Changes in Soluble Nitrogen, pH and Lactic Acid During Ripening of Chabichou-type Cheese

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ABSTRACT

Twenty-eight samples of Chabichou-type cheese made from goat's milk in Juiz de Fora, Brazil, were tested for soluble and total nitrogen, titratable acidity (expressed as percent lactic acid), and pH during a 30-day period. Soluble N amounted to 45-55% of total N after 30 days, and pH and lactic acid were increased and decreased, respectively, from 5.20 to 6.82 and from 0.83 to 0.05%. The composition of 14 cheese samples was determined between the first and fourth day after production. The minimal and maximal values were as follows: 20-25% fat, 16-20% protein, 1.6-2.3% soluble protein, 51-53% moisture, 1.4-2.2% NaCl, 0.7-0.9% lactic acid and 5.2-5.3 pH.

During cheesemaking and cheese ripening a gradual protein breakdown takes place; this is a complex process in which the enzymes from rennet, from starter bacteria and from milk itself play an important role (2.9). In mold-ripened cheese, the phenomena occurring during cheese ripening, partially caused by the proteolytic enzymes from specific molds, contribute to development of the organoleptic characteristics of the cheese.

In ripened cheeses with surface mold of the Penicillium roqueforti type, the proteolytic activity of this microorganism causes a breakdown of αs- and β-casein (3) and an increase in pH 4.6-soluble N to about 50% of the total N (5). Formation of amino acids and other nitrogenated compounds also results in an increase in pH during cheese ripening; the relation between pH and ripening days has been studied for Camembert cheese by Lenoir (7).

The Chabichou cheese has been produced in the Départements Vienne and Deux-Sèvres as well as in Poitiers, in France for many years. Experiments were conducted at the Dairy Institute Candido Tastes (4) to adapt the French technique of Chabichou cheese-making to the conditions in Brazil. This cheese was produced from goat's milk and the Penicillium glaucum (or roqueforti) was used as the lipolytic and proteolytic agent during the ripening. An active proteolysis that lead to appearance of significant amounts of soluble N during ripening of the cheese was observed. Changes in pH and in lactic acid content were followed as long as the ripening took place. The composition (minimal and maximal values) of cheese was also determined. The present paper reports the results of such determinations.

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EXPERIMENTAL PROCEDURES

Cheese were manufactured on different dates from goat's milk according to the previously described technique (4). Cheese samples were taken from the ripening chamber 1.4 (n = 14), 7 (n = 3), 14 (n = 4), 21 (n = 3) and 30 (n = 4) days after production and were analyzed for total and soluble N, lactic acid and pH. Between the first and fourth day (after production) 14 cheeses were analysed to determine the fat, protein, moisture and salt content, as well as the above-mentioned parameters. Each time a cheese not previously investigated was used; the samples analysed were not always from the same batch of cheese. All determinations were made in duplicate.

Total and soluble N were determined according to the method described by Kosikowski (6) but using 1 g of cheese and only 50 mg of the diluted sample to perform the Kjeldahl determination with a micro-Kjeldahl kit (AOAC 47.021; 1975). Fat was determined using 0.5 g of cheese, a Van-Gulik butyrometer, 10 ml of H2SO4 (d = 1.820), 5 ml of warm water and 1 ml of amyl alcohol (d = 0.815) for each determination. Determination of moisture and sodium chloride content was according to the method described by Kosikowski (6). The titratable acidity was measured using 0.1 N NaOH and the titration value of the sample was assumed to be lactic acid (6). The pH was determined according to Kosikowski (6) using a Radiometer potentiometer Model THM 26 (Denmark).

RESULTS AND DISCUSSION

Liberation of soluble nitrogen

Liberation of soluble N proceeded continuously throughout the ripening of the cheese. Soluble N increased from about 10% (first days) to about 26% of total N after 2 weeks (normal ripening period for this cheese), and up to 36% of total N at the end of 3 weeks. After 30 days, such N amounted to 45% of total N. High values for pH 4.6-soluble N were reported for Danish cheese (5). Levels of about 55% were found in inoculated cheeses produced aseptically and with P. roqueforti and Penicillium caseicolum (3). Proteolysis was evident on the surface of the Chabichou-type cheese and proceeded progressively to the center during ripening; this occurred because the P. glaucum was sprayed on the cheese surface where it grew. Due to its endo- and exopeptidase activity, an increase in soluble N was brought about and in a centripetal way. The changes in concentrations of soluble N with time of ripening of the Chabichou type cheese are shown in Fig. 1.

pH, lactic acid content and cheese ripening

Changes in pH paralleled the proteolytic activity in the cheese because the amino acids, peptides, peptones and amines formed during the protein breakdown contribute
to changes in basicity of the cheese. One day after the cheese was produced, the pH of the cheese was near 5.2, and after 7 days it increased by 0.4 pH-unit (for the same period soluble N increased approximately 4%). After 14 days, the pH was about 5.8, and after 21 days, it was slightly over 6, whereas at the end of 30 days it reached 6.82. This is shown in Fig. 2. Desmazeaud and coworkers (3) reported that in cheeses containing Penicillium molds the pH increased after 12 days of ripening, and after 27 days the pH stayed constant at about 7.

On the other hand, the pH increased in the same way as the lactic acid content decreased. After cheesemaking, the percentage of lactic acid in the Chabichou cheese was about 0.85%, and after 4 days it decreased to 0.55%. After 1 week, the value decreased to about 0.10%, and at the end of 30 days it was less than 0.05% (See Fig. 2). The breakdown of sugars during Camembert ripening was studied by Berner (1). He showed that sugar breakdown proceeded more slowly in the interior of the cheese than in the rind, the velocity of breakdown depending on the number of microorganisms in the internal and external parts of the cheese. The decrease of lactic acid during ripening of Chabichou-type cheese probably reflects the amount metabolized by the mold. It was also observed that pH increased more rapidly in cheese rind than in the center; however, not enough data were obtained to report a mean value.

Finally, Table 1 gives the minimal and maximal values experimentally determined (n = 14) for the composition of the cheese.

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimal</th>
<th>Maximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (%)</td>
<td>16.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Total protein (%)</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Soluble protein (%)</td>
<td>51.0</td>
<td>53.0</td>
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<tr>
<td>Moisture (%)</td>
<td>42.0</td>
<td>51.2</td>
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<tr>
<td>Fat in dry matter (%)</td>
<td>1.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Salt (NaCl) (%)</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Lactic acid (%)</td>
<td>5.2</td>
<td>5.3</td>
</tr>
</tbody>
</table>

*14 cheese samples analysed within 1 and 4 days after production.

REFERENCES