Bangladesh Journal of Animal Science
Journal homepage: http://www.banglajol.info/index.php/BJAS

Use of date-palm (*Phoenix dactylifera* L.) brown sugar as a sweetener for making Dahi

AA Hossain[1], R Habib*[1], MN Islam[1], MRH Rakib[2]

[1]Department of Dairy Science, Bangladesh Agricultural University, Mymensingh 2202; [2]Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh

Abstract

This research was conducted to test the feasibility of using date palm(*Phoenix dactylifera* L.) brown sugar as an alternative to refined cane sugar in preparing sweet dahi. Quality assessment tests were conducted on four different types of dahi prepared by adding different levels of date palm brown sugar, such as 10% (A), 12% (B), 14% (C) and 12% refined cane sugar (D, as control). All the samples were analyzed for organoleptic, chemical and microbiological qualities. The scores for smell and taste, body and texture, color and appearance, and total scores for four types of dahi samples showed significant differences at various levels ($p<0.01$ to $p<0.05$). It was found that scores for all the organoleptic parameters of sample B were the highest among the samples, whereas sample D obtained the lowest scores. Total viable count of bacteria and coliform count, and sugar content, ash content, and protein content were differed significantly ($p<0.01$). Contents for fat also showed significant difference ($p<0.05$), though dry matter content, % acidity, and pH value showed insignificant differences. It could be concluded that sample B (containing 12% date palm brown sugar) was the best in terms of organoleptic, chemical and microbiological qualities.

Key words: Dahi, date palm brown sugar, refined cane sugar, quality

 Bang. J. Anim. Sci. 2014. 43 (1): 62-67

Introduction

Dahi is a popular fermented milk product noted for its typical flavor, characteristic semi-solid consistency, high nutritive value, and functional properties. It is one of the oldest fermented milk-products in the Indian sub-continent, and probably is one of the most popular foods in Bangladesh. Dahi is adored by people of all ages in the country. It is valued for controlling the growth of harmful bacteria in the bowel, and thus controlling intestinal disorders and diseases like constipation, diarrhoea and dysentery. Dahi is also believed to be effective in lowering the blood cholesterol. About 7% of the total milk production in India and 4% of the total production of Pakistan and Bangladesh is used for dahi production (Chakraborty 1998; Mustafa 1997).

Dahi typically contains 80-85% water, 5-8% fat, 3.2-3.4% protein, 4.6-5.2 lactose, 0.5-1.1% lactic acid, 0.70-0.75% ash, 0.12-0.14% calcium and 0.09-0.1% phosphorous (Laxminarayana et al. 1952). Dahi is prepared by using a mixed lactic acid bacterial (LAB) culture of *Streptococcus lactis*, *Lactobacillus bulgaricus*, *Strep. thermophilus, Strep. citrophilus, Lactobacillus planetarium,* etc. Both yoghurt and dahi are the cultured or fermented dairy products but there are little differences between these two. Yoghurt is prepared by using the starter organisms *Streptoccus thermophilus* and *Lactobacillus bulgaricus* in a proportion of l: 1, whereas dahi is prepared by using mixed culture of lactic fermenting bacteria of a number of strains (Mahanta 1984). So, dahi is a yoghurt-like fermented milk product (FAO 1990) made either plain (sour) or sweet.

The sweetened concentrated form of dahi in Bangladesh and West Bengal is known as mishti dohi i.e. sweet dahi (Early 1998). Sugar is usually added at the rate of l2-13% during preparation. Refined cane sugar is widely used as a sweetener in dahi preparation. However, the date palm brown sugar can also be use as an alternative. This brown sugar is available throughout Bangladesh at a reasonable price. date palm brown sugar was originally made from the sap of the *Palmyra palm*, the date palm or the sugar date palm. Now it is also made from the sap of the *Arenga pinnata* (sugar palm) and the nipa

*Corresponding Author: **raihanh46@yahoo.com**

palm, and may therefore also be sold as "*arenga sugar*". date palm brown sugar is made by making several slits into the stem of a palm tree and collecting the sap. The sap is then boiled until it thickens followed by drying into a mass. No research has ever been conducted to replace traditionally used cane sugar with date palm brown sugar to prepare dahi. The aim of this research was to test the feasibility of using date palm brown sugar as an alternative to refined cane sugar in making sweet dahi and also to study the costing of the manufactured dahi.

Materials and Methods

Whole cow milk was collected from Bangladesh Agricultural University Dairy Farm. At first 2.5 liter of milk was boiled in an opened pan called karahi for about 25 minutes in order to reduce the volume by 20%. The milk was then divided into 4 equal portions, 0.5 liter each. Date palm brown sugar was weighed at different levels 10%, 12% and 14% (weight/volume) of milk i.e. 50g (A), 60g (B) and 70g (C) for each 0.5 liter portion of milk. For the last portion, a standard 12% cane sugar as control, i.e., 60g was weighted (D). Date palm brown and cane sugar were added to each portion of hot (above 90^{o}C) milk and mixed well with a stirrer. The portions of milk were then cooled to 40ºC, and 2% mixed starter culture was added to each portion. The portions were transferred into 100 ml cups and were incubated at 37ºC in an incubator for 5 to 6 hours. After coagulation, all the samples were put in a refrigerator at about 4ºC until tested. So, four different types of dahi were prepared namely: A = Dahi containing 10% date palm brown sugar; B = Dahi containing 12% date palm brown sugar; C = Dahi containing 14% date palm brown sugar; and D = Dahi containing 12% refined cane sugar (control).

All the dahi samples were judged by a team of experienced judges for organoleptic evaluation using a 100-point scale. Organoleptic parameters such as smell and taste (50), color and appearance (20), body and texture (30) were assessed separately, as their scores were added to a total score of 100. Acidity was determined by titrating with N/10 sodium hydroxide solution using the procedure of Aggarwala and Sharma (1961). The pH was measured with the help of a pH meter-215 (Ciba Coming Diagnostics Ltd., Sundhury, Suffolk, England Co 106xD). Fat content was determined by the Babcock method following the procedure described by Aggarwala and Sharma (1961). Crude protein content was determined by the Kjeldahl procedure (AOAC, 2003). Dry matter (DM) content was determined by oven drying method according to AOAC (1982). Ash content of dahi samples were determined by the incineration method according to AOAC (2003). Carbohydrate content was determined by deduction of the aggregate of all other constituents from 100. Standard Plate Count (colony forming unit per gram or cfu/g) was done according to the method described by American Public Health Association (1967). Coliform count (cfu/g) was carried out by the methods described by Resubal (1977).

Data were statistically analyzed by using Analysis of variance (ANOVA) was carried out for means obtained for different parameters by Completely Randomized Design (CRD) with SPSS statistical package. Least significant difference (LSD) values were also determined to rank the samples. The experiment was replicated three times. Samples were analyzed in duplicate.

Results and Discussion

There were significant differences ($p<0.01$) among the smell and taste scores of different types of Dahi (Table 1). Among them sample B showed the highest value and sample D showed the lowest value. When Date palm brown sugar was added, smell and taste of Dahi was appreciably changed as compared to Dahi where refined cane sugar was added. The result of this experiment agrees with the work of Mustafa (1997) who found that addition of fruit juice improved the smell and taste score of Dahi.

There were significant differences ($p<0.05$) in respect to body and texture scores of different types of Dahi. The body and texture score was highest in the sample A, and the lowest in the samples C. Venkateshaiah et al. (1996) reported that higher levels of fat, SNF and sugar improved the body of yoghurt. The variation in body and texture score of different Dahi samples of this study could be attributed due to differences in protein and carbohydrate contents. Pette and Lolkema (1950) reported that if the total solids content of milk sample is low, then the texture of

dahi would also be low. Both Desai et al. (1994) and Yasmin (1999) found that the consistency of dahi or yoghurt improved due to the addition of fruit juice. In this study body and texture score changed subjected to the amount of date palm sugar added.

Table 1. Organoleptic parameters of Dahi prepared from different levels of Date palm brown sugar and 12% refined cane sugar

Parameters	Treatments				Sig.
	A	B	C	D	
Smell and taste (50)	$44.9^{b}\pm0.7$	$47.1^{a}\pm0.7$	$44.9^{b}\pm0.1$	$43.9^{b}\pm1.2$	**
Body and texture (30)	$27.7^{a}\pm0.7$	$27.6^{a}\pm0.9$	$27.1^{ab}\pm0.8$	$25.6^{b}\pm1.0$	*
Appearance and color (20)	$18.3^{a}\pm0.5$	$18.1^{a}\pm0.4$	$17.9^{a}\pm0.6$	$16.7^{b}\pm0.6$	*
Total score (100)	$90.9^{ab}\pm1.2$	$92.8^{a}\pm1.0$	$89.9^{b}\pm1.4$	$86.2^{c}\pm2.0$	**

A, Dahi with 10% brown sugar; B, Dahi with 12% brown sugar; C, Dahi with 14% brown sugar; D, Dahi with 12% cane sugar; means with different superscripts in the same row differ significantly (, p<0.05; **, p<0.01)*

Significant differences ($p<0.05$) were found in respect of color and appearance of different dahi samples (Table 1). The highest value of color and appearance was recorded for all the samples made from Date palm brown sugar, while lowest value was founded in case of the sample D, which contained 12% refined cane sugar. It implies that addition of date palm brown sugar improved the color and appearance of the dahi. Tauhid (2012) found that addition of colored fruit juice improved the color and appearance of Dahi. All the samples made from date palm brown sugar had a light brown color similar to caramelized milk. Therefore, consumer preference might have been improved.

The overall scores of various types of Dahi (Table 1) were determined on the basis of aggregate of the scores recorded for different sensory attributes by using a score card for judging by a panel of expert judges. Significant different ($p<0.01$) was found in respect of overall score of different Dahi samples. Dahi containing 12 % Date palm brown sugar showed the highest total score, followed by sample A. In contrast, Dahi containing 12% refined cane sugar showed the lowest value. The result of the present experiment agreed with those of Bozanic et al. (1998) and Pazakova et al. (1999).

Statistical analysis showed that dry matter content of Dahi samples (Table 2) did not differ significantly. The dry matter contents of Dahi samples prepared by various amounts of Date palm brown sugar were relatively higher than that made from refined cane sugar. This experiment showed that, when sugar content of Dahi increased, the dry matter content of Dahi also increased. All the samples showed normal dry matter contents ranging from 271.27 ± 3.37 to 280.03 ± 0.12 g/kg, which was almost similar to the findings of Ghosh and Rajorhia (1987).

Differences among the fat contents of different Dahi samples (Table 2) were significant ($p<0.05$). Fat content of sample C was higher than that of other samples. The fat content of all Dahi samples were within the range of 47-50 g/kg, which is typical for sweet Dahi in Bangladesh (Mustafa, 1997). The fat content of Dahi of this experiment were also agreed with the findings of Ghosh and Rajorhia (1987) who observed that on an average fat content of Dahi was 48.33 g/kg.

Table 2. Chemical composition of Dahi prepared from different levels of Date palm brown sugar and 12% refined cane sugar

Parameters	Treatments				Sig.
	A	B	C	D	
DM (g/kg)	271.3 ± 3.4	277.7 ± 9.9	280.0 ± 0.1	271.2 ± 5.6	NS
Fat (g/kg)	$48.0^{b}\pm1.0$	$48.33^{b}\pm0.6$	$49.67^{a}\pm0.6$	$47.3^{b}\pm0.6$	*
Protein (g/kg)	$36.8^{a}\pm0.3$	$36.33^{ab}\pm0.5$	$35.2^{c}\pm0.2$	$35.5^{bc}\pm0.6$	**
CHO (g/kg)	$179.3^{c}\pm2.4$	$185.76^{a}\pm2.9$	$187.6^{a}\pm1.1$	$182.9^{b}\pm1.9$	**
Ash (g/kg)	$7.2^{b}\pm0.1$	$7.3^{b}\pm0.05$	$7.5^{a}\pm0.1$	$7.1^{c}\pm0.1$	**
Acidity (%)	0.6 ± 0.1	0.6 ± 0.1	0.54 ± 0.0	0.6 ± 0.1	NS
pH	5.0 ± 0.5	5.1 ± 0.4	5.30 ± 0.5	5.1 ± 0.4	NS

A, Dahi with 10% brown sugar; B, Dahi with 12% brown sugar; C, Dahi with 14% brown sugar; D, Dahi with 12% cane sugar; DM, dry matter; CHO, carbohydrate; means with different superscripts in the same row differ significantly (, p<0.05; **, p< 0.01); NS, non-significant*

Statistical analysis showed that protein contents (Table 2) of Dahi samples differed significantly

(p<0.01). Maximum protein content was found in sample A. On the other hand, lowest protein content was observed in sample C. The protein content of all Dahi samples ranged from 35.23 to 36.77 g/kg. The results of this study were slightly lower than those of Rahman (1998) who found that protein content of normal Dahi was around 38.9 g/kg.. The protein content of Dahi used in this study was in agreement with Desai et al. (1994) who reported that the protein percentages of fresh milk Dahi were within the range of 37 to 43 g/kg.

A significant difference (p<0.01) was observed among the Dahi samples for the sugar content (Table 2). The highest level of sugar was observed in sample C, followed by B and D, while the lowest value was recorded in sample A. It should be noted here that, the sample C contained the highest level of Date palm brown sugar which explains the high sugar content in this sample.

Statistical analysis showed that ash content of Dahi samples (Table 2) differed significantly (p<0.01). The ash contents of the samples ranged from 7.05±0.07 to 7.53±0.05 g/kg. The findings of this study were lower than those of Chakrabarty (1998) who reported that ash content of Dahi made from whole cow milk was 9.8±l.0 g/kg. Alam (1998) and Mustafa (1997) also found that ash content of Dahi were 9.1 and 11.5 g/kg respectively. The highest ash content was found in the samples C and lowest was found the samples D. Interestingly enough, all the Dahi made with Date palm brown sugar had higher ash content, which may be attributed to the high mineral contents of brown sugar as compared to refined cane sugar.

There was no significant difference among the samples for pH value (Table 2). Comparatively higher pH value was observed in sample C and the lower value was recorded in sample A. The high pH value of sample C might be due to some acidity in brown sugar. The findings in this experiment were higher than those of Mustafa (1997) who observed that pH of Dahi was 4.85. However, the results agreed with the findings of Rahman (1998) who found that average pH value of cow milk Dahi were 5.1±0.01. The pH values found in this experiment ranged from 5.0±0.47 to 5.3±0.53.

No significant differences were found in respect of acidity percentage of the samples (Table 2). Relatively higher acidity contents were found in sample A and B, and lower value for sample C. The results of acidity of Dahi samples agreed with the findings of Sarker et al. (1996) who found that the titrable acidity of Dahi falls within the range of 0.36 to 1.17%. In this experiment acidity per cent of Dahi did not agreed with the work of Desai *et al.*(1994) who found that the plain Dahi had titratable acidity of 0.78%. Similar results were found by Cardoso et al. (199l) who observed l% acidity in Dahi samples. The range of acidity in this experiment was from 0.54±0.04 to 0.58±0.06, which might be due to lower microbial activity, hence reduced rate of fermentation.

Table 3. Microbiological parameters of Dahi prepared from different levels of Date palm brown sugar and 12% refined cane sugar

Parameters	Treatments			
	A	B	C	D
Total viable count (cfu/g)	$83\times10^{5\,bc}$ $\pm2\times10^{5}$	81×10^{5c} $\pm1.7\times10^{5}$	85×10^{5ab} ±0.00	86×10^{5a} $\pm5.8\times10^{4}$
Coliform count (cfu/g)	0.00^{b}± 0.000	0.00^{b}± 0.000	2.00^{b}± 1.000	7.67^{a}± 2.517

*A, Dahi with 10% brown sugar; B, Dahi with 12% brown sugar; C, Dahi with 14% brown sugar; D, Dahi with 12% cane sugar; Means with different superscripts in the same row differ significantly (**, p<0.01)*

The total viable count per ml of Dahi samples are presented in Table 3. It was observed that there was a significant (p<0.01) differences among the different types of Dahi sample. The highest coloni forming unit /g was recorded for D type Dahi sample, which indicates that it contains more favorable condition for growth of microbes. On the other hand, lowest value was recorded for B type Dahi. However, all the samples showed normal number of microbial population. These results are in line with the findings of Davis and Mclachlan (1974).

The average coliform count per ml of Dahi samples A, B, C and D are shown in Table 3. It was observed that there was a significant (p<0.01) differences among the different types of Dahi sample. The highest coliform count (coloni

forming unit/g) was observed in sample D and the lowest was recorded in sample A and B. However, coliform count was within the standard value in every sample. Addition of sugar at the end of heating could be the cause of presence of coliform bacteria.

The prices of Date palm brown sugar and that of refined cane sugar were surveyed at three different markets of Mymensingh town – Motsho Bazar, KR Market and Notun Bazar. It was found that Date palm brown sugar was sold @ Tk. 70-80/kg throughout the year 2013, whereas refined cane sugar was available @ Tk. 42-52/kg. The prices of Dahi prepared by adding 10%, 12%, and 14% Date palm brown sugar were Tk. 72.50±0.50/kg, Tk. 74.00±0.60/kg, and Tk. 75.50±0.70/kg, respectively. On the other hand, the price of Dahi prepared by adding 12% refined cane sugar was Tk. 70.70±0.60/kg, which was significantly ($p<0.01$) lower than others types of Dahi. Nonetheless, the price difference of Dahi containing Date palm brown sugar did not exceed Tk. 5.00/kg, which can easily be compensated by higher level ($p<0.01$; Table 1) of consumer satisfaction. In fact, 12% Date palm brown sugar added Dahi, which was proved to be the most popular, was only around Tk. 3.30/kg higher than its 12% refined cane sugar containing competitor. Therefore, addition of Date palm brown sugar to Dahi is quite feasible in terms of cost analysis.

Table 4: Cost analysis of Dahi prepared from different levels of Date palm brown sugar and 12% refined cane sugar

Items of expenditure	Cost (Tk. /kg Dahi)			
	A	B	C	D
Whole milk	50.0±0.0	50.0±0.0	50.0±0.0	50.0±0.0
Container	5.0±0.0	5.0±0.0	5.0±0.0	5.0±0.0
Fuel and electricity	5.0±0.0	5.0±0.0	5.0±0.0	5.0±0.0
Starter culture	1.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0
Depreciation	4.0±0.0	4.0±0.0	4.0±0.0	4.0±0.0
Sugar	7.5^{b}±0.5	9.0^{c}±0.6	10.5^{d}±0.7	5.7^{a}±0.6
Total	72.5^{b}±0.5	74.0^{c}±0.6	75.5^{d} ±0.7	70.7^{a}±0.6

*A, Dahi with 10% brown sugar; B, Dahi with 12% brown sugar; C, Dahi with 14% brown sugar; D, Dahi with 12% cane sugar; Means with different superscripts in the same row differ significantly (**, p<0.01)*

Conclusion

The experiment was conducted to check the organoleptic, chemical and microbiological qualities of Dahi made by adding different levels (10%, 12% and 14%) of Date palm brown sugar as an alternative to refined cane sugar (12%) for making Dahi. The comparative cost analysis was also done. Considering the results of all parameters (organoleptic, chemical and microbiological) it is obvious that there were wide variation in quality of different Dahi samples. It can be concluded that Dahi which was prepared by adding 12% Date palm brown sugar was the best among the samples. It was found that cost of Dahi containing 12% Date palm brown sugar is only Tk. 3.30 per kg higher than that made with 12% refined cane sugar. Hence, Dahi of high quality can successfully be made using Date palm brown sugar as a sweetener, and it is also economically feasible.

References

Aggarwala AC, Shamra RM (1961). A Laboratory Manual of Milk Inspection. Asia Publishing House. Bombay.

Alam SM (1999). A comparative study on the quality of Dahi (yoghurt) prepared from Cow, Goat and Buffalo milk. MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

American Public Health Association (1967). Standard Methods for the Examination of Dairy Products. 12th Edn. American Public Health Association, Inc. New York. P. 34-62.

AOAC (1982). Official Methods of Analysis. 10th Edition. Association of Official Analytical Chemists. Washington DC.

AOAC (2003). Official Methods of Analysis. 10th Edition. Association of Official Agricultural Chemists. Washington DC.

Bozanic R, Rogelj I, Tratnik L (2002). Fermentation and storage of probiotic yoghurt from goat's milk. Mljekarstvo, 52: 93–111.

Cardoso-Castaneda F, Iniguez-Rojas-C, Hombre-Morgado-R-Do, Castaned F-Cardoso, Rojas-C-Iniguez, Morgado-R-De-Hombre (1991). Effect of heat treatment of firmness of yoghurt made from buffalo milk. Revista

cubanade. Alimentation yoghurt Nutrition, 5(2): 114-1I7.

Chakraborty M (1998). A study on the preparation of Dahi from whole milk of cow, buffalo, and their different proportion mixtures. MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Davis JG, Mclachlan T (1974). Yoghurt in the United Kingdom: chemical and microbiological analysis. Dairy Industry. 7: 149-177.

Desai SR, Toro VA, Joshi SV (1994). Utilization of different fruits in the manufacture of yogurt. Indian Journal Dairy Science. 47: 870-874.

Early R (1998). The technology of dairy products, 2nd Edn. International Thomson Publishing. England.

FAO (1990). The technology of traditional milk products in developing countries. Food and Agriculture Organization of the United Nations: Rome. 43: 163-169.

Ghosh J, Rojorhia GS (1987). Chemical microbiological and sensory properties of with misti Dahi in Calcutta. Asian Journal of Dairy Science. 6: 11-16.

Laxminarayana H, Nambudiripad V K N, Lakshmi N, Anantharamaiah S N and Sreenivasa Murthy V (1952). Studies on *Dahi* II Survey of the quality of market Dahi. Indian Journal of Veterinary Science and Animal Husbandry, 22: 13–25.

Mahanta CK (1984). Dairy Microbiology. 2nd Edn. Omsons publications. New Delhi. pp. 232-233.

Mustafa MD (1997). A study on the preparation of fruit Dahi (yogurt). MS Thesis submitted to Department of Dairy Science, BAU, Mymensingh, P. 22-32.

Pazakova J, Turek P, Laciakova A (1997). The survival of *Staphylococcus aureus* during the fermentation and storage of yoghurt. Journal of Applied Microbiology, 82: 659-62.

Pette JW, Lalkema H (1950). Yoghurt III. Acid production and aroma formation in yoghurt. Netherlands Milk Dairy Journal, 4: 261-273.

Rahman M (1998). A comparative study on cows' and buffaloes' milk and their shelf-life at room and refrigeration temperature. MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Resubal LE (1977) Introductory Bacteriology and Dairy. Microbiology Practical's. FAO. Rome, Italy. P. 41-43.

Sarker S, Kulia RK, Misra AK (1996). Organoleptical, microbiological and chemical quality of misti Dahi sold in different districts of West Bengal. Indian Journal of Dairy Science, 49: 54-61.

Tawhidul I (2012). Preparation of Dahi from whole milk fortified with wood apple (Aegle marmelos) Juice. MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Venkateshaiah BV, Kempanna C, Jayaprakasha HM (1996). Effect of different levels of fat, SNF and acidity on the sensory quality of frozen yoghurt. Indian Journal of Dairy and Bioscience, 7: 38-40.

Yasmin N (1999). Utilization of mango (*Magnifera Indica*) Juice for preparation of yoghurt. MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.