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Quality Evaluation of Traditional Fermented Milk “Dahi” in Bangladesh

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Abstract

We evaluated the quality of traditional fermented milk “Dahi”, collected from four areas (Dhaka, Mymensingh, Jamalpur and Bogra) in Bangladesh. Traditionally made 28 dahi samples were collected randomly from those areas and analyzed for chemical and microbial qualities. Of the four areas samples examined, the Bogra area sample had the highest total solids content (38.24 ± 4.37%) and the Mymensingh area sample had the lowest total solids content (29.82 ± 4.61%). Total solids content was markedly affected by the sugar value of the dahi samples. The other parameters examined by chemical analysis, namely, fat (4.88 ± 0.99%) and protein (4.74 ± 0.73%), were the highest in the Mymensingh area sample. On the other hand, the chemical and microbial parameters were very similar between Dhaka and Jamalpur area samples. Microbial analysis revealed that Bogra and Jamalpur area samples were free from molds. The presence of mold and yeast cells in samples might be an indication of contamination due to poor packaging, handling and inadequate transportation system.

Key words: Evaluation, Chemical and microbial quality, Traditional fermented milk, Dahi

Introduction

Indigenous dahi/yogurt is produced mainly in the Middle East and other countries around the eastern part of the Mediterranean and the southern part of East Asia, particularly, India, Bangladesh, Pakistan, Nepal and Bhutan. It is said to have originated thousands of years ago in Eastern Europe and Western Asia, is still consumed in large quantities today. Despite its worldwide popularity, however, no precise composition of the yogurt has been formulated so far1. A similar yogurt-like product is known as dahi in Bangladesh, and two types of dahi are available in local markets, sweetened/misti dahi (sugar added) and sour dahi, and both are prepared by a traditional method using previously made dahi (starter). Traditional method invariably involves production on a small scale, either in the consumer’s household or in the sweetmeat-maker’s shop in urban areas. In the household, milk is heated to boiling temperature until volume is reduced up to 15–20%, and 8–10% sugar added (sweetened dahi), cooled down to body temperature, inoculated 2–3% starter and poured into earthenware and kept for curd formation overnight by wrapping woolen cloth or straw or jute bag to maintain warmth. In the shops, the method is more or less the same and dahi is usually set in suitable containers (earthenware/glass bottles/plastic cups) of the required capacity (Fig. 1). Sweetened dahi has a characteristic brown color, a cooked and caramelized flavor and a firm body, and also to follow the same method for the commercial purposes. The pronounced and intense heating causes the milk to brown and get partially concentrated. Artificial color, sugar caramel and jaggery (gur) are also added during production. Most of the producers are used earthenware for setting dahi to firmness rather than glass bottles/plastic cups. Earthenware is assisting to absorb and evaporate a little amount of moisture from the dahi resulted more firmness. The quality and color of dahi are varies from shop to shop and area to area.
depending by using the different proportions and compositional milk and color improving agents. Various means and methods are adopted in its preparation so there can be seen a lot of variations among the quality of products. Though, dahi is prepared without any care of quality control and hygienic conditions and contain a lot of contaminants, which may be health hazards spontaneously. However, traditional fermented dahi still enjoy loyal following in rural communities in Bangladesh, and it is also used as a dessert served after typical Bangladeshi Polao dishes. The traditional containers are increasingly being replaced with commercially available ones, especially plastic containers at city areas. In Bangladesh, dahi are sold almost in open markets and kept on shelf at ambient temperature without cover on products. A few sellers of city areas are kept their products in refrigerators for prolonging storage and others kept their products at room temperature and they might be sold within a short time (1 or 2 days) before deterioration of products. Dahi is prepared mainly from cow’s milk because of its availability and a small amount is prepared from buffalo’s milk in Bangladesh, compared to a significant amount prepared from the same in India\(^2\). It has been reported that approximately 4.0\% of the total milk produced in Bangladesh is used for dahi preparation\(^3\).

Dahi is a well-known delicious fermented milk product that is consumed in large amounts in Bangladesh and the world either as part of the daily diet or as beverage\(^4\). It has been reported to exert a possible therapeutic effect by controlling bacterial growth and to cure such intestinal diseases as constipation, diarrhea, and dysentery, possibly because of its antibiotic effect\(^5,6\). It has been claimed that yogurt may help protect against heart diseases by lowering blood cholesterol level or against certain cancers\(^1,7\). Research has been conducted on
the different aspects of dahi production\textsuperscript{8–11}. However, very little research has been conducted on the quality of dahi available in the local markets of Bangladesh. The present study was undertaken to monitor the chemical and microbial qualities of dahi produced by a traditional method in Bangladesh.

Materials and methods

Samples collection

Four areas in Bangladesh (Fig. 2) were selected for the collection of dahi samples that were produced by a traditional method using previously made dahi as lactic acid bacterial starter. The samples were collected from the four areas designated as “A” (Dhaka area), “B” (Bogra area), “C” (Mymensingh area) and “D” (Jamalpur area). A total of 28 samples were collected from different producers from those areas. Eight samples each were collected from Bogra and Mymensingh area, and six samples each, from Dhaka and Jamalpur area. The samples were brought to the laboratory in a large wide-mouthed thermos flask and were maintained at low temperature (4–5°C) by use of an ice box until analysis and were analyzed after 6–10 hours of samples collection.

Chemical analysis

The following parameters were analyzed: pH, acidity, moisture, total solids, fat, protein, sugar and ash. Fat was determined by the Gerber method, total solids and moisture content were determined by the oven drying method at 105°C for 24 hours, and ash content was determined by igniting the dried samples (total solids) at 550°C for 5–6 hours in an electric muffle furnace according to AOAC procedure\textsuperscript{12}. Protein was determined by the Kjeldahl method as per International Dairy Federation (IDF)\textsuperscript{13}. Titratable acidity was measured with NaOH and phenolphthalein according to AOAC procedure\textsuperscript{12}. pH value was measured using a digital portable pH meter equipped with a combination glass electrode (Hanna, HI 8314) during sample collection. Sugar values were obtained by deduction method.

Microbial count

Microbial parameters (viable bacteria, yeast and mold counts) were determined by the standard plate count method according to APHA\textsuperscript{14}. Plate count agar and potato dextrose agar were used for viable bacteria count, yeast and mold counts, respectively. Plate count agar and sterile saline were prepared. The samples (1 ml) were transferred into sterile saline, and each serial dilutions, then put into plate and poured agar (10–15 ml) and allowed for solidification. After solidified, the plates were incubated at 32°C for 48 hours. The colonies were enumerated which plate having within 30–300 colonies. Potato dextrose agar was also prepared, and adjusted to pH 3.5 by adding 10 \% tartaric acid solution. Serial dilutions and agar pouring method were followed the same procedure of plate count agar. Plates were kept at room temperature (28–30°C) for 3–5 days. The molds and yeast colonies were enumerated.

Statistical analysis

All experimental materials were completely homogenous and the statistical analysis was done as per Steel and Torrie\textsuperscript{15} by using Completely Randomized Design (CRD). Duncan’s Multiple Range Test (DMRT) was carried out to determine the significant difference.

Fig. 2. Map of Bangladesh
Results and Discussion

Chemical analysis: The results of chemical analyses (pH, acidity, moisture, fat, protein, sugar, total solids and ash) are shown in Table 1.

Acidity: A significant difference (p < 0.05) was found in the acidity of all samples. The highest acidity was that of A sample at 0.92 ± 0.23% and lowest acidity was that of B sample at 0.63 ± 0.10%. The sample of A was showed higher acidity, it might be uncontrolled incubation, postproduction handling and prolonging storage cause increased in acidity or occurred further fermentation while B sample may be controlled incubation time and temperature or maintained at low temperature after production. An acidity of C and D samples were nearly similar and supported the result of acidity to production. An acidity of C and D samples were further fermentation while B sample may be controlled incubation time and temperature or maintained at low temperature after production.

Temperature or maintained at low temperature after production. An acidity of C and D samples were nearly similar and supported the result of acidity to recommend by Bureau of Indian Standard for sweetened dahi. An acidity of traditional fermented beverages (Maziwa Lala) in East Africa was 0.6 to 0.92%\(^1\) which are supported of this results. An acidity of 0.78% in plain yogurt samples\(^2\), which was very similar to that of D sample (0.78 ± 0.06%). An acidity of 0.94 ± 0.25% for dahi from cow’s milk\(^1\) which was very similar to the acidity of A sample. The Bureau of Indian Standard has recommended an acidity of 0.7% for sweet dahi and 1.0% for sour dahi. It is evident that the acidity of the dahi samples from the four areas was within the acidity range of fermented milk products.

pH: Statistical analysis revealed that the pH values of all the samples were significantly different (p < 0.01). The highest pH value was that of B sample (5.00 ± 0.30) and the lowest was that of C sample (4.38 ± 0.32). The higher pH value of B sample due to improper fermentation whereas C sample was lower pH value due to time interval of storage that occurred further microbial fermentation. The pH value of D sample was slightly lower than B sample, and the pH value of A sample was slightly higher than C sample. So, in traditional dahi, proper fermentation conditions are not fully controlled, hence a large variation of pH value in the end products is obviously. An increase in the amount of protein resulted in a slight increase in pH\(^3\). The pH values of all the samples indicated that the conditions were good for microbial growth, although pH 4.3 is regarded to be inhibitory for total viable bacterial growth and pH 4.6 is expected to be less inhibitory for the growth\(^4\). One of the features of traditional yogurt with a pH of 3.8 to 4.0 is safety, as vegetative cells of pathogenic bacteria can not grow or survive under such conditions\(^5\).

Fat: There was no significant difference among the fat contents of all the samples. The sample of C had the highest fat content (4.88 ± 0.99%) due to use of local cow’s milk or mixing of cow’s and buffalo’s milk and the sample of B had the lowest fat content (4.31 ± 0.80%), it may be used of cross-bred cow’s milk or low fat content milk. Fat content of local cow’s milk is higher (4.0% to 6.0%) due to low milk producer compared with Shahiwal or Holstein cross-bred (fat content 3.5 to 4.5%) animal in Bangladesh. The variation in fat content among the four areas samples might be used the different proportions and compositional milk from area to area or day to day or batch to batch for dahi making.

The average fat content in cow’s milk dahi is 4.5%\(^6\). Fat contents of different types of dahi varied from 4.3 to 8.8%\(^7\). Fat content in plain misti dahi from different areas of West Bengal and found a range of 1.1 to 11.5%, with an average of 5.14%\(^8\).

Protein: Protein analysis revealed that all the samples showed no statistically significant difference. The protein content of D sample was lower (3.99 ± 0.17%) than those of other samples (4.66 & 4.74%). Our results agreed with the findings that yogurt and dahi contain 4.68%\(^9\) and 3.89%\(^10\) protein, respectively. Dahi made from cow’s and buffalo’s milk has 4.22% protein, respectively. Normally, protein in dahi was similar of milk protein which used for dahi making. As, milk composition vary from species to species or individual to individual animals or day to day that were used for dahi making, so, protein content might be a little variation among the different areas samples.

Total solids: A statistically significant difference (p < 0.01) was observed among the total solids contents in samples from the four areas. The total solids content in B sample was the highest (38.24 ± 4.37%) due to the higher sugar content and that in C sample was the lowest (29.82 ± 4.61%) due to...
the lower sugar content. The other two areas (A & D) samples of total solids content were also higher and nearly similar and same affect by sugar value. From the table–1 showed that chemical parameters (fat, protein and ash) had a little variation within the samples but large variations of sugar contain among the samples and affected to the total solids of all samples. In case of traditional dahi, milk and extra sugar (8–10%) were used without subjecting to standardization leading to much variation as observed in total solids content of different areas samples. The study of plain misti dahi reported that the average total solids content of the dahi collected from different districts in west Bengal was within the range of 29.5 to 52.30%, with an average of 40.27%\(^2\). The total solids content in plain dahi varied from 26.92 to 40.04%, with an average of 34.64%\(^8\).

**Sugar:** Sugar indicates lactose plus the extra table sugar, which added in preparing dahi. The sugar contents in all samples showed a statistically significant difference (p < 0.01). The sugar contents in dahi were markedly differing because nobody strictly followed added sugar (8–10%) in sweet type dahi during preparation. The amount of sugar added is largely dependent on the consumers' demand. In some areas consumers prefer sweeter dahi more whereas those in other areas prefer otherwise. Of the samples studied, B sample had highest sugar (28.33 ± 4.29%) content due to added higher amount of sugar, and C sample had the lowest sugar content (19.27 ± 4.26%), which may be referable sugar added within the range (8–10%) and also it revealed that areas consumers did not like more sweetened dahi. On the other hand, other area samples had the higher sugar content which might be caused by the addition of higher amount of sugar and also consumers demand. Although sweet type dahi is more popular in Bangladesh than the unsweetened one, though, it is proved that sweet type dahi is not good for health from a scientific viewpoint especially for peoples who were suffering diabetics and also lactose mal-digestion.

**Ash:** Statistical analysis revealed a significant difference (p < 0.01) among the samples examined. The highest ash content was that of A sample (1.08 ± 0.09%), it may be used by mixing of buffalo’s milk with cow’s milk and/or a little effect by higher number of microbial population, and the lowest was that of D sample (0.81 ± 0.09%). The ash content of samples B and C were similar and also slightly higher due to higher microbial population. Ash content of plain dahi was 0.83 ± 0.06%\(^9\), similar to our findings. From the above discussion, we concluded that the ash contents in dahi from the four areas were different but were within the acceptable range of ash content.

**Microbial count:** Total viable bacterial count, and yeast and mold counts are shown in Table 2.

**Total viable bacterial count:** Statistical analysis showed no significant difference among the total viable bacterial counts of the dahi samples from the four areas. The samples of C and D had higher bac-

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### Table 1: Chemical analysis of dahi samples collected from four areas in Bangladesh.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A Mean ± SD</th>
<th>B Mean ± SD</th>
<th>C Mean ± SD</th>
<th>D Mean ± SD</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.5(^8) ± 0.31</td>
<td>5.0(^9) ± 0.30</td>
<td>4.38(^9) ± 0.32</td>
<td>4.87(^9) ± 0.52</td>
<td>**</td>
</tr>
<tr>
<td>Acidity%</td>
<td>0.92(^8) ± 0.23</td>
<td>0.63(^9) ± 0.10</td>
<td>0.70(^9) ± 0.23</td>
<td>0.76(^9) ± 0.07</td>
<td>*</td>
</tr>
<tr>
<td>Moisture%</td>
<td>63.14(^8) ± 4.61</td>
<td>61.76(^9) ± 4.37</td>
<td>70.05(^9) ± 4.50</td>
<td>66.00(^9) ± 2.82</td>
<td>**</td>
</tr>
<tr>
<td>Total solids%</td>
<td>36.86(^8) ± 4.61</td>
<td>38.24(^9) ± 4.37</td>
<td>29.82(^9) ± 4.61</td>
<td>34.00(^9) ± 2.82</td>
<td>**</td>
</tr>
<tr>
<td>Fat%</td>
<td>4.83(^8) ± 0.75</td>
<td>4.31(^9) ± 0.80</td>
<td>4.88(^9) ± 0.99</td>
<td>4.75(^9) ± 0.76</td>
<td>NS</td>
</tr>
<tr>
<td>Protein%</td>
<td>4.74(^8) ± 0.51</td>
<td>4.66(^9) ± 0.58</td>
<td>4.74(^9) ± 0.73</td>
<td>4.79(^9) ± 0.17</td>
<td>NS</td>
</tr>
<tr>
<td>Sugar%</td>
<td>26.22(^8) ± 4.50</td>
<td>28.33(^9) ± 4.29</td>
<td>19.27(^9) ± 4.26</td>
<td>24.45(^9) ± 2.44</td>
<td>**</td>
</tr>
<tr>
<td>Ash%</td>
<td>1.08(^8) ± 0.09</td>
<td>0.93(^9) ± 0.12</td>
<td>0.93(^9) ± 0.15</td>
<td>0.81(^9) ± 0.09</td>
<td>**</td>
</tr>
</tbody>
</table>

A = Dhaka area (8 samples)
B = Bogra area (8 samples)
C = Mymensingh area (8 samples)
D = Jamalpur area (6 samples)

**Level of Significance**
- **p < 0.01**
- *p < 0.05*

N.S.: Not significant
**Table 2** Microbial profiles of dahi samples collected from four areas in Bangladesh.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A Mean ± SD</th>
<th>B Mean ± SD</th>
<th>C Mean ± SD</th>
<th>D Mean ± SD</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable bacteria (cfu/ml)</td>
<td>3.82 × 10^2 ± 2.98</td>
<td>2.76 × 10^2 ± 2.74</td>
<td>2.98 × 10^2 ± 5.19</td>
<td>2.27 × 10^2 ± 4.44</td>
<td>NS</td>
</tr>
<tr>
<td>Yeast (cfu/ml)</td>
<td>3.84 × 10^4 ± 2.55^a</td>
<td>2.30 × 10^3 ± 2.85^b</td>
<td>1.44 × 10^4 ± 1.03^b</td>
<td>4.85 × 10^3 ± 6.48^b</td>
<td>***</td>
</tr>
<tr>
<td>Mold (cfu/ml)</td>
<td>0.33 ± 10^2 ± 0.51</td>
<td>0.75 ± 10^2 ± 1.38</td>
<td>0</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

A = Dhaka area (6 samples)  
B = Bogra area (8 samples)  
C = Mymensingh area (8 samples)  
D = Jamalpur area (6 samples)  
*** 0.001% level of significance  
N.S.: Not significant

The variation of microbial counts of all areas samples might be used the undefined traditional culture (starter) improper ratio and amount for dahi making. **Yeast count:** Statistical analysis revealed a highly significant difference (p < 0.001) among the yeast counts of the four dahi samples. The sample of A content higher number of yeast cell (3.84 × 10^4 ± 2.55) compared than other areas samples, it might be possible to happen by traditional culture (starter) or contamination of postproduction and handling defects. It is reported that yogurt should not contain any yeast cells^{21,25} but traditional made dahi contained yeast cells of 10^2/ml^{41}. The yeast cells detected in all areas samples which might be contaminated by air, earthenware or to the lack of observance of proper hygiene by the producers or of culture (previously made dahi).

**Mold count:** Mold was existing only in two area samples of A (0.33 × 10^2 ± 0.51 cfu/ml) and C (0.75 × 10^2 ± 0.38 cfu/ml). The presence of molds in these samples indicated the contamination of products by air or by the persons who were engaged in the preparation, packaging or transportation of the products. Other two area samples were free from mold which indicates better hygienic condition.

**Conclusion**

An overall analysis of the results of this study revealed that the dahi produced by a traditional method and collected from different areas in Bangladesh were acceptable quality in terms of chemical parameters, although their sugar contents were very high. Some samples contained yeast and molds due to contamination either by air, earthenware or during transportation, or when the products were left to sell without cover on the container for a long time. The findings of this study are expected to contribute to the production of good-quality dahi. It is necessary to follow the proper amounts of ingredients and to follow a standard for the amount of sugar added for better health and maintenance of hygiene. This study is a preliminary research of the qualities of dahi. Our next step will be the isolation and identification of lactic acid bacteria from the collected dahi samples, and the use of the isolated probiotic lactic acid bacteria in the production of probiotic fermented dairy products.

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バングラデシュの伝統的発酵乳“ダヒ”の品質評価

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バングラデシュの４地域（ダッカ、マイメンシン、ジャマルプルおよびボグラ）から収集した伝統的発酵乳“ダヒ”の品質を評価した。伝統的な方法で製造されたダヒの28試料を各地域から任意に収集し、それらの化学的および微生物学的品質を各地域毎の試料についてまとめた。ボグラ地域から収集した試料は最も高い全固形分含量（38.24 ± 4.37％）を示し、マイメンシン地域の試料は最も低い全固形分含量（29.82 ± 4.61％）であった。全固形分含量はダヒ試料へのショ糖添加の有無によって大きく影響された。その他の化学分析項目のうち、脂肪含量（4.88 ± 0.99％）とタンパク質含量（4.74 ± 0.73％）はマイメンシン地域の試料において最も高い値であった。ダッカとジャマルプル地域からの試料は化学的および微生物学的品質において非常に似通っていた。微生物学的品質の分析結果から、ボグラとジャマルプル地域からの試料ではカビの汚染が見られなかっただけのもの、すべての地域からの試料において酵母の汚染が認められた。ダヒ試料におけるカビや酵母の存在は、伝統製法で作られたダヒ試料の包装形態や衛生管理の不備あるいは不適切な流通システムに起因すると考えられた。