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ESTIMATIONOF PARAMETERS INFLUENCE ON THE RENNET CLOTTINGBY MEANS OF DISPERSION ANALYSIS

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Summary: The article is devoted to improvement of the quality of cheese production by studying the fermentation process of different types of cheese. The influence of clotting time and temperature conditions on the rennet clotting process in the production of soft-ripened and brine-ripened cheeses has been analyzed and determined.

Keywords: Cheesemaking, enzyme, rennet, rennet clotting, soft-ripened and brine-ripened cheeses, dispersion analysis.

Cheeses have high calorific value and physiological usefulness. Raw materials for the manufacture of cheese are quite diverse: cow's, goat's, sheep's and buffalo's milk. In the process of cheesemaking, all the basic nutrients of milk are kept safe, except carbohydrates. A significant part of water is removed from milk during cheese production and the result is a concentrated food product. There are proteins in cheese, which are split into separate amino acids during itsripening.The chemical composition of cheese includes native proteins (about 25%), which are easier to digest by the body, milk fat (about 25%), mineral substances (salts of calcium, sodium, phosphorus, etc.), fat-soluble and water-soluble vitamins (A, D, E, B, B2, PP) [1]. As a result, we get a very valuable food produce. Its production requires innovative technologies to preserve and improve the quality of the end product.Therefore, there is a relevant theoretical research problem of microbiological, biochemical and physicochemical processes occurring during cheese manufacture development and ripeningin order to form theoretically grounded recommendations for organization of technological processes.Many scientific works contain the main directions development of the cheesemaking process, which could be improved to provide higher of the product quality. The studing of the chemical milk’s composition and its technological properties, establishing the dependence between the milk clotting time, the pasteurization temperature, the action of rennet and the phase of gelation. However, the analysis of materials revealed a lack of information referring to the influence of a temperature regime and a clotting time on the amount of added enzyme as well as normally, the mechanism for calculating the various parameters in the cheesemaking. The value of the technological processindicators is determined in a practical way, so there are no calculation mechanisms for determining their best values.The volume and the quality of theoretical studies is insufficient to obtain the optimal mode for the clotting process, which affects the quality of the end product.

The aim of the research work was to assess the effect of clotting time and temperature regime on the amount of enzyme in the different types of cheese.

The cheese is obtained by clotting of milk with rennet or lactic acid, with the subsequent processing and aging of cheese mass. One of the operations in a general technological scheme of cheese production is preparation of milk for clotting, namely, cooling to a certain temperature, and adding necessary amount of enzyme according to this scheme.The type of the basic raw material, the method of milk clotting involved in the production of microflora cheese, the main indicators of the chemical composition and the fundamental features of the technology are the basis for cheese classification.

In cheese-making, four types of milk clotting are used: rennet, acid, rennet-acid, thermo-acid. Rennet cheeses are divided into hard, semi-hard, soft-ripened and brine-ripened. Rennet clotting is the result of rennet effect on milk. The duration of milk clotting is set depending on the type of cheese, in the production of hard cheeses it is 30-35 minutes, for low-fat cheeses – 35-40 minutes, for soft cheeses – 50-90 minutes. The clotting of milk is carried out at a temperature of 28°C to 35°C, depending on the type of cheese. When the milk ability to clottingis reduced, the temperature is increased within the limits permissible for each type of cheese[2].

The brine-ripened cheeses were represented in our research by Mozzarella and soft-ripened byGuada. The peculiarities of the production for each typeof cheese were taking into account. So, the dose of the rennet necessary for the clotting of milk was calculated under the following conditions: for Guada cheese the clotting time was 28-35 minutes and the clotting temperature was 30-32°C; for Mozzarella cheese the clotting time was 25-32 minutes and the clotting temperature was 35-37°C [2].The quantitative indicators of these parameters influence on the dose of the enzyme for milk clotting were found by dispersion analysis.At the first stage, the clotting time with varying temperature values was selected as factorial featurefor the analysis of the indicators of a brine-ripened cheese. At the second stage, the temperature of clottingwith varying clotting time was selected as the factorial feature(table 1).

Table 1

The amount of the added rennet enzyme

factor	Time (min)								R_i	R_i^2	P_i
	25	26	27	28	29	30	31	32			
30°C	5,83	5,61	5,4	5,21	5,03	4,86	4,70	4,56	41,20	1697,71	213,61
31°C	5,65	5,43	5,23	5,04	4,87	4,70	4,55	4,41	39,87	1589,95	200,05
32°C	5,47	5,26	5,06	4,88	4,71	4,56	4,41	4,27	38,63	1492,13	187,74
Sdg	4,33	Sfac	0,41	Sres	3,92	σfac	2,17	σres	0,19	4779,79	601,39
40°C	4,38	4,21	4,05	3,91	3,77	3,65	3,53	3,42	30,90	954,964	120,15

factor	Time (min)								R_i	R_i^2	P_i
	25	26	27	28	29	30	31	32			
41°C	4,27	4,10	3,95	3,81	3,68	3,56	3,44	3,33	30,15	908,948	114,36
42°C	4,17	4,01	3,86	3,72	3,59	3,47	3,36	3,26	29,43	866,18	108,98
Sdg	2,37	Sfac	0,14	Sres	2,24	σfac	0,07	σres	0,11	2730,09	343,5

Similar calculations were made for indicators of Guada cheese. The calculations of the experimental value and tabulated value for Fisher criterion identified, that for cheese Guada, factors of temperature and clotting time did not change the values of the added enzyme amount, therefore the selected limits of these parameters were optimal. For brine-ripened cheeses, the factor of temperature did not affect on clotting factor, when the clotting time factor affected.Is showed that, it was necessary to observe carefullythe time interval and calculate the dose of the required enzyme with higher accuracy, to obtain favorable conditions for the fermentation process. The proposed algorithm for determining the parameters of the rennet clotting process allowed to analyze and obtain the optimal values for the factor characteristics of the studied value –theamount of the added enzyme.

Conclusion. The dispersion analysis was used in the research of the rennet clotting process in cheese manufacturing. The influence of temperature and clotting time on the amount of added enzyme for soft-ripened and brine-ripened cheeses was evaluated. The optimal limits of the fermentation process parameters were revealed. This improve the conditions of the process.Comparative analysis of the values of the rennet dose for each type of cheese in the clotting sample were made taking into account the time and temperature of milk clotting. Further research prospects might be devoted to comparative analysis of rennet clotting parameters for hard and semi-hard cheeses, with the identification of mechanisms of cheesemaking process patterns of flow and determining the optimal values of the parameters.

References

1. Krus' G.N. Tekhnologiya moloka i molochnykh produktov. (Milk and dairy technology). Kiev, 2012. P. 28.

2. Bogdanov V.M. Mikrobiologiya moloka i molochnykh produktov. (Microbiology of milk and dairy products). Minsc, 2015. P.112.