Microbiological Researches of the Curd and the Pressed Cheese from Cow’s Milk During Processing

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Abstract. The main purpose of these researches is to study the variation of microbiological parameters in curd processing in cheeses with scalded paste. The pressed cheeses are obtained by scalding the ripening curd at 72-74 °C for 50-60 sec. [2, 3]. The temperatures used for milk pasteurization and for curd scalding reduce contamination of milk and curd used in pressed cheese manufacturing. The further evolution of these microorganisms during the pressed cheese ripening is quite interesting.

Microbiological analysis of cheeses is an important step in controlling cheeses production in order to assure quality, reproducibility and brand identity [2].

Key words: microbiological indicators, coliforms, micromycetes.

INTRODUCTION

Coliforms are sanitary microbiological indicators of great importance. Presence of these organisms in milk may have as source the washing water from the collection recipes (if infected), and most times, the faeces reaching the milk vessels with dust. The coliforms group includes the following taxonomic bacteria types: Escherichia, Enterobacter, Serratia, Citrobacter, Klebsiella, Acromobacterium [1].

Coliforms become sometimes pathogenic if they are found in large number in milk (a few million/ml) or even in a very small number when it comes to recognized pathogenic strains. From technological point of view they are responsible for the occurrence of defects and alterations (early cheese bloating) due to gas fermentation, with gas production.

Moulds contamination of milk can cause changes of its three main features in terms of quality: wholesome, nutritious and enjoyable, phenomena having at the same time hygienico-sanitary implications. Yeast and micromycetes load of cheese depends on raw milk quality and hygiene during processing and storage.

Moulds can lead to changes in organoleptic properties of milk, translated by altering particular odor, discoloration and taste and great difficulty in preserving milk contaminated with mould. The moulds can also affect the nutritional value of milk through changes in amino acid content, of casein and their action on fat, especially the lipolytic moulds as Aspergillus niger, Aspergillus fumigatus, Penicillium stekii [1].

MATERIALS AND METHODS

For analysis there were taken samples in four stages of the processing flow: during curd ripening, in the scalded and kneaded curd, in the partial dried cheese and in the pressed cheese during ripening. Random samples were taken in sterile containers, according to STAS 9535/1-87, and were noted as follows:

V₁ - Curd during ripening;
V₂ - Scalded and kneaded pressed cheese;
V₃ – Pressed cheese after partial drying;
V₄ – Pressed cheese during ripening

The methodology used for cheese examination:

- Coliforms number (cfu)/g, CN/g
  - Microbiology of food and animal feeding stuffs – Horizontal method for the detection and enumeration of coliforms – Most probable number technique
  - SR ISO 4831/2006

- Coliforms number (cfu)/g, CN/g
  - Microbiology of food and animal feeding stuffs – Horizontal method for the enumeration of coliforms – Colony count technique
  - SR ISO 4832/2006

- Micromycetes number (cfu)/g, TNM/g
  - Microbiology - General guidance for enumeration of yeasts and moulds – Colony count technique at 25°C
  - SR ISO 7954/2001

RESULTS AND DISCUSSIONS

There were analyzed every 60 semi-processed samples coming from five processing milk plants specialized in obtaining pressed cheeses. Samples were collected and analyzed in batches in various stages of the manufacturing process and the microbiological parameters were monitored during the pressed cheeses manufacturing by the end of their ripening.

Statistical analysis of the microbiological parameters during the study within technological phases is presented in Table 1, for coliform bacteria and Table 2, for micromycetes.

Tab.1

<table>
<thead>
<tr>
<th>No.</th>
<th>Semi-manufactured product</th>
<th>Sample</th>
<th>Minimum value, NBC/g</th>
<th>Maximum value, NBC/g</th>
<th>Mean, ( \bar{X} )</th>
<th>Standard deviation of the mean, ( s_{\bar{X}} )</th>
<th>Standard error of the mean, ( s_{\bar{X}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Curd during ripening</td>
<td>60</td>
<td>130.0</td>
<td>46000</td>
<td>5095</td>
<td>9015</td>
<td>1164</td>
</tr>
<tr>
<td>2.</td>
<td>Scalded and kneaded curd</td>
<td>60</td>
<td>0.0</td>
<td>460.0</td>
<td>51.40</td>
<td>90.78</td>
<td>11.72</td>
</tr>
<tr>
<td>3.</td>
<td>Pressed cheese after partial drying</td>
<td>60</td>
<td>0.0</td>
<td>640.0</td>
<td>81.10</td>
<td>131.9</td>
<td>17.03</td>
</tr>
<tr>
<td>4.</td>
<td>Pressed cheese during ripening</td>
<td>60</td>
<td>0.0</td>
<td>690.0</td>
<td>107.1</td>
<td>147.1</td>
<td>18.99</td>
</tr>
</tbody>
</table>

During the curd ripening the CN/g varied between 130 and 46000 cfu/g product with a mean (\( \bar{X} \pm s_{\bar{X}} \)) of 5095 ± 1164 ufc/g.

For the scalded and kneaded curd CN/g varied between 0 and 460 cfu/g product with a mean (\( \bar{X} \pm s_{\bar{X}} \)) of 51.4 ± 11.72 cfu/g.

For the pressed cheese after partial drying the CN/g varied between 0 and 640 cfu/g product with a mean (\( \bar{X} \pm s_{\bar{X}} \)) of 81.1 ± 17.03 cfu/g.

During the pressed cheese ripening the CN/g varied between 0 and 690 cfu/g product with a mean (\( \bar{X} \pm s_{\bar{X}} \)) of 107.1 ± 18.99 cfu/g.
During processing it can be noticed a decrease of coliforms number of the product immediately after the curd scalding operation, and then it can be noticed a slight increase of these bacteria in the product, until the end of ripening (Fig. 1). The large number of coliforms in curd is explained by high initial microbiological load of milk, and their increase during ripening is due to the subsequent contamination of cheese semi-manufactured products because of the scalding brine and because of manipulation.

During curd ripening the TNM/g varied between 0 and 61000 cfu/g product with a mean ($\overline{X} \pm s_X$) of $2370 \pm 1022$ cfu/g. For the scalded and kneaded curd the TNM/g varied between 0 and 12500 cfu/g product with a mean ($\overline{X} \pm s_X$) of $403.5 \pm 209.6$ cfu/g. In case of the pressed cheese after partial drying the TNM/g varied between 0 and 26000 cfu/g product with a mean ($\overline{X} \pm s_X$) de $1038 \pm 446.6$ cfu/g.
In case of the pressed cheese during ripening the TNM/g varied between 0 and 70000 cfu/g product with a mean of \( \bar{X} \pm s \) de 3140 ± 1215 cfu/g.

During processing it can be noticed a decrease of micromycetes number from the product immediately after the curd scalding operation, after which there is an increasing of number of these microorganisms in the product until late ripening (Fig. 2). The large number of micromycetes from curd is explained by high initial microbiological load of milk, and their increase during ripening is due to subsequent contamination of the cheese semi-manufactured products caused by the air from the ripening rooms, due to manipulation and packing.

Statistical analysis of the differences registered between microbiological loads of various cheese semi-manufactured products during cheese manufacturing is presented in the Table 3 below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samples</th>
<th>Difference between means</th>
<th>t, df=59</th>
<th>Correlation coefficient (r)</th>
<th>p</th>
<th>Significance of the differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliforms, CN/g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_2 )</td>
<td>5044</td>
<td>4.378</td>
<td>0.9999</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_3 )</td>
<td>5014</td>
<td>4.372</td>
<td>0.9913</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_4 )</td>
<td>4988</td>
<td>4.356</td>
<td>0.9774</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>( V_2 - V_1 )</td>
<td>-29.70</td>
<td>5.270</td>
<td>0.9911</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>( V_2 - V_3 )</td>
<td>-55.65</td>
<td>7.016</td>
<td>0.9773</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>( V_3 - V_4 )</td>
<td>-25.95</td>
<td>8.187</td>
<td>0.9904</td>
<td>P&lt;0.0001</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Total number of micromycetes, TNM/g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_2 )</td>
<td>1966</td>
<td>2.420</td>
<td>0.9976</td>
<td>0.0186</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_3 )</td>
<td>1332</td>
<td>2.283</td>
<td>0.9894</td>
<td>0.0260</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>( V_1 - V_4 )</td>
<td>-770.1</td>
<td>2.824</td>
<td>0.9852</td>
<td>0.0065</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>( V_2 - V_1 )</td>
<td>-634.1</td>
<td>2.638</td>
<td>0.9913</td>
<td>0.0106</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>( V_2 - V_4 )</td>
<td>-2736</td>
<td>2.710</td>
<td>0.9853</td>
<td>0.0088</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>$V_1 - V_4$</td>
<td>-2102</td>
<td>2.730</td>
<td>0.9984</td>
<td>0.0083</td>
<td>**</td>
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</tr>
</tbody>
</table>

ns – (p > 0.05); * – (0.01 < p < 0.05); ** – (0.001 < p < 0.01); *** – (p < 0.001).

$V_1$ – Curd during ripening
$V_2$ – Scalded and kneaded pressed cheese
$V_3$ – Pressed cheese after special drying
$V_4$ – Pressed cheese during ripening

Regarding the CN/g there were registered statistically significant differences *** (p < 0.001) among all samples analyzed in different phases of work.

Regarding the TNM/g there were registered statistically significant differences * (0.01 < p < 0.05) between $V_1$-$V_2$, $V_1$-$V_3$ and $V_2$-$V_3$ and distinct ** statistically significant (0.001 < p < 0.01) between $V_1$-$V_4$, $V_2$-$V_4$ and $V_3$-$V_4$.

The correlation coefficient (r) was between 0.9773 and 0.9999.

CONCLUSIONS

During the pressed cheeses manufacturing process, evolution of the studied microorganisms had the following dynamics:

- For 45% of the samples there were found more than 1000/g product in the curd during ripening, and after the scalding operation the coliforms number cfu/g got situated below 1000/g;

- Total number of micromycetes, TNM/g of more than 1000/g product, was recorded for:
  - 38.3% of curd samples during ripening,
  - 8.3% of scaled and kneaded curd samples,
  - 16.7% of pressed cheese samples after the partial drying
  - 43.3% of pressed cheese samples during ripening.

- Microorganism’s evolution dynamics is being influenced by the following: the cleanliness of raw milk, cleanliness of the working rooms, machinery, instruments, staff, the cleanliness of the scalding brine, the ripening period, climate conditions from the ripening rooms (temperature and humidity).

REFERENCES

5. (2006). SR ISO 4831, Microbiology of food and animal feeding stuffs – Horizontal method for the detection and enumeration of coliforms – Most probable number technique;