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RESEARCH ON THE QUALITY INDICATORS OF CURD PRODUCTS BASED ON PROTEIN-HERBAL CLOTS

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Abstract: *The article presents the research of qualitative indicators of curd products with different nutritional ingredients based on protein-herbal clots. The effect of the number of Rumex juice and the duration of thermoacid processing on the process of precipitation of milk proteins was determined. It was established that the introduction of vegetative coagulant in the amount (9 ± 0.5)% at a temperature (93 ... 95) °C and endurance (3 ... 5) min - provides the optimal yield of protein-herbal clot taking into account restrictions according to organoleptic parameters. The effect of white sugar and apple pectin in fiber on the organoleptic, physico-chemical and rheological indicators curd products was investigated. The dietary fibers increase moisture-proof ability and effective viscosity of samples, and white sugar reduces these indexes due to dehydrating properties. The optimal option is to add to the protein-herbal bunch at the same time two components when mixing - white sugar and apple pectin in fiber in quantities of 15% and 2% respectively. Taking into account the influence of individual non-dairy ingredients - Rumex juice of white sugar and apple pectin in fiber on curd products, the performance of the finished product can purposefully be affected.*

Keywords: *protein-herbal clones, sorrel, cheese products, white sugar, apple pectin in cellulose.*

1. Introduction

Extension of assortment and improvement of quality of curd products is carried out as follows main directions:

- improvement of milk-protein concentrates, which are produced without significant changes of technology on existing equipment;
- creation of new types of curd products based on modified dairy raw materials from modern nutritional ingredients;
- use of innovative constructive ideas and technological processes.

Ingredients are generally administered in small quantities, taking into account to their efficacy. Ago special attention should be paid to the issue of preparation for their uniform distribution in raw materials, including milk-protein mixtures. To do this, you need to evaluate the structural state of raw material or semi-finished. Choose the stage in the process and the modes for making. Take into account the commercial form of the preparation (in the form of a solution, emulsion, dry powder, and granule), concentration (immobilized preparation on the carrier, composition, concentrate) and technological properties (water, fat solubility, salt stability, swelling, degree dispersion) and others [1-2]. Vegetable ingredients are used as a technological component in many production processes. So, the thermoacid coagulation of milk proteins occurs under action, as Serum with acidity (150 ... 200) °T, and coagulants of vegetable origin with relevant characteristics. The latest trend is aimed at expanding the production of milk- protein

products and also modernization of the assortment. Scientists have developed technologies for coagulation of milk proteins as berry raw materials [3-6], and other receptions. They provide a separation process constituents of milk with juice or extracts of plants including wild plants.

Consequently, the aim is to study the qualitative indicators of curd products on the basis of protein-herbal clots with different nutritional ingredients.

The object of the study is the technology of cheese products based on protein-herbal clots and also study of their quality indicators depending on the content of various foods ingredients. The subject of research - protein-herbal clots obtained by thermoacid coagulation of skimmed milk with sorrel juice, food fibers (apple pectin in fiber), white sugar, indicators of quality of model samples of curd products.

The task is:

- to get protein-herbal clots by thermal acid coagulation of fat-free milk in the presence of sorrel juice as a coagulant;
- research on the effect of white sugar and food fibers on organoleptic, physico-chemical and rheological indicators of curd products on the basis of protein-herbal clots.

2. Materials and methods

Sorrel (*Rumex*) was used as a coagulant for protein-herbal clots. It belongs to the genus of one-, two- and perennial herbaceous plants of the family buckwheat, the order of buckwheat flowers [7]. The water content of *Rumex* leaves is (90 ... 92)% protein 1,5%, total carbohydrates (3.0 ... 5.3)%, fiber 1%, minerals, in (mg%): Na (15), K (500), Ca (47), Mg (85), P (90), Fe (2,0). Vitamins, (mg%): C (43 ... 81), B1 (0.19), B2 (0.1), PP (0.3), β-carotene (2.5). The amount of oxalic acid is determined at the level of 360 mg% [8-11]. According to the literature [12, 13] oxalic acid is divided into organic and inorganic. In the first case, the acid contained in the fresh sorrel is useful for human health substance. It saturates the body with such necessary for the hemorrhage microelements as iron and magnesium. In the inorganic form it is a substance that is formed after heat treatment plants at temperatures above 100 ° C. The acid is coupled with free calcium, forming salts oxalic acid. Oxalates contribute to the formation of stones in the kidneys, the development of articular rheumatism and arthritis, destruction of teeth and bones. With moderate amounts intake of salt of

Oxalic acid, it is easily derived from the human body. The harmful amount is 50 mg per 100 g of product [14]. For thermal oxidation deposition from the leaves of *Rumex* received juice in the following sequences. The ground part was sorted, inspected from dirt and mechanical impurities, washed, dried. Chopped to a homogeneous state for (2 ... 3) minutes on the device of the brand DEX DHB-572 power of 750 W.

The raw material where a coagulation process was held is skim milk, which was pasteurized at a temperature (76 ± 2) ° C with a holding (15 ... 20) s. Mass fraction of dry matter is (11.2 ± 0.7)%, protein (3.7 ± 0.2)%, titrated acidity - (17 ± 1.0) ° T, density - 1032 kg / m^3.

Previous studies that took into account organoleptic constraints and protein release mass, the optimum amount of vegetative coagulant with pH (3.1 ... 3.5) is determined at the level (9 ± 0.5)% by weight of milk [3, 4]. This amount changes the active acidity of the mixture for providing a balanced isoelectric state of protein in the entire volume. It leads to their active coagulation for classical modes. In heated to a temperature (93 ... 95) ° C, skim milk it was added *Rumex* juice. During the application was moderately stirred and kept (3 ... 5) minutes until a clot was formed. Complex

the effect on high-temperature milk protein and acid reagent leads to the maximum complete their deposition. The process of coagulation was set visually for intense formation protein clot and serum release. The resulting protein-herbal clot had the following qualitative indicators: the mass fraction of moisture at the level (64 ± 2)%, titrated acidity (80 ± 1) ° T. The organoleptic characteristics of the clot were as follows. Color was light pistachio, not uniform; consistency of the clot was soft, plastic and tight; taste was milk-protein, cheese, without foreign smells, with a slight herbal flavor. At the next stage of the research, model samples of cheese products were made of proteinherbal clots with white sugar and food fibers (FF). The protein base was added into the mixer at a temperature of (12 ± 3) ° C and mixed with pre-sieved white sugar after partial mixing; prepared FFs were added to the mixture. If necessary, flavoring substances are introduced to disguise the color in the quantities recommended by producer (apple, kiwi - E600 - E699). The average duration of mixing was (5 ... 10) min.

As an FF, apple pectin in fiber was used (APF), which is produced in Ukraine according to TU U 30335750.001-2000. APF contains extruded wheat bran - 60%, apple powder - 38%, pectin - 2%. Chemical composition of 100 g above mentioned the food fibers the following, in%: the mass fraction of moisture – 6.0; Sugar - 48.7, including κeducing – 40.9; sucrose - 7.8, organic acids (by apple acid) - 5.0; cellulose- 13.4, pectin substances – 12.4, including water-soluble – 5.1, water-insoluble – 7.3; proteins - 6.7; fats - 6.8; potassium - 0.08; magnesium - 0.73; calcium – 0.32; phosphorus - 0.240. The vitamin complex of APF is represented by carotenoids (0.8 mg) and ascorbic acid (76.4 mg) [15].

During the experiment, the physical and chemical parameters of the model samples curd products were studied. Mass fraction of moisture was determined by drying the samples to a constant mass on the laboratory electronic scales-moisture series of ADS manufactured by the company "AHIS". Titrated acidity - a titration method based on neutralization of acidic substances contained in 100 g of product with a solution of sodium hydroxide or potassium concentration of 0.1 mol / dm^3. Moisture-retaining ability (HU) - by Grau-Hamm's method of modifications A.A. Alekseev, based on the determination of the amount (mass) of water released from the product is lightly compressed and absorbed by a filter paper. Effective viscosity - on a rotating viscometer "Reotest II". The viscometer uses a two-cylinder a measuring system that allows determining the structural mechanical characteristics of the syrup products. The measurement of the shear stress τ (Pa) was carried out with a change in the gradients of the shear voltage γ in the range of 0.33 ... 145.8 s^{-1} for direct traffic. The indicators of viscometer data were specified maximum angle of deviation of the arrow on the instrument scale. Displacement voltage (Pa) was calculated by the formula (Eq. 1):

$$\tau = Z \cdot \alpha, \qquad (1)$$

where Z is the cylinder constant, P · unit. scale; α is the measure of measurement.

The effective viscosity (Pa·c) was determined by the formula (Eq. 2):

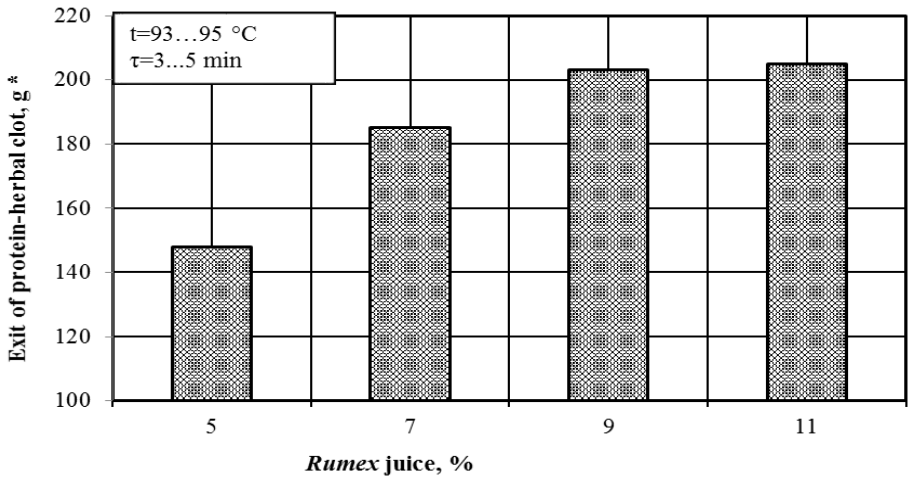
$$\eta_{ef} = \frac{\tau}{\gamma}, \qquad (2)$$

where γ is the gradient of shear force, c^{-1} [16-18].

All analytical definitions were performed at least three times. Indicator - is average the standard deviation value. The statistical analysis was conducted with the help of Microsoft Excel version 2010.

3. Results and discussion

The influence of the amount of *Rumex* juice on the process of coagulation of proteins in low-fat milk and output of protein-herbal clot has been confirmed. The output of the latter under the same conditions process and adjusted according to the amount of dry matter prepared *Rumex* is presented on Fig. 1.



* Mass fraction of moisture of protein-grassy clot - (64 ± 2) %

Fig. 1. The yield of a protein-grassy bunch, depending on the amount of *Rumex* juice

Organoleptic parameters are a limiting factor due to color variations of clots from barely green to intensely green (for 11% juice). Not formed clot that complicates the process of self-pressing (for 5% juice) is also a limiting factor. Number juice at the level (9 ± 0.5)%, taking into account the above restrictions, is optimal. Entrance Protein-herbal clot is (203 ± 5) g of 1000 g of skimmed milk. As for the course process, the result of coagulation is a partial dehydration, a decrease in the charge hydrated protein molecules and rapid precipitation in the precipitate. Curd products with a polycomponent composition should be elastic and plastic. This will allow the formation and packaging of products commonly accepted in the industry way on existing equipment [19]. As a result of the research, it was discovered the effect of the individual prescription components of sugar and food fiber with the above water absorption capacity on quality indicators of cheese products on the basis of protein-herbal clots. So, the amount of white sugar in the recipes of the classic soured items the range varies from 10% to 20% (creams, syrup masses, glazed curds, semi-finished products, etc.). To stabilize the moisture and enrichment of protein clots was Used APF. The basis of the distribution of ingredients is the need to clarify the effects of individual components of non-milk origin and their compositions on physico-chemical and rheological indicators of curd products. Results of determining the change in effective viscosity, moisture retention capacity and titrated acidity of the samples under study are presented in Table. 1.

Table 1

Dependency of titratable acidity, moisture-retaining ability and effective viscosity on the composition of curd products based on protein-grassy clots

№ Sample	Ratio of prescription components in curd products,%			Indicators of curd products		
	Protein-herbal clots	White sugar	APF	Titrated acidity, °T	Moisture-retaining ability, %	Effective viscosity, Pa · s
1	100	-	-	80 ± 1	57.5 ± 1.3	353.3 ± 3.3
2	90	10	-	78 ± 1	49.7 ± 1.0	293.5 ± 2.8
3	85	15	-	77 ± 1	46.4 ± 1.1	264.2 ± 2.7
4	80	20	-	76 ± 1	43.2 ± 1.3	234.8 ± 3.0
6	99	-	1	80 ± 1	60.3 ± 1.2	372.2 ± 3.0
7	98	-	2	79 ± 1	66.5 ± 1.1	411.3 ± 1.9
8	97	-	3	79 ± 1	71.8 ± 1.4	469.6 ± 2.5
10	89	10	1	79 ± 1	57.3 ± 2.1	345.99 ± 2.2
11	83	15	2	78 ± 1	61.1 ± 1.7	381.60 ± 2.5
12	77	20	3	77 ± 1	67.2 ± 1.6	401.03 ± 2.8

According to experimental data (Table 1), non-dairy ingredients that are added to the protein-herbal clot (namely, white sugar and / or APF), do not amplify the course of processes and do not activate the increase of acidity. This indicator basically depends from the constituent and qualitative parameters of the protein concentrate obtained by the way thermal coagulation of milk proteins with *Rumex* juice. White sugar slightly more reduces the acidity of the mixture than the APF. Samples containing 20% sugar and 80% protein-herbal clots have acidity of 3 ° T less than samples with the same amount protein component and 3% APF. The APF lowers the moisture content of the model samples, since they consist of hollow ones cells whose walls are cellulose. Other components are hemicellulose and pectin, which are in mostly located between empty cells. Hydrophilic substances of food fibers interact with moisture of dairy products due to the formation of H-bound polyasocyanates with the participation of water molecules and H-bound functional groups of hydrophilic substances. Molecules Hydrophobic groups become more ordered, as evidenced by a decrease in entropy. Due to dispersion forces hydrophobic groups are aggregated. When combined with moisture, they quickly get it adsorb, increase in size, which increases the viscosity of the system [20].

One of the most important physico-chemical indicators of model samples of curd products is moisture-retaining ability, which is associated with effective viscosity. Previous studies [19] found that for curd products, the index of moisture retaining ability (MRA) on levels above (82.0 ± 2)% are sufficient. Growth of the MRA leads to too dense consistency.

It is found that white sugar lowers the MRA and the effective viscosity of the model specimens. With adding a sugar to the protein-herbal clots in the amount of 20% of the MRA is reduced by 14.3%, and effective viscosity - almost 118.5 Pa · s. Intensively increase from (60.3 ± 1.2)% to (71.8 ± 1.4)% moisture-retaining ability curd products APF with high water

absorption capacity and hydrophilicity. At added to the protein-herbaceous clot above the above non-dairy ingredient in an amount from 1 to 3%, MRA is increased by 11.5%. At the same time, the effective viscosity increases from (372.2 ± 3.0) Pa · s to (469.6 ± 2.5) Pa · s. The ability of the FF to absorb water is related to the degree hydrophilicity and the number of biopolymers present in them, the nature of the surface and porosity particles, their sizes. They combine in their composition biopolymers with different kinship to water. Thus, pectin substances and some hemicelluloses are classified as hydrophilic colloid. This causes their ability to keep water. However, a significant increase in moisture retaining ability and effective viscosity of sour cream products are also undesirable because of this complication is transportation and mechanical the formation of products. Concerning the conditions of the introduction, the optimal option is to add at the same time two components - white sugar and APF. So, when added to the protein-herbal clot. 15%of white sugar and 2% of food fibers (sample number 11), moisture-retaining ability rises from (57.3 ± 2.1)% to (61.1 ± 1.7)% (Table 1), and the effective viscosity increases from (345.99 ± 2.2) Pa · s to (381.60 ± 2.5) Pa · s. The samples under study have organoleptic characteristics, which satisfy the requirements for such products.

4. Conclusions

The possibility of using *Rumex* juice in the amount (9 ± 0.5)% as a coagulant of milk proteins has been confirmed. This makes it possible to obtain organoleptically suitable protein-herbal clots of thermoacid coagulation of skimmed milk for regimes: temperature- (93 ... 95) ° C, duration - (3 ... 5) min.

Adding prescription components of sugar and APF to protein-herbal clots in different ways affects the physico-chemical and rheological indices of model samples of curd products. It has been confirmed that the moisture-retaining ability and effective viscosity of the samples increase food fibers. The process is due to the hydrophilicity of biopolymers. White sugar has dehydrating properties and reduces the moisture-retaining ability and effective viscosity of the samples. The acidity of curd products based on protein-herbal clots is determined by acidity the protein base is from (76 ± 1) ° T and up to (80 ± 1) ° T. Taking into account the influence of individual components non-dairy origin of the quantity of juice *Rumex*, white sugar and APF for curd products, you can purposefully influence the performance of the finished product. Its addiction will make it possible ensure compliance with regulatory documents and production conditions.

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