Effect of processing variables on the sensory quality of milk cake

Anil Kumar, G. R. Patil, R. R. B. Singh and A. A. Patel

Abstract  Sensory quality of milk cake as a function of processing variables was evaluated to standardize the process for manufacturing long-life milk cake. Different levels of processing variables that were studied included fat percentage (4-6%) in milk, levels of sugar (8-12%) and corn syrup (0-6%) and thermization temperature (60 to 80°C for 60 min.). The sensory parameters studied were flavour, body & texture, colour & appearance and overall acceptability. The sugar and corn syrup levels and thermization temperature were found to significantly (p<0.01) affect all the sensory parameters while the effect of fat percentage in milk was not significant on colour and appearance of the product but significant (p<0.01) for other sensory parameters. It was concluded that the levels of fat in milk at 5%, sugar at 10%, corn syrup at 2% and thermization temperature of 75°C/60 min were optimum for the preparation of milk cake with best sensory quality.

Keywords: Traditional milk product, milk cake, process standardization, sensory quality

Introduction

Production of traditional dairy products account for more than 50 percent of total milk produced and is hence of considerable significance to the Indian dairy sector. Milk cake is one of the popular traditional dairy products (sweets) of northern and central parts of India. Such milk-based Indian sweets have established domestic markets and are popular among Indian ethnic population in other countries as well. However, technology for milk cake manufacture, like other traditional products (sweets), has remained confined mostly to the unorganized sector (halwais) where quality of the products depends on the skills of the manufacturer. For a consistent quality, a standardized method of manufacture of milk cake which can be scaled up for the organized industry is therefore very relevant. The processing variables both in terms of the levels of ingredients added during the manufacture and the thermization treatment given to the product for texturization and development of typical colour and luster play a key role in sensory acceptability of the product. The fat content of milk, level of sugar added, the concentration of other additives and the time-temperature combinations employed during the thermization are the most critical factors. Several workers in the past have tried different methods for the manufacture of milk cake. Ramesh, (2000) used milk with 6% fat, 9% solids not fat (SNF) and 12% sugar whereas Karwasra et al., (2001) made milkcake using 6% sugar and 0.02% citric acid. Landge et al. (2004) used 0.01% alum for coagulation and 2% ghee for improved sensory attributes. Rao et al., (2003) made milkcake of good quality using milk with 6% fat, and 15% sugar and Varma et al., (2005) standardized the process for making milkcake from cow milk.

Sucrose being an important ingredient of milkcake not only imparts flavour but also helps in maintaining the physical characteristics of the product. But in addition to positive effects of sucrose, several negative influences have also emerged. The most important of these have been health concerns associated with high levels of sucrose consumption, principally dental caries, obesity, diabetes, hypertension, hypoglycemic and heart diseases, etc. These have resulted in efforts to find alternative sweeteners that lessen these risks and also help to achieve a reduction in energy consumption (Chetana et al., 2005). When searching for replacements for sucrose it is important to be able to deliver both the physical
effects and the clean sweetness characteristics of sugar (Kilcast, 1999). To meet these requirements, production of reduced/low calorie foods including sugar-free products is on the rise and hence unique qualities (including physical properties and their interaction with other ingredients in the system) of such new additives as ingredients like corn syrup, maltodextrin, polydextrose, polyols such as sorbitol as bulk sweetener, etc. must be studied and understood (Wright, 1990).

To replace sugar, apart from texture and sensory attributes, the stability and packaging aspects of the products must be considered. Corn syrup is a well-known humectant used in various food products. It lowers the water activity of food products in which it is added in addition to improvement in the body & texture, especially of dairy products. Thus, it not only acts as a sweetener but also helps in enhancing storage stability of the product. Dharam Pal (2000) replaced 50% of cane sugar with corn syrup (42 DE) in burfi and observed improvement in texture along with the reduction in water activity which exerted an inhibitory influence on the growth of the bacteria. Ramesh (2000) has also reported that the body and texture of milkcake was adversely affected, body being drier and brittle during subsequent storage period.

Milk sweets and syrup based sweets prepared from cereal or legume flours, individually or in combination are highly common all over India. However, information regarding standardization and storage behaviour are lacking for a variety of traditional sweets with such new ingredients (Sen and Ramanna, 1979; Arya, 1990). As the present study was intended to optimize the processing parameters with a long time objective to develop technology for the manufacture of long-life milkcake using hurdle concept, it was considered necessary to study the effect of different processing variables and ingredients on the sensory quality of the milkcake.

Materials and Methods

Buffalo milk obtained from the experimental dairy of the institute was standardized to different fat levels (4 - 6%) and 9% SNF. The levels of fat and SNF were selected based on the results of the market survey (Kumar, 2005) and available literature. Corn syrup was added as an ingredient to act as a humectant which could also improve the texture of the product. Three levels of cane sugar (8, 10 and 12 %) and fat (4, 5 and 6%) were tried. The corn syrup was added at four different levels (0, 2, 4 and 6%) whereas five thermization temperatures (60, 65, 70, 75 and 80°C for 60 min) were studied during the experiments. The method of manufacture of milkcake recommended by Ramesh, (2000) served as broad guideline for standardization of the process for milkcake manufacture.

For the manufacture of milkcake, standardized milk was heated to 35 to 40°C in a double jacketed steam-heated kettle and filtered with muslin cloth. The milk was boiled and acidified (0.18%LA) with food grade acidifying agent (citric acid, 0.05%) to induce partial coagulation and grain formation in the product. Desiccation was continued till patting stage, sugar added and mixed by stirring properly. After working the mass for few minutes, corn syrup was added and worked further till the mass started leaving surface of the kettle. The hot mass was then packed in laminated pouches, sealed and thermized at different time-temperature combinations in hot air oven. After thermization, the product was taken out, cooled to room temperature and served to the panel of judges for sensory evaluation. Samples were evaluated for sensory characteristics on a 9-point hedonic scale (Lawless and Hayman, 1998) by a panel of six judges. The data obtained from sensory evaluation was analyzed statistically according to the method described by Snedecor and Cochran, (1994).

Results and Discussion

Effect of fat level on sensory quality

The effect of three levels of fat in milk i.e. 4, 5 and 6 % on the sensory quality of milkcake was evaluated. The flavour, body & texture and overall acceptability score increased significantly (p<0.01) with the increase in fat level from 4 to 6% (Table 1). The flavor score of milkcake made with 6% fat was significantly higher than the milkcake made with 4% fat milk, but was statistically at par with the flavour score of milkcake prepared from 5% fat milk. Ramesh (2000) and Kumar (1999) also observed that increase in fat level significantly (p<0.01) affected flavour and overall acceptability score of milkcake. In a similar study, Varma et al., (2005) also revealed that with the increase in the fat level, significant (p<0.01) increase was observed in the flavour, body and texture and overall acceptability scores of milkcake made from cow milk. However, in the present investigation the product was subjected to thermization at different time-temperature combinations and it was noted that when the milkcake was made with 6% fat there was little fat separation visible on the surface of the product and fat was also found adhering to the inner sides of the package. It was, therefore, concluded that a maximum of 5% fat level could be used for the manufacture of milkcake when in-package thermization treatment was to be adopted.

Effect of sugar level on sensory quality

Sugar contributes to the sweetness and caramelized flavour of the milkcake and hence affects the overall acceptability of the product. Three different levels of sugar added on the milk weight basis (8, 10 and 12 %) that were used in the study were evaluated for its effect on the overall acceptability of the product. The average sensory scores for various sugar levels presented in Table 2 showed that the sensory scores increased with the increase in the level of sugar from 8 to 10% while...
the milkcake with 12% sugar was rated as too sweet. The addition of sugar at 10% level not only resulted into highest score for flavour but also for overall acceptability of the product. Sugar at 10% level gave desired sweetness and caramel flavour. Moreover, at 12% sugar level, browning and caramelization was pronounced which possibly decreased the average flavour and overall acceptability scores for milkcake.

Contrary to these observations however, Ramesh (2000) reported that flavour and overall acceptability score for milkcake was higher for 12% sugar level. The body and texture score increased as the sugar level was increased from 8 to 10%, which is in accordance with the results obtained by Ramesh, (2000). However, several authors in the past have reported that 6-7% sugar (on the basis of weight of milk) is appropriate for good quality milkcake and other such products viz. burfi, peda and kalakand (Kumar, 1999; Reddy, 1985; and Sachdeva, 1980). In our study, milkcake containing sugar at 6% level was reported to be less sweet by the sensory panel. So based on our observations 10% level of sugar was selected as the optimum. The flavour score of milkcake was found to be statistically significant (p<0.01) for all the three levels of sugar.

Effect of corn syrup level on sensory quality

Corn syrup was added in milkcake with the purpose of preventing adverse changes in body & texture or colour during manufacture as well as during subsequent storage. It was observed during the preliminary studies that addition of corn syrup at the initial stage led to significant browning in the fresh product and if added at the last stage of manufacture the obtained product was pasty. Addition of corn syrup at the patting stage however resulted in an acceptable quality. Four different levels of corn syrup (0, 2, 4, and 6%) were used and the average sensory scores (Table 3) for milkcake added with corn syrup revealed that the sensory attributes of milkcake were significantly (p<0.01) affected at all the levels of addition. When the corn syrup was added at the 2% level, the average sensory scores increased slightly for flavour and body and texture but for colour and appearance or overall acceptability there was marginal decrease in the scores. And as the concentration was further increased from 2 to 6%, the average sensory score for overall acceptability was subsequently reduced. At the 6% concentration, the scores decreased below 7.0. Hence, it was found that corn syrup at the level of 2% contributed well towards sensory properties of freshly prepared milkcake improving its acceptability.

Effect of in-package thermization on sensory quality

Milkcake is a heat desiccated dairy product. Heat treatment is also further given to the final product after packaging for product texturization. The in-package heat treatment is followed by cooling under controlled condition for the development of

### Table 1: Effect of level of fat on the sensory attributes of milkcake

<table>
<thead>
<tr>
<th>Fat level (%)</th>
<th>Flavour</th>
<th>Body and texture</th>
<th>Colour and appearance</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>7.04</td>
<td>7.18</td>
<td>7.64</td>
<td>7.16</td>
</tr>
<tr>
<td>5</td>
<td>7.62</td>
<td>7.70</td>
<td>7.66</td>
<td>7.62</td>
</tr>
<tr>
<td>6</td>
<td>7.76</td>
<td>7.86</td>
<td>7.68</td>
<td>7.72</td>
</tr>
<tr>
<td>F-test</td>
<td>**</td>
<td>**</td>
<td>NS</td>
<td>**</td>
</tr>
<tr>
<td>C.D. at 1%</td>
<td>0.2311</td>
<td>0.2364</td>
<td>0.2026</td>
<td>0.2417</td>
</tr>
<tr>
<td>SEM</td>
<td>0.05353</td>
<td>0.05477</td>
<td>0.04692</td>
<td>0.05598</td>
</tr>
</tbody>
</table>

** = Non significant; ** significant at (p<0.01)

### Table 2: Effect of level of sugar on the sensory attributes of milkcake

<table>
<thead>
<tr>
<th>Sugar level (%)</th>
<th>Flavour</th>
<th>Body and texture</th>
<th>Colour and appearance</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>7.42</td>
<td>7.36</td>
<td>7.50</td>
<td>7.42</td>
</tr>
<tr>
<td>10</td>
<td>7.86</td>
<td>7.82</td>
<td>7.90</td>
<td>7.82</td>
</tr>
<tr>
<td>12</td>
<td>7.82</td>
<td>7.80</td>
<td>7.80</td>
<td>7.80</td>
</tr>
<tr>
<td>F-test</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>C.D. at 1%</td>
<td>0.1830</td>
<td>0.2085</td>
<td>0.2230</td>
<td>0.1727</td>
</tr>
<tr>
<td>SEM</td>
<td>0.04239</td>
<td>0.04830</td>
<td>0.05165</td>
<td>0.04000</td>
</tr>
</tbody>
</table>

** = significant at (p<0.01) NS = Non significant; ** significant at (p<0.01)
desirable colour and texture (gumminess, chewiness, etc). It also ensures product stability in terms of microbial and physical characteristics. Based on the observations made by Ramesh (2000) and during our preliminary trials, different time-temperature treatments (60, 65, 70, 75 and 80°C for 60 minutes) were given to milkcake packed in laminated pouches. Table 4 shows average sensory scores for milkcake subjected to different thermization treatments.

Results of the preliminary trials showed that the first two time-temperature combinations viz. 60°C/60 minutes and 65°C/60 minutes did not result in the development of desired texture in the product. This observation is contradictory to the results obtained by Ramesh (2000) who noted that thermal treatment at 60°C for 60 minutes gave milkcake with better body and texture than those subjected to the same temperature for 90 and 120 minutes. This could be due to the fact that in our experiments thermization was carried out by placing the product packaged in laminated pouches in hot air oven at specified temperature for a given period of time whereas Ramesh (2000) treated the hot milkcake in the Al-alloy mould open at one side probably resulting in reduced heat transfer rate. However, the average sensory scores increased significantly (p< 0.01) upto 75°C/60 minutes. The flavour and body and texture scores were better for the higher temperatures viz. 70, 75 and 80°C. However, thermization treatment at 80°C/60 min decreased the scores significantly (Table 4). So, thermization treatment at 75°C/60 min. was considered appropriate for the best sensory scores of the final product.

Conclusions

Realizing the potential of developing a standardized method for the manufacture of milkcake which could be taken up by the organized dairy industry, an attempt was made to study the levels of various important variables which affect the sensory quality of the product. It was observed that the level of fat in the milk, sugar concentration, corn syrup level and the temperature-time of thermization had significant effect on the sensory properties of the product. The study revealed optimum levels of the variables for sensorily acceptable quality of milkcake.

Acknowledgements

The first author expresses deep sense of gratitude to the Council of Scientific and Industrial Research (CSIR) for financial assistance in the form of Senior Research Fellowship.
(SRF) to carry out the study. The technical support rendered by the staff of Dairy Technology Division in conducting study at National Dairy Research Institute (NDRI), Karnal, is duly acknowledged.

References


