STUDIES ON CHANGES DURING RIPENING OF BUFFALO CHEDDAR CHEESES MANUFACTURED BY DIFFERENT METHODS

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INTRODUCTION

Because of major compositional differences in buffalo milk as compared to cow and differential behaviour of the milk and its constituents during cheddar cheese manufacture, it cannot be assumed that the cheese manufactured from buffalo milk by the methods standardised for cow milk can give the product exactly similar to cow cheddar cheese. Such a product tends to be different from the cow milk product in as much as the body is dry and crumbly, flavour being flat with predominance of bitter taste. This is mainly because of the problems of slow acidity development, faster renneting time, low retention of moisture and lower proteolysis and lipolysis encountered during buffalo cheese manufacture. Several attempts have been made to overcome these problems (Czulak, 1964, Srinivasan & Burde, 1972) and to standardise a process to make a good quality cheddar cheese from buffalo milk. Little, however, is known about the chemical and sensory changes during ripening of buffalo cheese made by these methods. This paper enlightens this particular aspect.

MATERIALS AND METHODS

Milk: Fresh mixed cow milk from cross-bred and Indian breeds of cow and buffalo milk from Murrah breed was obtained from the Experimental Dairy of the NDRI, Karnal.

Manufacturing methods: The cow milk cheddar cheese was made using method of Kosikowski (1966). The buffalo milk cheddar cheese was made from modified methods of Czulak (1964) involving salt treatment during cooking of curd and of Srinivasan and Burde (1972) involving elimination of ripening of cheese milk before renneting. All three cheeses, after paraffining, were stored for ripening at 13° ± 1°C upto 12 months.

Chemical analysis:

Milk: Cow and buffalo milk was analysed for acidity (ISI, 1960), fat (ISI, 1977), total solids and casein (ISI, 1961), total nitrogen, non-casein nitrogen, non-protein nitrogen (Meneffee, et al. 1941).

Cheese: A wedge of cheese (2 to 3 kg) was cut from main block for analysis, at intervals. After removal of the wax and the rind, the cheese was grated, mixed thoroughly to secure representative sample and stored in screw capped polyethylene bottles at 10°C till analysis were completed. The cheese samples were analysed for moisture and salt (ISI, 1964), fat (Laboratory Manual, 1959), total nitrogen, non-casein nitrogen and non-protein nitrogen (Meneffee, et al. 1941) and pH (O'Keefe et al. 1976).

Sensory Evaluation of cheese:

All the cheese samples were evaluated for
their body, texture, taste and aroma by a panel of judges using a 9-point hedonic scale.

RESULTS AND DISCUSSION

Chemical changes: The buffalo milk cheeses manufactured by two methods, namely, Czulak (CZ) and Srinivasan and Burde method (SB) were studied for the chemical changes during ripening in comparison with the ripening changes in a conventional cow milk cheese made by Kosikowski (CK) method. The chemical changes have been described, one by one, hereunder.

Moisture: The initial moisture content of SB cheese was appreciably lower than that of the other two (Fig. 1). There was a gradual decrease in moisture content during ripening, the SB cheese showing significantly greater loss of moisture. The moisture loss in the CZ and CK cheese was comparable with that observed by Nofal et al. (1977).

Fat: The fat content (on DM basis) in all the three lots of cheese was more or less similar (Table 1) and was within the normal range for cheddar cheese, (El. Sokkary and Hassan, 1951; Nofal et al. 1977).

Total nitrogen: The total nitrogen contents in cow and buffalo cheeses were (Table 1) similar to those reported by Gupta (1971) and Nofal et al. (1977) for cheese made from milk standardized to a casein : fat ratio of 0.7.

Non-casein nitrogen (NCN): The NCN content during the 12 months ripening period showed a tendency to increase as anticipated (Fig. 2), the increase being significant after 2, 3 and 1 month for CK, CZ and SB cheese respectively. It may however, be noticed that beyond 4 months of ripening the NCN content of the SB cheese became nearly constant while that of other two lots increased at even higher rates. After 9 months of ripening, the NCN contents of CK and CZ cheese became almost similar.

Non-protein nitrogen (NPN): The NPN content (Fig. 3) increased considerably after 1, 3, and 2 months of ripening in CK, CZ and SB cheese respectively. The increase was
TABLE 1

Fat and Total Nitrogen (TN) (% on DM basis) contents in cheese manufactured by different methods

<table>
<thead>
<tr>
<th>Ripening period (months)</th>
<th>Method</th>
<th>CK</th>
<th></th>
<th>Method</th>
<th>CZ</th>
<th></th>
<th>Method</th>
<th>SB</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Fat</td>
<td>TN</td>
<td></td>
<td>Fat</td>
<td>TN</td>
<td></td>
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<td>TN</td>
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<tr>
<td>0</td>
<td></td>
<td>39.8</td>
<td>6.48</td>
<td></td>
<td>39.7</td>
<td>6.44</td>
<td></td>
<td>41.7</td>
<td>6.52</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>45.6</td>
<td>5.93</td>
<td></td>
<td>43.7</td>
<td>5.56</td>
<td></td>
<td>45.4</td>
<td>5.88</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>49.2</td>
<td>5.55</td>
<td></td>
<td>49.6</td>
<td>5.55</td>
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<td>3</td>
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<td>46.2</td>
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<td></td>
<td>45.3</td>
<td>5.91</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>46.9</td>
<td>6.29</td>
<td></td>
<td>45.7</td>
<td>6.40</td>
<td></td>
<td>44.4</td>
<td>6.66</td>
</tr>
<tr>
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<td></td>
<td>45.6</td>
<td>5.98</td>
<td></td>
<td>44.8</td>
<td>5.37</td>
<td></td>
<td>45.9</td>
<td>6.55</td>
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<tr>
<td>6</td>
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<td>43.1</td>
<td>5.65</td>
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<td>44.4</td>
<td>5.74</td>
<td></td>
<td>44.7</td>
<td>5.73</td>
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<td></td>
<td>47.1</td>
<td>6.67</td>
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<td>48.5</td>
<td>7.36</td>
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<td>48.9</td>
<td>6.95</td>
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<td>48.9</td>
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<td>50.6</td>
<td>7.46</td>
<td></td>
<td>49.2</td>
<td>7.73</td>
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Salt-in-moisture (SIM) : As shown in Fig.4, the SIM contents of CZ cheese was significantly higher than that of the other two lots of cheese, obviously because of the higher initial amount of salt retained in the former. The SIM increased with a simultaneous decrease in the moisture content during first six months. Later on it remained almost constant.

pH of cheese : The pH of cheese decreased during the first month of ripening and subsequently increased considerably for all the three lots of cheese (Fig. 5). The increase was much faster in the first 6 months than during the latter half of the ripening period. During the initial stage of ripening the pH of CZ cheese was somewhat higher than the other two lots, the SB cheese showing the lowest pH. The rise in pH rather abrupt after 6 months of ripening in all the cases. In general, the CK cheese had somewhat higher NPN content as compared to SB and CZ cheese. The NPN contents in CK, CZ and SB cheeses after 12 months of ripening were 1.12, 1.13 and 1.05% (on DM basis) respectively. Mathur and Bhakarao (1969), however, found much higher NPN content (1.67%) in buffalo milk cheese after 12 months of ripening.

Fig. 3 Non-Protein nitrogen in cheese : Method of manufacture
Ripening Changes in Cheese

during ripening has been shown by Dawson and Feagan (1960) for cow milk cheese and by Tambat (1975) for buffalo milk product.

Changes in Sensory Characteristics:
Aroma and Taste: It appears that the aroma score (Table 2) in the CK cheese increased steeply in the first two months of ripening and gradually till 9 months, and thereafter it declined slightly, while in the buffalo milk cheese the aroma score declined sharply till first 3 months of ripening, and thereafter increased.

TABLE 2
Effect of methods of manufacture on sensory quality of cheese

<table>
<thead>
<tr>
<th>Ripening period (Months)</th>
<th>Aroma</th>
<th>Taste</th>
<th>Body</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CK</td>
<td>CZ</td>
<td>SB</td>
<td>CK</td>
</tr>
<tr>
<td>1</td>
<td>6.25</td>
<td>6.40</td>
<td>6.20</td>
<td>6.25</td>
</tr>
<tr>
<td>2</td>
<td>7.67</td>
<td>5.83</td>
<td>5.60</td>
<td>7.40</td>
</tr>
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<td>3</td>
<td>7.75</td>
<td>5.63</td>
<td>5.63</td>
<td>7.75</td>
</tr>
<tr>
<td>4</td>
<td>8.00</td>
<td>6.26</td>
<td>6.38</td>
<td>8.13</td>
</tr>
<tr>
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<td>8.00</td>
<td>6.78</td>
<td>6.75</td>
<td>8.11</td>
</tr>
<tr>
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<td>7.57</td>
<td>7.25</td>
<td>6.63</td>
<td>7.86</td>
</tr>
<tr>
<td>9</td>
<td>8.29</td>
<td>7.29</td>
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<td>8.29</td>
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<tr>
<td>12</td>
<td>7.94</td>
<td>6.69</td>
<td>5.43</td>
<td>6.94</td>
</tr>
<tr>
<td>Av</td>
<td>7.58</td>
<td>6.51</td>
<td>6.18</td>
<td>7.59</td>
</tr>
</tbody>
</table>
and decreased similarly as for the cow milk product. While the score in the beginning (at the end of first month of ripening) was not much different for the three lots, subsequently the CK cheese scored significantly higher than the remaining two lots, SB cheese being poorest particularly after six months of ripening. The aroma score (average of 12 ripening periods) was considerably higher for CK (7.7) than those for CZ (6.5) and SB (6.2). The taste scores followed more or less a similar pattern as that of the aroma scores (Table 7). Here again, the CK cheese score (average of 12 ripening period) was the highest (7.6) and that of SB the lowest (5.9) while CZ scored 6.7. No bitterness was observed in the CK or CZ product while the SB cheese was found to be bitter after 4, 5, and 12 months of ripening. The buffalo milk cheese was generally found to lack the typical flavour of the traditional cheddar cheese.

As has been reported by Czulak (1964) that the pH of buffalo milk cheese should not fall below 5.2 to control bitterness and the SIM should be above 5 percent (Jago, 1974), from Figures 4 and 5 it is evident that both the characteristics were below the limits prescribed hence the greater bitterness in SB cheese.

Body and texture: The body and texture scores have been presented in Table 2. The scores (average of all ripening periods) for body and texture were substantially higher in the CK cheese (7.7 and 7.9) as compared to CZ (6.4 and 6.7) and SB (6.4 and 6.6) cheese respectively. The characteristic mellowness of the cheddar cheese was largely lacking in the buffalo milk cheese especially during the first few months of ripening. Frequently the body was hard, corky and brittle. The higher body score for the CK cheese corresponded with greater protein degradation as indicated by the NCN and NPN values and higher moisture content (Figures, 1, 2 and 3).

As for the body, the texture of CK cheese was noted to be appreciably superior to that of the buffalo milk product the CZ cheese scoring slightly higher than the SB cheese particularly after five months of ripening.

SUMMARY

Cheddar cheese made from buffalo milk does not possess the characteristic flavour of cheese, it is flat, more bitter and has hard, corky, dry and crumbly body. An attempt was, therefore, made to compare the chemical & sensory changes during ripening of cheddar cheese made from cow milk by the Kosikowski method (CK) with that made from buffalo milk by Czulak (CZ) and Srinivasan and Burde (SB) method. The buffalo milk cheeses (CZ and SB), in general, had lower moisture, NPN, NCP and pH than cow milk (CK) cheese, SB cheese showing the lowest rates. The aroma and taste scores (average of 12 ripening period) were considerably higher for CK (7.7 and 7.6 on 9-point hedonic scale) than those for CZ (5.5 and 6.7) and SB (6.2 and 5.9) cheese. Only SB cheese was observed to be bitter at 4.5 and 12 months of ripening. Similar were the scores for body and texture, respectively 7.7 and 7.9 for CK, 6.5 and 6.7 for CZ and 6.4 and 6.6 for SB. Lower moisture content and slower proteolysis seems to be responsible for low sensory score of buffalo cheese particularly of SB cheese.

REFERENCES


ISI (1964) IS: 2785, Specification for Hard cheese, processed cheese and processed cheese spread, Indian Standards Institution, New Delhi.


