Sensorial, chemical and microbial quality of spongy rosogolla

MS Hossain*, MMH Khandakar*, MN Islam, MA Islam

Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

ARTICLE INFO

ABSTRACT

The goal of this investigation was to compare the physical, chemical and microbial qualities of laboratory made and market spongy rosogolla. Two types of spongy rosogolla were made in laboratory from the cow and buffalo milk chhana to reveal the quality in regards of the species and three types of market spongy rosogolla were collected from three different shops. With regard to the physical attributes, laboratory made spongy rosogolla were found better than the market spongy rosogolla and cow milk spongy rosogolla was the best. In chemical aspects, laboratory made spongy rosogolla had greater pH, fat, protein, and ash content, whereas, market spongy rosogolla showed higher acidity and carbohydrate content. The moisture content of cow milk spongy rosogolla was highest. The mineral contents (Ca, P, and Mg) were also differed significantly (p<0.01) among the samples except for Na content. Highest Ca, P and Mg contents were found in market spongy rosogolla. The total viable count (TVC) was significantly (p<0.01) lower in laboratory made spongy rosogolla. However, the Escherichia coli count was found similar (p>0.05) in both cow and buffalo milk spongy rosogolla but lower (p>0.05) than other market spongy rosogolla samples. Considering all the findings, it may be concluded that the quality of market spongy rosogolla needs improvement and responsible authorities might take necessary initiatives for monitoring.

Introduction

Milk and milk products are important human foods that are well recognized since the ancient period, and rosogolla is one of the most popular, tasty, and healthy sweetmeats in Bangladesh (Mannan et al., 1995). Rosogolla is a popular syrupy dessert made by cooking and soaking of chhana balls (a milk protein and whey protein co-precipitate produced by heat and acid precipitation) in sugar syrup, which is generally soft and spongy in texture (David, 2016; Gurveer and Goswami, 2017). Rosogolla is most popular sweetmeat which is highly acceptable to the people for its characteristics texture and a pleasant sweetness (Desai et al., 1993). It has high nutritional value because of its digestibility and high protein, fat, mineral content, particularly Ca and P, as well as fat-soluble vitamins A and D. (Kumar and Prasad, 2010; Prajapati et al., 2011). Rosogolla has 186 calories per 100g, with 153, 16, and 17 calories coming from carbohydrate, protein, and fat, respectively (Gurveer and Goswami, 2017). It is widely consumed because of its nutritional and physiological benefits for humans (Chavan et al., 2009; Sahu and Das, 2009) and its consumption has surged in India at a pace of more than 20% per year because to its health benefits (Singh et al., 2007). Aside from acceptable shelf life and public health safety, rosogolla has been regarded a vital meal item in numerous festivals of life in our country, such as Eid, Puja, birthdays, and marriage ceremonies, and it would be meaningless without offering this sweetmeat to people of all ages during these occasions (Islam et al., 2003). Spongy rosogolla is one kind of rosogolla which is more resilient in texture than...
the conventional type and very popular in Bangladesh. In majority of the sweetmeat shops, spongy *rosogolla* is a common item. The quality of such sweetmeats varies from place to place, market to market, and shop to shop (Prodhan et al., 2017). The manner of chhana production, the standard of chhana, the use of an appropriate proportion and kind of binding material, and other process factors all affect the quality of this type of sweetmeat, and the quality of raw materials plays an essential part in the body and texture subsequently the overall quality of it (Gurveer and Goswami, 2017). To get a hefty profit, some manufacturers use low quality ingredients for rosogolla preparation that leads to deterioration of spongy rosogolla’s quality.

*Rosogolla* is typically produced using cow milk (Rao et al., 1989), and there are just a few accounts of rosogolla made with buffalo milk (Kanwal et al., 1980). As per authors’ knowledge, very few or no research works have been done to improve the quality of spongy rosogolla available in market. Therefore, we prepared the spongy rosogolla in the laboratory from both cow and buffalo milk to reveal the best quality in regards of species variation as well as to assess the quality of market spongy rosogolla against same product manufactured in laboratory from cow milk and buffalo milk chhana.

**Materials and Methods**

**Raw milk collection**

Cow milk and buffalo milk was collected in the morning from Bangladesh Agricultural University (BAU) Dairy Farm (24°43’46.5”N, 90°25’22.8”E), Mymensingh-2202, Bangladesh. Following that, the milk samples were transferred to the laboratory for spongy rosogolla manufacture and further analysis. An automated milk analyzer (Lactoscan, SLP, MILKOTONIC Ltd., Nova Zagora-8900, Bulgaria) was used to examine gross milk compositions at the Dairy Chemistry and Technology Laboratory, Department of Dairy Science, BAU, Mymensingh-2202. Following the methods of Kibria et al. (2017) and Ghosh et al. (1983). In addition, total viable count (TVC) and coliform count was carried out at Dairy Microbiology and Biotechnology Laboratory, Department of Dairy science, BAU.

Table 1 shows the chemical composition and microbial quality of raw cow milk and buffalo milk.

**Table 1. Chemical composition (%) and microbial quality (Log cfu/ml) of raw cow and buffalo milk**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Buffalo Raw Milk</th>
<th>Cow Raw Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.88</td>
<td>6.87</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td>TS</td>
<td>15.64</td>
<td>12.38</td>
</tr>
<tr>
<td>Moisture</td>
<td>84.36</td>
<td>87.58</td>
</tr>
<tr>
<td>Fat</td>
<td>6.60</td>
<td>4.23</td>
</tr>
<tr>
<td>Protein</td>
<td>3.45</td>
<td>3.20</td>
</tr>
<tr>
<td>CHO</td>
<td>37.77</td>
<td>36.37</td>
</tr>
<tr>
<td>Ash</td>
<td>0.71</td>
<td>0.68</td>
</tr>
<tr>
<td>Calcium*</td>
<td>0.184</td>
<td>0.122</td>
</tr>
<tr>
<td>Phosphorus*</td>
<td>0.105</td>
<td>0.074</td>
</tr>
<tr>
<td>Sodium*</td>
<td>0.052</td>
<td>0.052</td>
</tr>
<tr>
<td>Magnesium*</td>
<td>0.076</td>
<td>0.048</td>
</tr>
<tr>
<td>TVC</td>
<td>29.67</td>
<td>36.67</td>
</tr>
<tr>
<td>E. coli</td>
<td>13.33</td>
<td>13.33</td>
</tr>
</tbody>
</table>

*cfu, colony forming unit; * in mg/kg; TS, total solids; CHO, carbohydrate; TVC, total viable count; E. coli, Escherichia coli

**Preparation of spongy Rosogolla**

Chhana from cow milk and buffalo milk was prepared by using whey water (with acidity ≈1.1% lactic acid). First, the temperature of the milk was increased to 90 - 92°C by heating followed by cooling to 85°C. Following that, sour whey was progressively mixed together with the milk as a coagulant, with constant gentle stirring. The coagulant was added until the pH reached 5.2 and the milk coagulated, resulting in a greenish-yellow hue in the whey. When precipitation of milk protein was completed, the chhana was gathered in a muslin cloth, and the whey was drained out for 3 hours. Messing of chhana was done to soften the coagulum uniformly. To make the dough, 5% of flour was added to the chhana and thoroughly kneaded until visible fat separation occurred on the palms. This dough was made into chhana balls by rolling
them between palms for 1 minute without cracking the surface (Sengupta et al., 2017) otherwise these balls would lose their integrity when cooking. After making all chhana balls, they were cooked in the syrup of sugar (Sugar: water = 2:1) for 40 to 60 minutes. During the continuous boiling of sugar syrup, hot water was sprinkled to maintain syrup concentration. After boiling, the chhana balls were kept in hot water of above 80 - 90 °C for 1 hour. Next, the balls were kept into another sugar syrup (Sugar: water = 1:1) for 3 hours at above 80 °C. Finally, the spongy rosgolla were allowed to stay for sometimes to cool. The spongy rosgolla manufactured from cow milk chhana was coded as \( R_1 \) and from buffalo milk chhana was coded as \( R_2 \).

Collection of spongy Rosogolla from market

Market spongy rosgolla samples were collected from three different shops namely Adorsho Mistanno vander, Kalibari Road, Mymensingh Sadar, Mymensingh (\( R_3 \)), Cantonment Mistanno vander, Shankipara, Mymensingh Sadar, Mymensingh (\( R_4 \)), and Abdus Salam Mistanno vander, Haulaghat bazar, Haulaghat, Mymensingh (\( R_5 \)). After collection, the samples were transferred to the Laboratory of Dairy Chemistry & Technology, and Laboratory of Dairy Microbiology, Department of Dairy Science, Bangladesh Agricultural University for further analyses.

Sensory evaluation

A panel of five judges from Department of Dairy Science, Bangladesh Agricultural University, Mymensingh, Bangladesh, evaluated spongy rosgolla samples using a score card containing 45 marks for flavour, 30 marks for body and texture, 15 marks for colour and appearance and 35 marks for taste.

Chemical and microbial analysis

The proximate components (moisture, total solids, fat, protein, and ash) of the spongy rosgolla samples were determined using the standard methods of AOAC (2003). The aggregated value of protein, fat, and ash contents was subtracted from total solids content to calculate the carbohydrate content. Mineral elements (Ca, P, Na and Mg) were determined similarly as described for the raw milk minerals determination. Acidity was determined by titrating with N/10 sodium hydroxide solution according to the method of Agarwala and Sharma (1961) and pH was measured with help of pH meter-215 (Ciba Corning Diagnostic Ltd. Sudbury, Suffolk, England Co. 106*D). The microbial quality (total viable count and coliform count) of the samples were evaluated according to the methods described by Marshall (1993).

Statistical analysis

Statistical analysis of data obtained on various parameters was accomplished by One Way ANOVA using MSTAT 6.1.4 program and the means were compared by the least significant difference (LSD) test.

Results and Discussion

Sensory characteristics of Rosogolla

The results of sensory evaluation of spongy rosgolla were described in Table 2.

Flavour

The average flavour score of rosgolla samples from different sources showed significant differences (p<0.01). \( R_1 \), \( R_2 \), and \( R_3 \) spongy rosgolla samples were significantly (p<0.01) higher than \( R_4 \) and \( R_5 \) samples for flavour score. However, the highest score was found in \( R_1 \) samples and the lowest in \( R_5 \) rosgolla samples. Begum et al. (2020) and Acharya and Kanth (2005) indicated that flavour of rosgolla was enhanced by cooking. Joshi et al. (1991) revealed that, chhana from cow and buffalo milk had acceptable flavour whereas that from goat milk had an acidic flavour.

Body and texture

The \( R_1 \) spongy rosgolla samples obtained the highest (p<0.01) score than other samples. \( R_2 \) and \( R_3 \) samples were statistically similar (p>0.05) but they were significantly better (p<0.01) than \( R_4 \) followed by \( R_5 \) samples. Body and texture of rosgolla may vary with various factors such as quality of raw ingredients, type of coagulant, proportion of chhana binding agent, sugar syrup concentration, etc. Joshi et al. (1991) observed that chhana prepared from buffalo milk had a hard body and coarse texture. Cow and goat milk produced chhana with soft body and smooth texture. This might be the reason behind the highest score or \( R_1 \) spongy rosgolla samples because these samples were prepared from the chhana of cow milk. The texture of rosgolla might also be decreased with increased temperature and length of storage time.
(Arora et al., 1996; Dongare et al. (2019); Kaur and Goswami (2019); Sarkar et al., 2021b) which might decrease the body and texture score of R3, R4, and R5 samples.

Table 2. Comparison of average score of organoleptic characteristics of spongy Rosogolla

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sources of Spongy Rosogolla</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour()</td>
<td></td>
<td>40.00±3.00</td>
<td>39.67±1.53</td>
<td>39.00±1.73</td>
<td>36.33±1.53</td>
<td>35.00±1.00</td>
<td>0.0001</td>
</tr>
<tr>
<td>Body and Texture()</td>
<td></td>
<td>28.00±2.00</td>
<td>26.67±1.53</td>
<td>25.00±2.65</td>
<td>23.33±1.53</td>
<td>21.33±1.53</td>
<td>0.0020</td>
</tr>
<tr>
<td>Colour and Appearance()</td>
<td></td>
<td>13.00±2.00</td>
<td>12.00±1.00</td>
<td>12.09±1.73</td>
<td>12.04±1.00</td>
<td>11.67±1.53</td>
<td>0.0071</td>
</tr>
<tr>
<td>Taste()</td>
<td></td>
<td>8.00±1.00</td>
<td>7.67±0.58</td>
<td>7.65±0.51</td>
<td>6.33±1.15</td>
<td>5.33±1.15</td>
<td>0.0041</td>
</tr>
<tr>
<td>Total()</td>
<td></td>
<td>89.00±2.00</td>
<td>86.01±3.61</td>
<td>83.74±6.11</td>
<td>78.03±4.00</td>
<td>73.33±2.52</td>
<td>0.0021</td>
</tr>
</tbody>
</table>

Table with different superscripts in a row vary significantly; R1, Laboratory made spongy rosogolla from cow milk; R2, Laboratory made spongy rosogolla from buffalo milk; R3, Spongy rosogolla from A. Salam Mistanno Vander; R4, Spongy rosogolla from Cantonment Mistanno Vander; R5, Spongy rosogolla from Cantonment Mistanno Vander.

**Colour and appearance**

The highest mean value (p<0.01) of colour and appearance was recorded in laboratory made spongy rosogolla made from cow milk chhana (R1) than other spongy rosogolla samples. R2, R3, R4 and R5 samples were statistically similar (p>0.05) although the lowest score was observed for R5 rosogolla. The variation of colour and appearance was probably due to fat % in milk and high fat percentage is positively correlated with the colour of rosogolla (Chavan et al., 2011). According to Mini et al. (1995) rosogolla prepared from whole milk scored higher than that of skim milk for colour and appearance. R3, R4, and R5 samples might be prepared from low fat milk chhana. Though buffalo milk contains higher fat content than cow milk, the colour of milk fat of buffalo milk is creamy white because of the conversion of beta-carotene pigment into colourless vitamin-A. Therefore, rosogolla prepared from buffalo milk chhana (R2) scored lower than that of from cow milk chhana (R1). The addition of flour level also has effect on the colour and appearance of rosogolla (Tambat et al., 1992; Begum et al., 2022). Sometimes cooking time might enhance the colour of rosogolla (Bhattacharya and Raj, 1980) but overcooking and prolonged boiling should be avoided as it can lead to brown color formation in rosogolla due to Maillard reaction (Sarkar et al., 2021a).

**Taste**

The difference between R2 and R3 spongy rosogolla was not significant (p>0.05) for their taste score. However, the maximum score was reported for R1 samples which was significantly higher (p<0.01) than R2 and R3 samples followed by R4, and R5 samples. The taste of rosogolla actually depends on the raw ingredients used for the manufacture of rosogolla. Begum et al. (2022) reported that the rosogolla contained 53.43% moisture, 33.83% carbohydrate, 6.65% proteins and 5.58% fat had better taste. Basak et al. (2007) found that rosogolla with 5% added flour received the highest flavour rating. During preparation of rosogolla in the laboratory, all the ingredients used as standard levels tended better taste in laboratory made spongy rosogolla than in market spongy rosogolla.

**Total sensory score**

From table 2, it was revealed that the highest overall score for sensory evaluation was recorded for R1 spongy rosogolla followed by R2, R3, R4, and R5. All the samples from different sources differed significantly (p<0.01) from each other. As all physical parameters for laboratory made spongy rosogolla from cow milk and buffalo milk chhana were greater than the market spongy rosogolla that is why total physical score went highest for R1 spongy rosogolla. And this higher value indicated that the laboratory made spongy rosogolla was superior to the market sources. Our findings are supported by Tarafder et al. (2002), who observed superior quality of
Spongy rosogolla from cow milk, buffalo milk and market

Rosogolla over market rosogolla. The total physical score of spongy rosogolla may vary with different factors. According to Puranik et al. (1997) pure recombined milk chhana was not acceptable and according to Mini et al. (1995) the overall quality of rosogolla depends on the sources of milk (such as whole milk, coconut milk, or skim milk), and in these cases, laboratory-made (control) rosogolla scored higher than other samples.

Chemical composition and microbial quality

The chemical composition and microbiological quality of spongy rosogolla from various sources are presented in Table 3. It has been noted that all the chemical and microbial parameters differed significantly for different samples except sodium content (mg/kg) and E. coli count (cfu/g).

The pH of the sample R2 was found significantly (p<0.05) higher followed by sample R1. Sample R3 was found similar (p>0.05) to samples R1 and R4. Sample R5 has the lowest value but differed non-significantly (p>0.05) from sample R4. Haque (2000) reported pH of rosogolla prepared from cow milk and buffalo milk chhana was 6.60 and 6.73, respectively while Chanda (1999) stated that the pH of rosogolla ranges within 5.92 and 6.36. All the samples were similar or slightly higher to these findings in their pH value.

Table 3. Average chemical composition (%) and microbial quality (log cfu/g) of various sources of spongy rosogolla

<table>
<thead>
<tr>
<th>Parameters</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.87±0.029</td>
<td>6.88±0.029</td>
<td>6.77±0.076</td>
<td>6.70±0.087</td>
<td>6.68±0.029</td>
<td>0.002</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.072±0.003</td>
<td>0.071±0.002</td>
<td>0.076±0.002</td>
<td>0.08±0.002</td>
<td>0.08±0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>TS</td>
<td>46.33±1.06</td>
<td>50.23±0.90</td>
<td>49.91±0.63</td>
<td>51.58±1.14</td>
<td>49.73±1.39</td>
<td>0.000</td>
</tr>
<tr>
<td>Moisture</td>
<td>53.67±1.06</td>
<td>49.77±0.90</td>
<td>50.09±0.63</td>
<td>48.43±1.14</td>
<td>50.28±1.39</td>
<td>0.000</td>
</tr>
<tr>
<td>Fat</td>
<td>5.40±0.36</td>
<td>7.77±0.15</td>
<td>4.75±0.05</td>
<td>4.57±0.06</td>
<td>4.70±0.10</td>
<td>0.000</td>
</tr>
<tr>
<td>Protein</td>
<td>3.82±0.025</td>
<td>3.91±0.036</td>
<td>3.58±0.076</td>
<td>3.46±0.055</td>
<td>3.60±0.050</td>
<td>0.000</td>
</tr>
<tr>
<td>CHO</td>
<td>36.37±0.71</td>
<td>37.77±0.71</td>
<td>40.87±0.61</td>
<td>42.83±1.04</td>
<td>40.70±1.45</td>
<td>0.000</td>
</tr>
<tr>
<td>Ash</td>
<td>0.74±0.012</td>
<td>0.78±0.015</td>
<td>0.71±0.010</td>
<td>0.71±0.014</td>
<td>0.72±0.008</td>
<td>0.000</td>
</tr>
<tr>
<td>Calcium*</td>
<td>1.443±0.001</td>
<td>1.603±0.001</td>
<td>2.405±0.001</td>
<td>1.283±0.001</td>
<td>0.481±0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>Phosphorus*</td>
<td>0.009±0.001</td>
<td>0.008±0.001</td>
<td>0.009±0.001</td>
<td>0.008±0.001</td>
<td>0.010±0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>Sodium*</td>
<td>0.038±0.00</td>
<td>0.132±0.17</td>
<td>0.042±0.00</td>
<td>0.041±0.001</td>
<td>0.013±0.00</td>
<td>0.151</td>
</tr>
<tr>
<td>Magnesium*</td>
<td>0.097±0.00</td>
<td>0.049±0.001</td>
<td>0.972±0.001</td>
<td>0.194±0.001</td>
<td>0.486±0.00</td>
<td>0.000</td>
</tr>
<tr>
<td>TVC</td>
<td>49.00±3.06</td>
<td>44.67±6.24</td>
<td>92.00±7.09</td>
<td>88.67±6.66</td>
<td>84.33±4.16</td>
<td>0.000</td>
</tr>
<tr>
<td>E. Coli</td>
<td>10.00±3.61</td>
<td>10.00±5.77</td>
<td>16.67±5.75</td>
<td>13.33±11.55</td>
<td>16.67±5.77</td>
<td>0.123</td>
</tr>
</tbody>
</table>

In contrast to the pH value, the highest acidity was observed in R5 rosogolla whereas the lowest in R2 samples. The acidity of laboratory spongy rosogolla was found lower than market spongy rosogolla. Haque (2000) revealed that the acidity of rosogolla were 0.75, 0.70 and 0.71%, respectively which are prepared from cow milk, buffalo milk and equal combination of cow milk and buffalo milk. Arora et al. (1996) stated that the acidity was increased during the storage of sample. Laboratory made spongy rosogolla was fresh whereas market spongy rosogolla probably stored, therefore, the acidity of laboratory made spongy rosogolla was relatively lower than collected market spongy rosogolla. The total solids (TS) content of laboratory manufactured spongy rosogolla from the chhana of cow milk was significantly (p<0.01) lower than other samples. R2 spongy rosogolla contained highest TS content as it was prepared from buffalo milk chhana. The TS content of market rosogolla was also higher in our study which is close to the...
Higher level of added flour or higher sugar concentration of syrup. Tarafdar et al. (2002) indicated that rosogolla manufactured in laboratory had carbohydrate content of 357 (g/kg) whereas market rosogolla had 408-461 (g/kg) carbohydrate content that supported in favour of this study. Adhikari et al. (1992) found that chhana with a higher percentage of lactose contributed to the higher percentage of lactose in rosogolla (spongy).

There were significant differences (p<0.01) among the rosogolla samples for their mineral contents except for sodium content. However, there was no clear distinction between two types of laboratory made and market spongy rosogolla.

**Microbiological quality**

From Table 3 it is clear that the microbial quality of spongy rosogolla manufactured in laboratory was significantly superior over market spongy rosogolla. Total viable counts (TVC), and E. coli count were higher in market spongy rosogolla than laboratory made spongy rosogolla. Nonetheless, the differences in E. coli counts in different sample were not significant. Higher bacterial count of market spongy rosogolla indicates that strict hygienic conditions might not be maintained during the manufacturing time.

**Conclusion**

The spongy rosogolla manufactured and evaluated clearly indicates that the laboratory prepared product has better quality attributes in all three aspects of the quality viz. organoleptic, chemical and microbiological. This implies the importance of studying methodologies follow in the market level for spongy rosogolla production and standardizing them. This could lead to the better uniform quality products to the consumer. The variation between the cow milk and buffalo milk spongy rosogolla necessitates more studies to obtain comparable buffalo milk products.

**References**


Haque MA (2000). A Comparative study on rasogolla production from fresh cow milk, buffalo milk and mixture of cow and buffalo milk, M. S. Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.


Spongy rosogolla from cow milk, buffalo milk and market

https://doi.org/10.5455/vetworld.2010.495-496


