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Застосування мінеральних добавок у виробництві м'ясних продуктів

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Анотація

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

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

Результати. Проведені дослідження дозволили визначити раціональний склад структуро-моделюючих композиції на основі нанокомпозитів і розробленого червоного барвника з буряку. Підтверджена можливість стабілізації ξ-потенціалу бурякового соку буферним комплексом і мінеральною добавкою, перспективність використаня даних композитів у технології виробництва м'ясних та м'ясомістких продуктів, що виробляються за технологіями виробництва варених ковбас і м'ясних хлібів.

Ключові слова: барвник, стабілізація, нанокомпозити, якість, м'ясомпродукти.

Использование минеральных добавок в производстве мясных продуктов

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Аннотация

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

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

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

Ключевые слова: краситель, стабилизация, нанокомпозиты, мясопродукты.

Use of mineral additives in the production of meat products

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Abstract

Introduction. Lately in the group of texturizing food additives a great emphasis is placed on stabilizing systems consisting of several components.

Materials and methods. We determined the optimal composition of composite mixtures of factorial experiments, color using chromaticity scale, moisture-binding capacity and flexibility of mixtures pressing method using and thermal stability of beet dye by heating at different temperatures, ξ-potential of the dye solutions with nutritional supplements.

Results. The research allowed to determine the rational composition of a model mixtures based nanocomposites and developed a red dye from beets for stabilizing technological, structural and mechanical properties of meat products and groups containing meat, meat bread. The possibility was confirmed to stabilize ξ potential of beet juice by adding buffer compound and mineral additive, as well as a viable potential for applying such compositions in production of meats and processed meats manufactured using the cooked sausage and meat loaf technology.

Keywords: dye, color, stabilization, nanocomposites, quality, meat and containing meat products.

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

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

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

Silicon is also a component of collagen. Its primary function consists in strengthening the fibers of collagen and elastin, ensuring the strength and resilience of connective tissue, and participation in chemical reactions. Humans consume ca. 10-20 mg of silicon daily with vegetables, fruit, meat, and other foods [3]. That quantity is required to ensure normal vital functions, growth, and development of humans. About 70 elements are not assimilated in the event of silicon shortage.

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

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

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

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

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

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

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

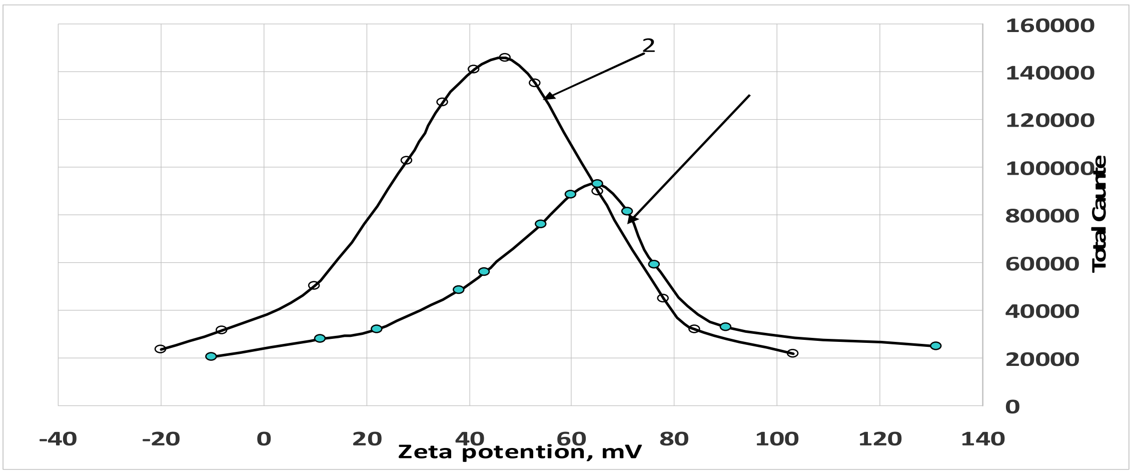
Description	T, %
Solution storage time, days	
0 (fresh solution):	4
1	24

6	62
Solution heating temperature (0 days of storage), °C 50 72	 15 72

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

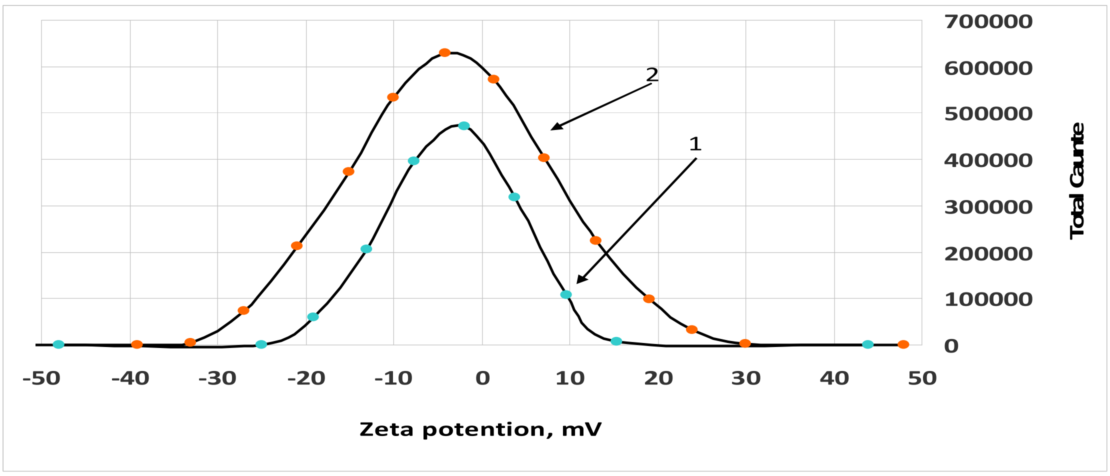
To investigate the stability of colorant solutions combined with food additives in the course of storage (fresh and past 6 days of storage), ξ potential was detected for the following variants: 1: beet juice; 2: red beet colorant; 3: red beet colorant + 1% of nanocomposite.

The following diagrams describe the results:



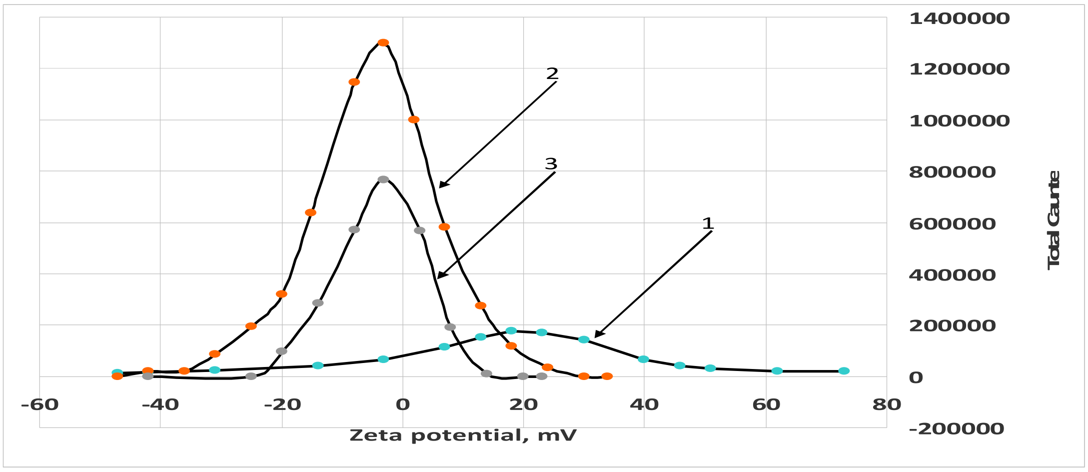
1- beet juice, 2 - red beet colorant

Figure 1. ξ potential of beet juice and stabilized beet colorant on the first storage day



1- red beet colorant on the first day , 2 - red beet colorant on the sixth day

Figure 2. ξ potential of red beet colorant on the first and sixth storage day



1- beet juice, 2 - red beet colorant, 3 - red beet colorant with nanocomposite
Figure 3. ξ potential of beet juice and beet colorant with nanocomposite on the sixth storage day

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

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

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

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

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

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

Table 2. Options of beet colorant and nanocomposite applied to the mixture.

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

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

Table 3. Process features of soybean paste for different options.

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

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

Table 4. Soybean paste colors of samples according to Tintorama scale.

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

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

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

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

Conclusions.

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

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

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