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ADVANTAGES OF USING PROTEINS IN THE PRODUCTION OF TRUNCATED SEMI-FINISHED PRODUCTS

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Abstract: *In world practice, recently, the question of using physico-chemical methods of treating biotechnological objects by means of substances of cryoprotective action is increasingly being discussed. The principle of these substances is to create an amorphous structure throughout the volume of the product and to reduce the number of crystallization centers and water activity.*

On the basis of proteins in blood plasma Vepro 75 PSC, wheat sodium caseinate, flax fiber and cellulose plantain were used to get protein-polysaccharide compositions with high functional-technological and cryoprotective properties and to produce chopped semi-products of deep freezing and extended storage at a temperature of - 18 °C. The conducted studies confirmed that developed composite mixtures have high functional and technological properties, which increase the moisture-retaining, fat-retaining ability and form stable properties of meat systems. The mechanism of cryoprotective action of the developed compositions is associated with the formation of an amorphous structure in the middle of meat system, as well as with the decrease in the number of crystallization centers and a decrease in water activity.

Keywords: *freezing, meat systems, food fibers, crystallization, cryoprotectants.*

1. Introduction.

A necessary condition for the preservation of quality indices of chopped semi-finished products after defrosting is compliance with the optimal conditions of refrigeration (freezing temperature, humidity, air flow velocity). However, this does not always allow maintaining high consumer properties of frozen semi-finished products, as the degree of destructive impact of low temperatures on muscle fibers of raw meat also depends on the functional and technological properties of raw meat [1-3].

Recently, there has been a steady trend in food development with minimal content of chemical (synthetic) origin, with the simultaneous increase in the popularity of dietary supplements and natural ingredients. This allows obtaining products

that best meet the requirements of a healthy diet [2-4].

Recently, according to world's practice, the issue of the use of physico-chemical processing methods of biotechnological objects through the use of substances of cryoprotective action is being discussed more frequently. These substances' principle of operation is to create an amorphous structure throughout the volume of the product, to reduce the number of crystallization centers and to reduce the activity of water.

In order to develop food products that meet the requirements of healthy diet and reduce the negative effects of freezing on the functional and technological properties of raw meat, as well as to prevent significant crystallization and slow down the freezing process, cryoprotective properties of protein-polysaccharide mixtures of animal proteins and plant fiber were studied.

2. Materials and methods

Protein-polysaccharide composition mixtures

As a functional, technological and cryostating component in meat stuffing, four composite mixtures were studied, with protein and polysaccharide the ratio 1 to 1. Their structure includes: blood plasma protein, sodium caseinate and wheat cellulose - mixture No. 1; blood plasma protein, sodium caseinate and flax fiber - mixture No. 2; blood plasma protein, sodium caseinate and plantain fiber - mixture No. 3; blood plasma protein, sodium caseinate, plantain fiber and flaxseed mixture No. 4. During the determination of organoleptic, physical and chemical indices of modulated minced meat systems and chopped semi-finished products, standard methods of research were used. Structural-mechanical indices were determined on a penetrometer Ulab3-31M. The penetration properties of chopped products were determined by the depth of the immersion of the indenter in a test sample at a temperature of 20 °C.

Three measurements were made on the exposed surface of the sample at a distance of not less than 10 mm from the edge of the product and at the maximum distance from the points of other measurements, so that the deformed part of the surface did not interfere with the measuring zone, after which the penetration value was recalculated in the penetration tension value.

The water activity index a_w of the model fermented systems and meat brooded semi-finished products was determined using the rotronic Hygro Palm-23 analyzer.

Measurement of the cryoscopic temperature of the model fermented systems and chopped half-finished products was carried out by the method of

thermal analysis, which is based on the construction of curves of temperature changes in time.

Preparation of experimental samples

Protein-polysaccharide mixtures were added to the modulated minced systems made on the basis of single-grade beef (50%) and semi-bulk pork (50%) in the amount of 2% to replace a single-breed beef. For control, a meat-stuffed meat system without animal proteins and food fibers was used. The minced samples were subjected to stirring at a temperature of 12 °C for 15 minutes and frozen at a temperature of minus 18 °C. The duration of storage at the indicated temperature was of 30 days. In all samples, the organoleptic, physico-chemical, functional-technological, structural and mechanical parameters, as well as water activity a_w and cryoscopic temperature values were determined before freezing, after defrosting and thermal treatment.

The statistical analysis

All the analytical determinations were performed at least three times and the value reported for the determined characteristics was the average value \pm of the standard deviation (S.D.). The statistical analysis was performed at the Microsoft Excel statistical software version 2010.

3. Results and discussion

The development of a rational composition of chopped semi-finished products was carried out by computer optimization method based on the chemical composition of the recommended ingredients and the results of research on their functional and technological properties (FTP). As a target function, moisture retainer (HU) and fat-retaining ability (LUW) were selected, which are criteria of maintaining the

stability of moisture and fat content in meat systems. Knowledge of FTW is necessary for the rational processing of raw meat. It provides an opportunity to predict and direct the quality characteristics of finished products [5-7]. Selected as cryoprotectants of plasma proteins Vepro 75 PSC and sodium caseinate are thermostable functional proteins used both at minus temperatures and in pasteurization regimes. They are high molecular weight substances that can reduce the growth rate of crystals and protect the muscle cells from osmotic changes. In addition, they have high functional properties and the ability to stabilize meat systems.

Wheat fiber, flax fiber and plantain fiber are multifunctional components that can improve consistency, adsorb water, reduce mass loss, and enrich the final product with ballast substances, but as for most fibers containing a mixture of soluble and insoluble fractions, have a low the ability to adsorb fat [1-3].

In the organoleptic study of modulated samples of meat chopped meat systems, it has been established that the use of developed functional compositions in the amount of 2% does not lead to significant changes in the organoleptic properties of meat systems. All samples before freezing had a pinkish-red color, a smell characteristic for fresh meat and a gentle consistency. The experimental specimens were characterized by a high degree of adhesion compared to the control sample. After defrosting, the prototype had a darker color. The greatest changes in the organoleptic parameters after freezing, storage for 30 days and defrosting were

characteristic of control samples characterized by a loose structure of muscle tissue and a sour smell.

In order to develop recommendations for the use of investigated protein-polysaccharide mixtures as functional and technological ingredients with cryostating properties in the production of chopped semi-finished products, the chemical composition and functional and technological properties (FTW) of the model meat-stuffed meat systems with their use were studied. The results of studies are shown in the Table.1.

The conducted studies suggest that the addition of protein-polysaccharide compositions as cryoprotectants positively influence the increase in moisture-retaining capacity by 9.7 - 17.3% and the fat-retaining ability by 9.4 - 9.7% in the modulated meat systems, which certainly contributes to the improvement of the structure of the modulated chopped semi-finished products (Table 2).

An important indicator of the quality of semi-finished products is the stability of the forage systems of chopped semi-finished products. This indicator characterizes the amount of water and fat bound in the meat system [2, 3]. The results of the studies indicate an increase in the stability of the meat systems of the experimental samples by 15.7 - 16.5% more, as compared with the control sample.

The consistent use of animal proteins and fibers contributes to the improvement of structural and mechanical performance of modulated meat systems. The results of studies are shown in the Table. 2

Table. 1
Chemical composition and functional and technological properties of model meat stuffing systems
(n = 3; P ≥ 95)

Indexes	Control	Sample №1	Sample №2	Sample №3	Sample №4
Mass fraction of moisture,%	69.95	71.47	71.50	72.67	72.56
Bulk protein,%	9.89	10.61	10.63	10.60	10.65
Mass fraction of fat,%	19.46	17.19	17.14	16.00	16.06
Mass fraction of ash,%	0.70	0.73	0.73	0.73	0.73
pH	6.0	6.02	6.07	6.08	6.07
Moisture-binding ability,%	78.20	79.09	79.85	80.10	81.14
Moisture Capacity,%	67.90	74.50	74.70	75.1	75.79
Fat-retaining ability,%	68.00	74.50	74.52	74.63	74.57
Emulsifying capacity,%	69.80	79.90	79.86	79.91	79.88
Emulsion stability,%	77.30	89.40	90.40	89.95	90.02
Entrance	74.58	80.76	81.30	81.78	81.83

Table2.
Structural mechanical characteristics of experimental samples of truncated semi-finished products after thermal treatment

Sample No	Penetration (Depth of Immersion of the Needle Indenter, mm)	Penetration voltage, Pa
Control	28.4±0,15	17.25±0,09
Sample № 1	19.7±0,1	24.87±0,12
Sample № 2	17.9±0,09	27.37±0,14
Sample № 3	17.6±0,1	27.54±0,12
Sample № 4	17.09±0,09	27.63±0,14

The results of the study of these indicators give a complete picture of the meat systems, their structure, their ability to absorb and retain moisture during heat treatment [2-9].

The addition of the above mentioned substances as cryoprotectants in the

modulated meat system positively affects the rate decrease in water activity a_w 0.027-0.034 as compared with a control sample. The results of the study are presented in Fig. 1

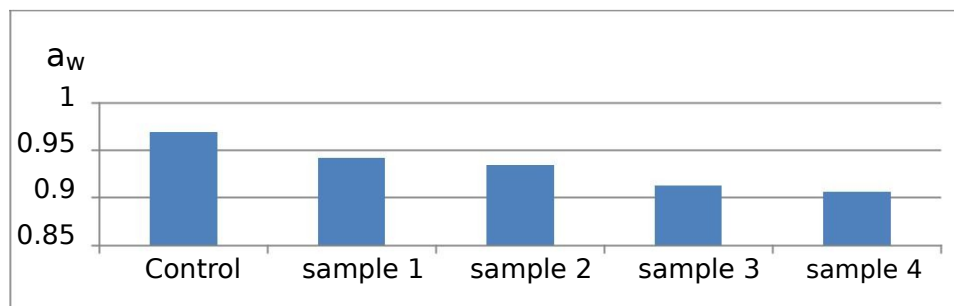


Fig. 1 Dynamics of changes in the activity of water of heat-treated samples of truncated semi-finished products after 30 days of storage

The decrease of a_w value in experimental samples is associated with an increase in the concentration of soluble substances in meat juice, which in its turn involves the lowering of temperature at the beginning of the crystallization of moisture in meat systems and, accordingly and changes the nature of ice crystals formation in the cellular structure of meat systems [7-11]. The results of the study of the effect of cryoprotectants on the change in the water activity criterion of the chopped semi-finished products indicate an increase in the value of this indicator in comparison with the values for freezing in the experimental samples - by 0.002, and in the control sample - by 0.005, which is explained by the partial destruction of cell walls and the separation of meat juice, which is more significant for a control sample which does not contain protein-polysaccharide ingredients [7-9]. The value of the cryoscopic temperature for the prototype samples was: for the control - -1.75 °C, for the sample number 1 - -3.84 °C, for the sample number 2 - -4.16 °C, for the sample number 3 - -4.58 °C, for sample number 2 - -4.56 °C (fig. 2).

During freezing, storage, defrosting and heat treatment in meat systems for the production of chopped semi-finished products, a slight decrease in the pH value is observed at 0.02 ... 0.04 units relative to the initial level due to the decomposition of the glycogen remaining in the meat until freezing and the formation of lactic acid [10, 11, 12].

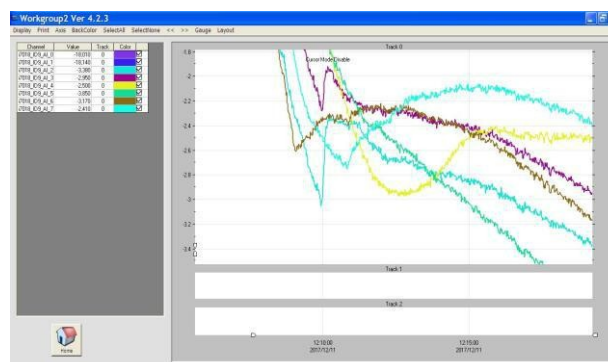


Fig.2. Cryoscopic points of model samples of truncated semi finished products when introducing different types of protein-polysaccharide mixtures

Of all the test samples of heat-treated split model meat products, the biggest changes in organoleptic quality (after freezing, storing for 30 days and thawing) were observed in control samples, characterized by a lack of succulence, fragility structure and lower mass losses and higher than 6.18 - 7.25 % losses due to heat treatment. The best qualitative characteristics were registered by the prototypes using a protein-polysaccharide mixture of plasma proteins, sodium caseinate, fiber of plantain and flax. However, they all had increased juiciness and a more dense consistency.

4. Conclusion

Thus, two promising directions of use of protein polysaccharide mixtures in the production of chopped semi-finished products can be singled out: this is the stabilization of the functional and technological properties of raw meat and the cryostabilization of meat systems in the manufacture of frozen semi-finished products.

The results of complex studies on the quality of the modulated chopped semi-finished products show the stabilizing properties of protein-polysaccharide mixtures, which manifest themselves in improving their qualitative and structural-mechanical parameters, reducing losses in heat treatment and increasing the yield of finished products.

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