Abstract

Fruit yoghurt was prepared with the addition of different ratios (5, 10 and 15%) of jackfruit and mango juice. The physical, chemical and microbiological characteristics were analyzed to assess the quality of yoghurt. The physical parameters showed that 5% JFD and 10% MFD came in top position compared to other types of yoghurt or Dahi. The fat and protein contents decreased in both JFD and MFD but not in plain Dahi owing to the lower fat and protein content of fruit juice. Acid contents increased in JFD and MFD due to the high concentrations of fermentable sugars in fruit juice which promotes acid formation. The microbial concentration of fruit Dahi were within standard values, though the H and K Dahi samples contained slightly below standard cocci and bacilli. The findings confirm that the addition of fruit juice up to a certain limit, not exceeding 5-10% of the milk, improved the color, texture, flavor and taste of yoghurt.

Keywords: Fruit juice, Yoghurt intervention.

1. Introduction

Dahi is a coagulated milk product produced by using a culture of Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus salivarius subsp. thermophilus bacteria. In addition, Lactobacillus acidophilus, bifidobacteria and Lactobacillus casei are sometimes added during or after yoghurt culturing (Wikipedia, 2009). Dahi is the curd resulting from the lactic fermentation of milk. Good quality Dahi or yoghurt has a weak jelly like junket, clean sweet curd, no proteolysis and gassiness, milk color (gold or yellow), cream layer on the top, and no off-flavors. Of all cultured milk products, yoghurts are well known and most popular worldwide (Mansour et al., 1994). Similar to milk fruit, Dahi is a healthy and delicious food thanks to its high nutritive and therapeutic value (Perdigon et al., 2002). It also has medical uses, in particular for a variety of gastrointestinal conditions (Adolfsson et al., 2004). Yoghurt has medicinal properties, stimulate the immune system and kill harmful pathogen or bacteria in the human gut (Bell, 1994). Moreover, due to its low lactose content, it is more easily digestible and palatable than milk.

In our country, sweet and sour types of Dahi are prepared from whole cow milk or sometime by mixing dry skim milk powder. About 4% of the total milk produced in Bangladesh is used in the preparation of Dahi (Mustafa, 1997) adding Dahi culture at a rate of 1.5 to 2.5 percent depending on the season. In contrast, a wide variety of yoghurt is available in the supermarkets of European countries. At present, there is good demand for fruit Dahi (Routary and Mishra, 2011). Fruits such as strawberry, jackfruit, apricot and blackberry are usually used in manufacturing fruit yoghurts (Rahman, 1998). Very little research has been conducted on fruit Dahi in Bangladesh. Jackfruit and mango are customarily cheap in view of their huge production in summer. Keeping this in mind, attempts were made to prepare a healthy fermented fortified dairy product to open the door to milk marketing.
2. Material and Methods

The experiment was conducted from July 2012 to June 2013 in the dairy science laboratory, Sylhet Agricultural University. Raw milk was collected from the governmental dairy farm in Sylhet. Jackfruit, mango, sugar and starter culture were collected from local markets.

Three levels of jackfruit and mango fruit juice were incorporated to prepare F, G and H samples of Jackfruit (JF) Dahi and J, K, L for Mango fruit (MF) Dahi, respectively. In both cases, plain Dahi was prepared from fresh milk using a traditional method. Fruit Dahi was prepared by adding two types and three levels of fruit juice to milk. After collection, the milk was heated to boiling temperature until its volume was reduced by 20-25%. Sugar was gradually added at the rate of 8-10% during boiling and was stirred thoroughly. After completion of heating, the mixture was taken off the burner and allowed to cool down to 40°C. When the milk’s temperature reached 40°C, it was divided over four plastic cups. JF juice was incorporated into each cup at the ratios of 5%, 10% and 15% except the control (E) group. After the addition of culturing agents, the cups were placed in the incubator at 37°C until complete coagulation (8-12 hours) was achieved. The same process was followed to prepare MFD Dahi. Similarly, plain Dahi was prepared with milk and the addition of the mother culture following the same procedure. Their qualities were monitored by physical, chemical and microbial tests. The chemical parameters were determined according to AOAC (2003).

The microbial counts were performed by the method as described in the ‘Standard Methods for examination of Dairy products by APHA (1998).

Statistical analysis was done using SAS 2007/ 9.1 Version for statistically arranged Completely Randomized Design (CRD).

3. Results

Physical parameters:

The smell and taste scores of E, F, G, and H Dahi samples were 40.22, 43.44, 41.44 and 40, respectively (Table 1). There were significant differences in respect of the smell and taste scores of plain yoghurt and of both the jackfruit and mango fruit Dahi. The highest smell and taste scores were recorded in the F type Dahi and the lowest in the H type Dahi. On the other hand, the K type mango fruit Dahi content scored the highest in terms of smell and taste and the L sample was the lowest in the smell and taste scoring.

Statistical analysis showed that there were significant differences (P<0.001) among the body and consistency

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Plain (E)</th>
<th>Jackfruit Dahi (JFD)</th>
<th>Mango Fruit Dahi (MFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>Smell and Taste (50)</td>
<td>40.22 c</td>
<td>43.44 a</td>
<td>41.44 b</td>
</tr>
<tr>
<td>Body and Consistency (30)</td>
<td>22.56 b</td>
<td>25.78 a</td>
<td>21.56 b</td>
</tr>
<tr>
<td>Color and Texture (20)</td>
<td>16.00 b</td>
<td>18.11 a</td>
<td>15.11 c</td>
</tr>
</tbody>
</table>

*** = Significant score at 0.1% level.

The above plain, 5%, 10% and 15% JFD Dahi samples were designated as E,F,G,H and Plain, 5%, 10% and 15% MFD Dahi were designated as E, J, K and L samples, respectively.
a,b,c and d on the superscript in the same row differ significantly.
scores of different Dahi types (Table 1). The body and consistency scores were the highest in the F sample and the lowest in the H type Dahi. In MF Dahi, the highest body and consistency scores were allocated to the K type and the lowest to the J sample.

These highly significant differences (P<0.001) were found among the color and texture scores of different Dahi types (Table 1). It was found that the color and texture

### Table 2. Nutritional parameters of plain, jackfruit and mango fruit Dahi

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Plain (E)</th>
<th>Jackfruit Dahi (JFD)</th>
<th>Mango Fruit Dahi (MFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>4.467</td>
<td>4.13</td>
<td>4.24</td>
</tr>
<tr>
<td>Protein</td>
<td>3.67</td>
<td>3.50</td>
<td>3.51</td>
</tr>
<tr>
<td>Total Solids</td>
<td>24.78</td>
<td>32.33</td>
<td>27.67</td>
</tr>
<tr>
<td>Ash</td>
<td>0.68</td>
<td>0.73</td>
<td>0.81</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.95</td>
<td>0.97</td>
<td>0.98</td>
</tr>
</tbody>
</table>

*** = Significant level at 0.1%.

The above plain, 5%, 10% and 15% JFD were designated as E,F,G,H and Plain, 5%, 10% and 15% MFD were designated as E, J, K and L samples, respectively.

A,b,c and d on the superscript in the same row differ significantly.

The maximum fat percentage was recorded in plain Dahi (E sample) and the minimum in the H Dahi sample. There were significant differences (P<0.001) in the fat content of different Dahi samples. The addition of mango juice to milk might have decreased the fat percent of mango fruit Dahi.

The average total solids content for E, F, G and H Dahi types were 24.78, 27.89, 32.33 and 41.44, respectively. There were significant differences (P<0.001) between the total solids content of different types of Dahi. The total solids content was the lowest in the E Dahi sample and the highest in the H sample of JF Dahi. In the Mango fruit Dahi, the highest percentage of total solids was in the L type and the lowest percentage was in the E type Dahi.

There were significant differences (P<0.001) among the protein contents of plain and different types of Dahi. In the jackfruit Dahi, the highest protein content was found in the E type and the lowest was found in the H type. The acidity percentages of E, F, G and H Dahi samples were 0.95, 1.02, 0.95 and 0.97, respectively. It was found that the E sample had the lowest acidity percentage but the highest was in the F Dahi sample. There were significant differences (P<0.001) observed in respect of the acidity content of the samples.

The ash content percentages of E, F, G and H Dahi samples were 0.68, 0.71, 0.73 and 0.82 respectively (Table 2). Statistical analysis showed that there were significant differences (P<0.001) in the ash content of different Dahi samples.

### Microbiological study:

The percentages of gram positive cocci content in the E, F, G and H Dahi samples were 66.00, 62.12,
There were significant differences (P<0.001) among the different Dahi samples. The highest and lowest cocci counts were found in the E plain sample and the H sample of JFD. Similarly, the L sample had the highest cocci count and the K sample the lowest count. This result indicates that the culture contained more gram positive cocci. On microscopic examination, gram positive rods contained in E, F, G, H types Dahi were 32.89, 33.00, 35.77 and 41.89, respectively. The H sample contained a higher rod count than any other types of JFD. On the other hand, the highest gram positive rods were in the J sample of MFD and the lowest counts were in the E type - plain Dahi. Statistical analysis showed that there were significant differences (P<0.001) in both JFD and MFD varieties. The yeast count of E, F, G and H type JF Dahi were 1.11, 2.11, 3.35 and 4.88, respectively. A,b,c and d on the superscript in the same row differ significantly.

### Table 3. Microbial density of plain, jackfruit and mango fruit Dahi

<table>
<thead>
<tr>
<th>Microbial Parameter</th>
<th>Plain (E)</th>
<th>Jackfruit Dahi (JFD)</th>
<th>Mango Fruit Dahi (MFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>G+Cocci</td>
<td>66.00d</td>
<td>63.75c</td>
<td>62.12a</td>
</tr>
<tr>
<td>G+Rod</td>
<td>32.89a</td>
<td>33.00a</td>
<td>35.77a</td>
</tr>
<tr>
<td>Yeast</td>
<td>1.11a</td>
<td>2.11b</td>
<td>3.35c</td>
</tr>
</tbody>
</table>

*** = Significant level at 0.1% ratio.

The above plain, 5%, 10% and 15% JF Dahi were designated as E,F,G,H and Plain, 5%, 10% and 15% MF Dahi were designated as E, J, K and L samples, respectively.

4. Discussion

The smell and taste scores of fruit juice yoghurts were better than those of plain Dahi. Similar results were reported by Keating and White (1990). The body and consistency score of 5 % JFD and 15 % MFD were higher than those of other types of Dahi. The findings of the present experiment concur with the work of Desai et al. (1994), Rahman (1998) and Mustafa (1997). These researchers found that the body and consistency of Dahi or yoghurt improved through the addition of fruit juice. Mustafa (1997) explained that the addition of fruit juice improved the color and texture of Dahi, which corroborates the present findings, but that the color and texture of mango fruit Dahi were very high at 20% mango juice content. Similar conclusions were reached by Ahmed et al. (2010).

Desai et al. (1994) found that fruit yoghurts contained lower amounts of fat compared to plain yoghurt. Similar results were obtained by Rahman (1998) and Mustafa (1997). Rashid and Miyamoto (2005) found that the fat content of plain yogurt was 4.31-4.88%. It was supported the present study. Ara et al. (2010) observed the fat content of plain dahi depends on the composition of milk. Yonus et al. (2002) reported a fat content of plain Dahi within the range of 0.96 % to 4.3 %. Similar observations were made by Desai et al. (1994) who found that total solids contents increased significantly through the addition of fruit juice. The same results were reached by Rahman (1998). Mustafa (1997) also conducted an experiment with different types of fruit juice and found that juice addition significantly increased the total solids content of Dahi Ghosh and
Rajorhia (1987) observed that the total solids content of plain market Dahi varied from 26.92% to 43.04% with an average value of 34.64%. Kamruzzaman et al. (2003) reported that plain Dahi contained a lower amount of total solids compared to fruit Dahi. The results of this experiment are corroborated by the findings of Desai et al. (1994) who explained that the titratable acidity of fruit yoghurt was significantly increased due to the addition of fruit juice which speeded up the process of milk fermentation, which explains the higher acidity in fruit Dahi. The findings of this experiment are in agreement with those of Rahman (1998), Mustafa (1997) and Desai et al. (1994). Similar results were reported by Mustafa in 1997. A proper ratio of cocci and rods is generally important for cultured dairy products to obtain a better quality (Davis et al., 1971, and Driessen et al., 1982). Mustafa (1997) reported that the yeast content of plain Dahi was 6.33% and that fruit Dahi had a yeast content ranging between 4.0 and 9.0%. The result concurs with the findings of Rahman (1998) and Mustafa (1997) on the aspect of yeast. Bakri and Zubeir (2009) found that traditional plain yoghurt contains more yeast and moulds than fruit Dahi and suggested that manufacturers give more attention to hygienic practices. 5% JF Dahi contained the highest physical score while 10% MF Dahi also contained the highest physical score. Addition of fruit juice increased the physical score but decreased when adding larger amounts. Addition of fruit juice decreased the fat and protein content in both JFD and MFD and increased the total solids and ash content in both cases. Moreover, it increased the acidity percentage with the addition of higher amounts of fruit juice. The highest gram positive cocci were observed in plain Dahi. The increased microbial load might be due to the addition of fruit juice but it was not constant.

**Conclusion**

A variety of plain yoghurts are available in supermarkets, but fruit juice flavored Dahi or milk is an exception. Addition of fruit juice in the fermented dairy product might catch the consumer’s attention and uplift the yoghurt’s nutritional value as well. On the other hand, it may seasonally reduce production costs. These new dairy products might benefit elderly consumers by reducing the risk of blood cholesterol, and would also make use of seasonal surplus fruits and therefore profit to farmers.

**References**


Nomenclature

<table>
<thead>
<tr>
<th>MFD</th>
<th>Mango Fruit Dahi</th>
</tr>
</thead>
<tbody>
<tr>
<td>JFD</td>
<td>Jackfruit Dahi</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of variance</td>
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<tr>
<td>CRD</td>
<td>Completely Randomized Design</td>
</tr>
<tr>
<td>DMRT</td>
<td>Duncan Multiple Range Test</td>
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