INNOVATIVE APPROACH ON THE METHOD OF PRODUCING FRESH MILK CHEESE

L. Molokanova, I. Hovanets
Donetsk National University of Economics and Trade,
31, Shchorsa Street, Donetsk 83050 Ukraine
mshovanets@mail.ru

Abstract. The method of making fresh milk cheese with the use of alternative methods of milk preservation – the use of enzyme preparations with high basidial fungi is examined in the article. Milk coagulation activity of enzyme preparations derived from high basidial fungi – producers of protein milk action Hirschioporus laricinus (Karst.) Ryv. and Irpex lacteus was established by the Method Kawai, Mukai. It was established that the highest milk coagulation activity have enzyme preparations with strains A-Don-02 and P-04. It was defined that the concentration of calcium chloride solution needed as a catalyst for the process of milk coagulation. The new method of obtaining fresh milk cheese using enzyme.

Keywords: milk cheese, food, cheese, milk product, hirschioporus laricinus, basidial fungi.

Introduction

The consumption of dairy products, especially curd (cottage cheese) and cheese products is highly desirable for all groups of the population. Curd is a concentrate of a milk protein casein, which is also located in a swelled and partially denatured state, which is much more accessible to digestive enzymes and is absorbed by a human almost completely. From this point of view curd is regarded as an effective source of complete animal protein, the deficit of which in the diets of the Ukrainian population is felt rather sharp.

The large amount of acid in curd makes its use for certain categories of people (patients with gastritis and stomach ulcers) quite problematic, that’s why they were recommended the use of curd which is derived with acid-Frennet method.

Today the curd is obtained in industry by a number of ways.

One of the ways of getting fresh milk cheese is in casein precipitation with calcium chloride when heated. This method is carried out in the following way.

Into the cold milk (temperature 24-25 °C) skimmed or normalized a 40% aqueous solution (5 litres of solution per 1 ton of milk) of 0,2 crystalline calcium chloride (CaCl2) is added and thoroughly mixed. Then the milk is heated up to 85°C without stirring and is allowed to stand still during 40-60 minutes till the formation of a clot. The clot and serum obtained in the result in a still state (without breaking the clot) is cooled till the temperature (40-45 °C). After that the clot is separated from the serum and is exposed for self-pressing during 1-2 hours and then is cooled till the temperature 8°C (Krus, 1992).

The disadvantage of this method is the presence of the specific flavour in the ready-made milk cheese caused by lots of calcium and consistency with protein grains. That’s why this kind of cheese is mainly used as a gemiproduct, because there is a need of its further processing – grinding to a homogeneous state (for getting rid of protein grains) and mixing with other components (for elimination of a specific flavour).

The mechanism of the following method is in applying of enzyme coagulation of milk casein – with the help of rennet enzyme (renninum). Its essence is to ensure that 40% solution of calcium chloride and the solution of rennet enzyme are added into the milk fermented with bacterial cultures at temperature (32-34 °C) that promotes the coagulation of milk and the formation of a thick and sturdy clot. The obtained clot is separated from the serum, is exposed for self-pressing and further processing Gorbatova K., (1984) biochemistry of milk and dairy products, legkay i pishevay promishlenost».

Meanwhile this method also has some disadvantages:
- renninu deficit, which is explained by the decrease in productivity of domestic animal husbandry;
- low quality of domestic renninu – domestic renninu is produced inadequately purified, it contains an admixture of pepsin which is characterized by high proteolytic activity in the amount of 30-40%;
- high cost of imported renninu;
the need to use highly concentrated calcium chloride solution in order to intensify the process of coagulation of milk.

In addition the obtained clot is dense and durable. It makes convenient to use the renninu method in the production of cheese that mature, but problematic in the production of dairy cheese. The use of enzyme preparations of microbial or other origin that are the nearest to renninu on their effect on milk proteins is the most effective and promising method for the dairy industry. The most famous in the world market are enzyme preparations “Pfitser” (Czech Republic), “Fromaza” (France), “Méïté” (Japan), “Russulin” (Russia). However, the description of the production process for the fresh milk cheese using enzyme preparations of microbial origin is absent.

Method
To clarify the applicability of preparations of microbial origin as substances capable to coagulate the milk, we use method Kawai, Mukai which allows to set the milk coagulating activity (MCA) of enzyme preparations (EP). This method is based on establishing of milk coagulating time and allows to calculate the conditional milk coagulating activity (CMCA) and absolute milk coagulating activity (AMCA) (1979).

According to this method, into the test tube with 10 ml of substrate (milk), which was sustained in the water bath (at 35 °C) during 2 minutes, 1 ml of EP was added, carefully shaked and again was placed in the water bath at 35°C. At the moment of shaking tube the stopwatch and the countdown of milk coagulation were run and were ended at the formation of a dense clot. The conditional MCA expressed in minutes is considered the time of milk coagulation, the absolute MCA is calculated in units of milk which coagulates 1 g. of enzyme for 40 minutes at 35°C. The dilution factor of EP is 1000.

After determining enzyme preparations the milk coagulating activity of which is the highest, the concentration of calcium chloride solution was determined which is needed as an activator of catalyst of milk coagulating process.

For this purpose calcium chloride solution was added into milk with concentration of 40F5% in steps of 5% (i.e. 40%, 35%, 30%, 25%, 20%, 15%, 10%, 5%).

Results
It was installed the milk coagulating activity of enzyme preparations derived from the highest basidial fungi Hirschioporus laricinus (strains A-031, A-032, M-81, P-323) and Irpex lacteus (strains A-Don-02 and P-04) Boyko M. et al. (1988, 1995), Fedotov O., Negrutskii S. and Boyko M. (1997).

EP of fungal origin were obtained at the Department of Plant Physiology DonNU from the culture fluid by the culturing indicated strains at 80% ammonium sulfate deposition followed by centrifuging and purificating method of dialysis against distilled water.

Milk coagulating activity was compared with milk coagulation activity of rennet and lactic ferments.

Research results of milk coagulating activity of enzyme preparations are given in Table 1.

The pasteurized milk was used as the substrate in determining MCA of enzyme preparation. In the first step-undiluted milk with 3.2% of fat and in the second step – the fatless milk were used. For the purity of the experiment in both cases the pH adjusting of milk by acidification, as it is required by the technological instruction for the cottage cheese production, is not performed. The data of pH of undiluted milk is 6.86 and of fatless milk is 6.9.

The obtained data show that the highest MCA have the enzyme preparations A-Don-02 and P-04 derived from the fungus Irpex Lacteus the value of which is 2.7-3.9 times higher that the value of MCA of enzyme preparations from fungus Hirschioporus laricinus and 4.3-4.7 times higher than MCA of milk ferment and only 1.8-2 times lower than MCA of rennet (Fig.1).

Similar results were obtained at the research of MCA of fatless milk substrate. The difference is that the value of MCA of absolutely all EP were increased, indicating a specific effect on the rate of fat content in milk.

Milk coagulating activity of EP varies significantly depending on the fat content of milk. So it is necessary to make constant recalculations of the EP amount introducing into milk when producing fat, half-fat and low-fat cottage cheese.

Taking into account that the highest milk coagulating activity have enzyme preparations A-Don-02 Hirschioporus laricinus and P-04, derived from the fungus Irpex lacteus, they were selected as the active substance.
According to the technological instruction in the manufacture of cheese the calcium chloride solution is added into milk at a concentration of 40%.

When using calcium chloride in the specified concentration together with enzyme preparations A-Don-02 and P-04 the obtained cheese has the specific taste due to the great amount of calcium and excessive dense texture.

When adding calcium chloride of different concentration into milk the evaluating criteria was the consistency of clot and the degree of presence of a specific flavour.

Based on the results of the experiment the best solutions are those with concentration of 20% and 15% with the introduction of which the ready-made product is characterized by soft, moderately dense texture and purely milk flavour.

Samples of cheese obtained from calcium chloride solution at the concentration of 20% and 15% are practically the same according to their organoleptic characteristics. That’s why, from the economic point of view, the optimal concentration is considered of 15%.

**Discussion**

We have not changed the technological operations prior to the inclusion in the milk of calcium chloride and enzyme preparation and are preparatory.

Thus, the preposed method of obtaining the fresh milk cheese includes:

---

### Table 1

<table>
<thead>
<tr>
<th>Enzyme Preparation (EP)</th>
<th>Undiluted milk</th>
<th>Fatless milk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time of milkcoagulation, minutes</td>
<td>MCA, un.milk</td>
</tr>
<tr>
<td>Rennin</td>
<td>3,85</td>
<td>1038960</td>
</tr>
<tr>
<td>Streptococcus thermophyllus</td>
<td>29,45</td>
<td>110204</td>
</tr>
<tr>
<td>A-031</td>
<td>25,16</td>
<td>158982</td>
</tr>
<tr>
<td>A-032</td>
<td>20,52</td>
<td>194932</td>
</tr>
<tr>
<td>M-81</td>
<td>27,83</td>
<td>143729</td>
</tr>
<tr>
<td>P-323</td>
<td>22,10</td>
<td>180995</td>
</tr>
<tr>
<td>A-Don-02</td>
<td>7,72</td>
<td>518130</td>
</tr>
<tr>
<td>P-04</td>
<td>7,06</td>
<td>566572</td>
</tr>
</tbody>
</table>

---

### Fig. 1. Milk coagulating activity of enzyme preparations, un. milk.
- Preparation of milk – using the separators-milk cleaners at the temperature (37±3 °C);
- Normalization of milk – when making cheese with a fat mass of 2-9%;
- Homogenization of milk;
- Pasteurization – at the temperature (78-80 °C) during 20-30 seconds;
- Cooling – till the temperature (27±3 °C);
- Introduction of 15% calcium chloride solution;
- Introduction of enzyme preparations (A-Don-02 or P-04) – 2 g.;
- Mixing of milk;
- Coagulation of milk till forming of a dense clot;
- Processing of a clot depending on the purpose of a ready-made fresh cheese: grinding – in case of the use of the cheese as an independent product or grinding to a homogeneous mass in case of use as a basis for cheese products.

The distinctive features and advantages of the preposed method of making fresh milk cheese compared to the traditional are the following:

- Enzyme preparations Irpex lacteus strain A-Don-02 and atrain P-04 are characterized by the high MCA (milkcoagulating activity) – 518000-565000 con.u. and 566000-606000 con.u. correspondently, making their use in the manufacture of fresh milk cheese very perspective;
- The introduction of lactic ferments is eliminated from the technological process;
- Calcium chloride (the activator of enzyme preparation) is used in much less concentration allowing to avoid the specific flavour;
- The method provides the obtaining of fresh milk cheese with a pure milk flavour (without the sour taste) and a low amount of milk acid, which makes it suitable for people diets, especially for people with gastritis and gastric ulcer;
- Significant reduction (3 times) for mixing milk helps to reduce the cost of the finished product;
- Ready-made cheese has a delicate, slightly smear texture, allowing without extra expenses to use it for making cheese curd, pastas, desserts;
- This method does not require the use of special equipment (traditional stationary equipment) which allows to wide the industrial production of fresh milk cheese.

The use of enzyme preparations of strain A-Don-02 and P-04 as active agents for coagulation of milk and getting fresh milk cheese is promising, as it helps to expand the resource base for the dairy industry, dairy assortment of cheeses and cheese products based on it, the assortment of high-protein food products for people with diseases of the stomach.

References


Krus, G. (1992) Technology of cheese and other dairy products, Moscow: Kolos