7±0,01	0,6±0,01
Emulsifying ability, ml/g	2,4±0,1	2,2±0,1	1,7±0,1	1,6±0,2	2,0±0,1	1,9±0,2

The analysis of IR spectrums of the researched powders in average area of radiation characterizing skeletal molecular vibrations showed presence of frequencies of absorption of average intensity.

At 1000 cm^{-1} in all samples of powders was indicated peaks of group -OH. In powder from apples, banana and oranges the peak is shown more, on the second place – powder from spinach less manifestation of dive is observed in powders from carrots and strawberry. In 1720 cm^{-1} and 1610 cm^{-1} in all samples indicated the presence of powdered peaks showing the presence of dicarboxylic α-amino acids and chlorine hydrogenous salts of amino acid. At 3280 cm^{-1} indicated the presence of peak of identical character for all samples of powders, wich demonstrates presence of a water phase. However, in powder from spinach a shoulder peak is more expressed.

So, the conducted researches indicate existence in investigated raw materials OH groups which are hydrophilic active connections that will promote water absorption of powders, a certain amount of moisture in powders and the content of amino acids.

Conclusion

Thus, based on the conducted researches of functional and technological properties of powders from banana, carrots, strawberries, the apple, spinach and orange received by cold spray drying are shown benefits of use of these plant ingredients due to good organoleptic properties, dispersion, the largest amount of particles in powders is provided with sizes up to 20 microns, and also a high ability to bind water.

Using of dressers from nonconventional plant raw materials allows not only to increase nutrition value of confectionery, to intensify engineering procedure, but also to give to products of a treatment and prophylactic orientation. In this regard actual and perspective direction development of confectionery production is use of p powders in the production technology of confectionery semifinished products.

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ИССЛЕДОВАНИЕ ФУНКЦИОНАЛЬНО-ТЕХНОЛОГИЧЕСКИХ СВОЙСТВ РАСТИТЕЛЬНЫХ ПОРОШКОВ ДЛЯ ИСПОЛЬЗОВАНИЯ В КОНДИТЕРСКОЙ ПРОМЫШЛЕННОСТИ

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Аннотация. Статья посвящена исследованию функционально-технологических свойств порошков банана, моркови, клубники, яблока, шпината и апельсина полученных холодной распылительной сушкой. Обоснована целесообразность использования овощных и фруктовых порошков в кондитерской промышленности, в том числе добавление их при производстве кондитерських полуфабрикатов. Определены органолептические свойства порошков, а именно: внешний вид и консистенцию, вкус, запах и цвет. Микроскопическим методом исследована дисперсность порошков банана, моркови, клубники, яблока, шпината, апельсина, результаты исследований представлены в виде диаграмм. Также были исследованы технологические показатели растительных порошков, а именно: влагосвязующая способность, коэффициент водопоглощения, эмульгирующая способность и жироудерживающая способность.

Ключевые слова: растительные порошки, холодная распылительная сушка, дисперсность, функционально-технологические свойства, коэффициент водопоглощения, жироудерживающая способность.

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