SHORT COMUNICATION

OPTIMIZATION OF MANUFACTURING TECHNOLOGY OF SOFT CHEESE

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Abstract

The aim of this work was optimization of production processes and determination of the goals settings of the optimal values in production of investigatory soft cheese. Consequently, fat and protein ratio of the prepared pasteurized milk mixture for soft cheese production, and their influence on the fat content in dry matter of final product was determined, moisture of the coagulum and the final product established and the coagulum moisture content and coagulum drying effect on the duration of the final product moisture investigated.

It was established that the largest fat content in dry matter of soft cheese (52.21%) is by the fat/protein ratio of – 1.21, and the lowest (41.69%) – by the ratio of 0.83. Optimal pasteurized mixture of milk fat/protein ratio for soft cheese is from 0.830 to 0.962. The ideal fat/protein ratio for given soft cheese – 0.89. The lowest moisture content of the final product (51.9±0.08%) was obtained by the coagulum moisture at 76.1±0.07%, and the highest – 55.0±0.09%, when coagulum moisture was 71.4±0.13%. The optimal coagulum moisture range, conforming to corporate standards for the final product moisture soft cheese is from 69.01 to 75.55%. The longest drying time of the coagulum (35 min) corresponds to the minimum moisture content of soft cheese – 51.438±0.492%. The maximum moisture content of soft cheese 54.87±0.38% was obtained, when the coagulum drying time was 30 min. This period of time is also optimal drying time for coagulum of investigatory soft cheese.

Keywords: milk, soft cheese, coagulum.

Introduction

Production of cheese has started in the year 8000 BC, according to the various sources. Cheese is ripened or unripened, soft or semi-hard, hard or very hard product (which may have a coating or shell), and the protein (casein) ratio of whey should not exceed the amounts in milk (Sekmokien et al., 2008).

The quality of produced cheese acts the composition, quality and activity of the leaven of the milk used in tanning for the cheese production, decisive. Cultures micro flora catalyzes the enzymatic milk clotting process, stimulates enzymatic curd syneresis and provides unfavorable conditions for the secondary micro flora. Cultures micro flora changes the main milk components (lactose, proteins, lipids) in the compounds, leading to cheese flavor, aroma, nutritional and biological value. Compounds, secreted of cultures micro flora, in particular CO_2, form the porosity and consistency of cheese (Rupsiene, 2003).

Soft cheese is characterized by the fact that there is a considerable amount of moisture, which causes a variety of problems if quantity of humidity is too high. Excessive moisture can cause unwanted micro-organisms appearance and reproduction, therefore, in order to avoid of this, term of realization has to be short what is useless for the company in respect of sales. Also product loses marketable appearance, its organoleptic properties becomes lower (Gudonis, 2012; Masteikiene, 2006).

This investigation was focused on the one kind of dairy product – soft cheese. All the production from entering the establishment of milk to the finished product is analyzed, with the aim of optimization of production processes and determination of the goals settings of the optimal values in production of investigatory soft cheese.

Materials and Methods

This research was carried out in the Department of Biochemistry of LHSU and in the company "Modest".

The cheese-making technology. Milk for the production of cheese is normalized in fat and protein relation. To obtain the corresponding final product oiliness, the appropriate relationship of fat and protein must be used. Normalized mixture is heated to 35–45 °C and cleaned. Finally, in order to obtain the required normalized fat milk and a skim milk of minimum fat content, it must be separated. The following sequence is: filling of production machines, heating of milk, tanning and clotting of milk mixture, curd processing, cheese making, pressing, and the salting. Finally, the cheese is ripened and realized (TI-10-PL-3).

Milk analyzer Lactoscope C4 + (Holland) was used to detection of milk fat, protein, solids and freezing point. This spectrophotometer analyzes the milk and milk products composition using infrared technology. The moisture content was determined using a moisture analyzer KERN MLB-N.

In the statistical analysis of the data arithmetic averages of groups were calculated, the errors were estimated and statistical significance of intergroup was established (ANOVA, Duncan multiple comparisons test). The correlation coefficients were counted and regression analysis (linear and square studied addiction) was conducted for evaluation of relations between the characteristics of subjects. Calculations were made with the computer program Microsoft Excel 2007. The study is considered reliable at $p<0.05$, unreliable – if $p>0.05$.

Results

Soft cheeses are moist, and it causes many problems for the product. Undesirable microorganisms may appear due the high moisture content inside the cheese. In order to avoid this, a short term of product sales is recommended. Product loses marketable appearance, decreases its organoleptic characteristics, at the same. Consistency of the product becomes fragile; the product is crumbling, it is impossible to dice it nicely. This soft cheese is cut by hand and evacuated in the company; these conditions causes large yield losses because of large amounts of scrap and are not suitable for sale.

It was very important to optimize the production technology of soft cheese so as to control the moisture and get the best possible texture of the product, to minimize financial losses of company and to satisfy the buyer with the result. In order to achieve these targets it was necessary to look over the cheese-making technology and perform tests, focusing on normalization of pasteurized milk mixture in respect of fat/protein ratio, estimation of grain moisture and grain drying time impact on the quality of the product and evaluation and determination of the optimum values of these parameters in the production process.

Test of the pasteurized milk mixture fat / protein ratio influence on the final product.

The milk supplied to the company is usually too rich in fat and has too high protein content. Dairy products derived from such non-standardized milk are very creamy and low consistency – soiled, without form and excessive fat content can lead to extraneous taste, also. Therefore, in the milk industry in order to get cheese of standard fat and protein content milk is normalized by normalization instructions with skim milk, buttermilk or sour cream. This is the most important step, which determines the chemical parameters of the forthcoming final product.

Rations of fat and protein in pasteurized milk mixture were presented in Figure 1.

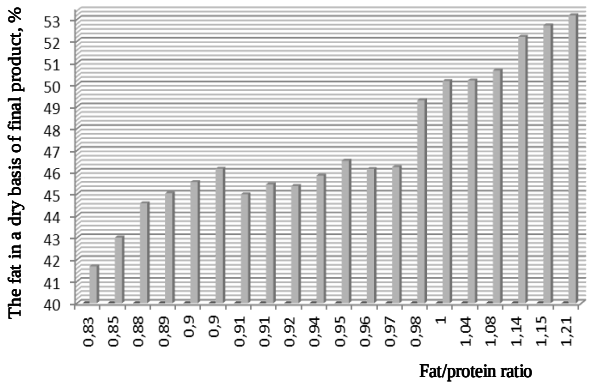


Figure 1. Dependence of the fat in a dry basis of soft cheese on fat/protein ratio of pasteurized milk mixture

The data showed that the increase of fat / protein ratio leads to the growing of the fat in a dry basis of soft cheese, almost evenly. The highest it is in fat / protein ratio of 1.21, and the lowest at 0.83.

The graphical regression analysis of the interdependence of these properties is presented in Figure 2. It was set very strong linear correlation ($r=0.96$, $p<0.001$) among the fat / protein ratio and the fat in a dry basis of soft cheese.

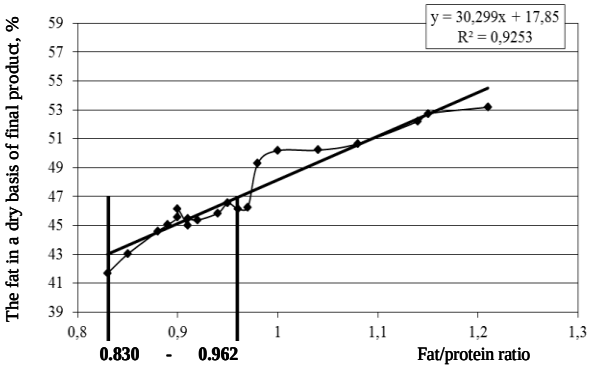


Figure 2. The interdependence regression analysis of fat/protein ratio and fat in the dry basis of soft cheese

The fat content on a dry basis of the final product increases with the increase of the fat / protein ratio. Since the linear equation describes the dependence statistically reliable, we can predict the fat / protein ratio limits, hoping to get optimal fat content on a dry basis of soft cheese. To obtain the final product within the fat content of the dry basis of 45±2%, the fat / protein ratio should range from 0.830 to 0.962.

Influence of grain moisture on the moisture of final product.

Cheese grains obtained during the manufacturing process distinguish the whey and forms a peel. If the peel arises very quickly, the whey fails to stand out from grains, so in grains, and thus the in mass of cheese, could increase the number of micro-organisms activity. Otherwise, when the peel arises very slowly too much whey is eliminated from the grain and the product becomes very dry and crisp. His consistency is crumbling.

During the technological process, when curd cutting, mixing and drying of grains were executed, the samples from the production machines were selected. The moisture contents in the milk samples were determined using a moisture analyzer KERN. In the Table 1 the average values of moisture in grains and in soft cheese are presented.

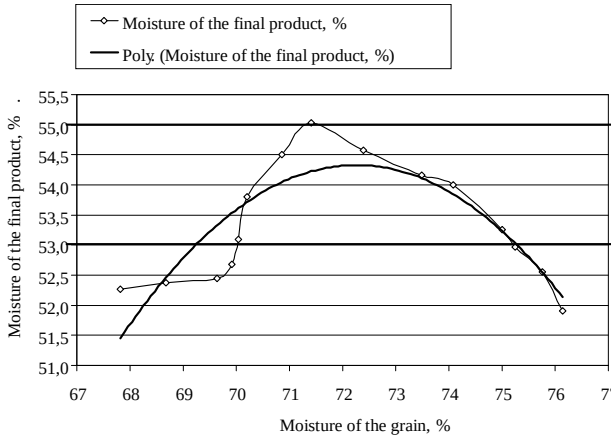
From the data presented in Table 1 it is evident that there is no linear relationship between the moisture of soft cheese and grains: initially, with the increase of grain moisture the moisture content of soft cheese is also growing, but later, after the optimum point is reached, soft cheese moisture begins decline, although grains moisture continues to increase. The maximum value of the final product moisture 55.0±0.09% is reached when the grains moisture is 71.4±0.13%.

Table 1

The average values of moisture in grains and soft cheese, %

Production No.	In grains	In soft cheese
1	67.8±0.11	52.3±0.06
2	68.7±0.11	52.4±0.07
3	69.6±0.22	52.4±0.11
4	69.9±0.09	52.7±0.08
5	70.1±0.07	53.1±0.07
6	70.2±0.09	53.8±0.06
7	70.9±0.07	54.5±0.06
8	71.4±0.13	55.0±0.09
9	72.4±0.09	54.6±0.05
10	73.5±0.09	54.2±0.04
11	74.1±0.05	54.0±0.03
12	75.0±0.06	53.3±0.03
13	75.2±0.06	53.0±0.05
14	75.8±0.04	52.6±0.03
15	76.1±0.07	51.9±0.08

The graphical dependence of the final product moisture on the grain moisture is given in Figure 3.



$y = -0.1455x^2 + 21.034x - 705.63$, $R^2 = 0.7397$

Figure 3. The soft cheese moisture dependence on the grains moisture

The dependence of soft cheese moisture on the grains moisture we described using the quadratic equation. Statistical significance of addiction was evaluated calculating the Fisher criterion ($F=3291.2$, $p<0.001$ ($p=4.01\times10^{-54}$)). Equation can be statistically significant ($p<0.001$) predicted that the moisture of the final product will vary within the permitted limits (53–55%), when grain moisture content will vary in the range from 69.01 to 75.55%, according to the dependence.

The influence of the moisture of soft cheese on grains drying time.

The grains drying time is particularly important process that determines the appearance of the product. It depends on the season of the year and from the composition of the milk changes. The grains drying time is determined by grains moisture, which is important in order to get a good consistency of the final product. The data presented in Table 2 shows influence of soft cheese moisture on the grains drying time.

Table 2

The influence of soft cheese moisture on grains drying time

	Test No.1	Test No.2	Test No.3
Grain drying time	25 min	30 min	35 min
Soft cheese moisture, %	53.44±0.489 a	54.87±0.38 1 bC	51.438±0.492 bD

a, b indicates a statistically significant differences at $p<0.05$. C, D indicates a statistically significant differences at $p<0.001$.

The average moisture content of soft cheese 53.44±0.489% is obtained after drying of grains for 25 min (Table 2). After drying for 30 min the average moisture content of soft cheese is 54.87±0.38%, and drying for 35 min – 51.438±0.492%. In the standard IST 121313693-01:2009 of JC Modest humidity for soft cheese is declared 55±2%, so after drying for 35 min the humidity of soft cheese does not meet the requirements of the standard above, and such a product could not be released to the market.

Discussion

Ratio of fat / protein in milk mixture is very important in milk industry. Too high fat content in the mixture can damage the sensory properties of produced cheese and the product could bee too soft, can not have its inherent consistency, moisture content of product will become too high and it could start multiplying of various bacteria. Too low level of fat content in the milk mixture will make the product lean, dry, it could become free-flowing and crumbly. According to company standard IST 121313693-01:2009, the ideal ratio of fat / protein in a milk mixture was 0.89, during our experiment (Fig.1).

The grains size of the cheese is very important for the moisture content of cheese mass. The whey will excrete much faster from the smaller grains than from the larger. Together with the whey and dissolved substances, releases colloidal and emulsion components of milk.

Because of the distinguishing of whey from the cheese grains, a peel forms on the surface. If the peel arises very quickly, the whey fails to stand out from grains, so in grains, and thus the in mass of cheese, could increase the number of micro-organisms activity. So, it is very important to determine appropriate moisture of grains to obtain standards-compliant product.

Moisture content of final product in SC Modest enterprise standard for soft cheese is defined 53–55% (IST 121313693-01:2009). When the moisture of

grains is 67.818%, the moisture of soft cheese – 52.268% (does not meet to the indicator defined by standard of the company). When grains moisture is 71.418%, moisture of soft cheese – reaches 55.038% (optimal variant of declared parameters), while the moisture of grains was 76.148%, soft cheese moisture was just 51.898% (does not meet to the indicator defined by standard of the company). The optimum range for grains moisture is from 69.01 to 75.55%.

All the studies and analysis of the results were based on our own assumptions and conclusions, as neither Lithuania's nor foreign authors on a similar theme was unable to find and compare.

Conclusions

1. The largest fat content in dry matter of soft cheese (52.21%) is by the fat / protein ratio of – 1.21, and the lowest (41.69%) – by the ratio of 0.83. Optimal pasteurized mixture of milk fat / protein ratio for soft cheese is from 0.830 to 0.962. The ideal fat / protein ratio for given soft cheese – 0.89.
2. The lowest moisture content of producet soft cheese (51.9±0.08%) was obtained by the coagulum moisture at 76.1±0.07%, and the highest – 55.0±0.09%, when coagulum moisture was 71.4±0.13%. The optimal coagulum moisture range, conforming to corporate standards for the final product moisture soft cheese is from 69.01 to 75.55%.
3. The longest drying time of the coagulum (35 min) corresponds to the minimum moisture content of producet soft cheese – 51.438±0.492%. The maximum moisture content of soft cheese 54.87±0.381% was obtained, when the coagulum drying time was 30 min. This period of time is also optimal drying time for coagulum of investigatory soft cheese.

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