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Partial replacement of skim milk with coconut milk for preparation of *Dahi*

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A B S T R A C T

Dahi is a highly nutritious fermented dairy product. A number of research works has been done on *dahi* preparation, but very few works has been reported for preparation of *dahi* from skim milk replacing with different levels of coconut milk. So, the present study was conducted to measure the feasibility of partial replacement of skim milk with coconut milk in the manufacture of *dahi*. Five different types of *dahi* were prepared by replacing 0, 5, 10, 15 and 20% skim milk with coconut milk and the prepared *dahi* samples were designated as A, B, C, D and E type, respectively. The prepared *dahi* samples were subjected to physical, chemical and microbiological analysis to evaluate their qualities. Replacement of skim milk up to 10% with coconut milk increased total organoleptic score but score decreased when level of coconut milk was 15% and 20%. *Dahi* having 10% of coconut milk was better in terms of smell and taste. *Dahi* manufactured incorporating 5% coconut milk gave superior results for body and consistency and also for color and texture. Addition of coconut milk increased the total solids (g kg^{-1}), fat (g kg^{-1}), ash (g kg^{-1}) and acidity (%) content but decreased the protein (g kg^{-1}) and pH content. *Dahi* containing 5% coconut milk showed better performance with respect to chemical qualities other than control. Total bacterial count was higher in the *dahi* manufactured by replacement of coconut milk than control. From this study, it could be suggested that *dahi* might be successfully prepared by replacement of 5% and 10% skim milk with coconut milk.

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INTRODUCTION

Milk is very nutritious and perhaps an indispensable food for human being. Nowadays milk is converted to various products as the food habit of common people is changing. About 4% of the total milk produced in Bangladesh is used for the preparation of *dahi* (Mustafa 1997). *Dahi* is the curd resulting from lactic acid fermentation of milk. It is very popular in Bangladesh, where it served as both an appetizer and dessert. It is a highly nutritious product containing all the nutrients present in milk. It has been demonstrated that acid milk is somewhat easily digestible than normal milk. For some individuals, it has definite therapeutic value, especially who usually suffer from stomach and intestinal disorders. *Dahi* is also effective in lowering the blood cholesterol level.

Fermentation has been an ideal technology to preserve milk from time immemorial (Begum et al. 2011). Fermentation of milk by specific microflora accompanying a technological modification, and using some additives induces changes in taste, texture, visual appearance, color, flavor and the nutritive properties of the milk and products (Oberman and Libudzisz 1998). Fermentation also imparts high therapeutic value to the fermented milk products (Adachi 1992; Yamamoto et al. 1994; Vantycer et al. 1989).

In Bangladesh, *dahi* is usually prepared from cow milk or buffalo milk or their mixture. Milk production of the country is very low. For this reason, it becomes very difficult to maintain regular supply of this product in the market. On the other hand, as coconut is very cheap and easily available in Bangladesh, its milk could be used to replace skim milk to increase the taste and also to make the product economic. In addition, coconut milk can play a vital role in balancing fat deficiency in skim milk *dahi*. It also contains high amount of other nutrients which can be useful for combating malnutrition in the poor population.

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The preparation of *dahi* from skim milk with various fruit juice and other food products has been investigated by a number of researchers in different parts of the world (Yasmin 1999; Mustafa 1997; Desai et al. 1994). But very few experiments have been reported for preparation of *dahi* from skim milk replacing with coconut milk. Therefore, the present research was undertaken to investigate the feasibility of partial replacement of skim milk with coconut milk in *dahi* preparation.

MATERIALS AND METHODS

Site and Time of the Experiment

The study was conducted at the Dairy Technology and Dairy Microbiology Laboratories of the Department of Dairy Science, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh during the period from July to November, 2013.

Preparation of Skim Milk

At first whole milk was collected from BAU Dairy Farm, Mymensingh. Skim milk was separated from the whole milk by using the cream separator machine (Milchzentrifuge 1999) at the Dairy Technology Laboratory of BAU.

Preparation of Coconut Milk

The coconut *(Cocos nucifera)* was purchased from local markets of Mymensingh district, and then the edible portion (kernel) of coconut was collected carefully to avoid the waste materials. One cup of coconut was mixed with two cup of boiled water. The coconut was blended with hot water until the mixture was as smooth as possible. The mixture was then poured with the muslin cloth, twists up, and squeezes as much milk as getting from the cloth and was kept in a plastic cup (Saha et al. 2014).

Chemical Analysis of Skim Milk and Coconut Milk

Before preparation of *dahi*, the initial quality of skim milk and coconut milk was measured. The specific gravity was determined by using Quevenne lactometer (Kimble Glass Co., USA) according to the method described by Aggarwala and Sharma (1961). Total solids and moisture content of the skim milk and coconut milk were determined by oven drying method according to Association of Official Agricultural Chemists (AOAC 2003). Fat percentage was estimated by Babcock method using the procedure described by Aggarwala and Sharma (1961). Protein was determined by Kjeldahal procedure. Ash was determined by muffle furnace according to AOAC (2003). Acidity was determined by titration with N/10 sodium hydroxide solution using the procedure of Aggarwala and Sharma (1961). pH was measured with the help of a pH meter 215 (Ciba Corning Diagnostics Ltd. Sudhury, Suffolk, England Co. 106 × D). It was observed that composition of skim milk used in this study was within normal range.

Preparation of Different Types of *Dahi*

Five types of *dahi* were prepared in this study. Out of five, one was prepared from skimmed milk (control) and other four were prepared by replacing skim milk with coconut milk at the rate of 5, 10, 15 and 20%, respectively.

Preparation of skim milk dahi

Skim milk was heated to boiling temperature until reduce up to 20% of the original volume of milk. At the time of boiling, sugar was added to the milk at the rate of 12%. During heating, milk was stirred thoroughly with the help of the spoon. After desired heating milk pan was taken out from the heater and allowed to cool down to 45°C. The starter culture (mixed culture) was added to the milk at the rate of 2% with continuous stirring. Then, the milk was poured in several pre-boiled water washed 50 mL plastic cups and kept undisturbed at an incubation of 40°C until complete coagulation of the samples. After complete coagulation (approximately 4 hours), the *dahi* samples were taken out from the incubator and were stored in a refrigerator at about 5°C for analytical purpose. This type of *dahi* was identified as A type (control) *dahi* for experimental purpose.

Preparation of dahi from skim milk with the replacement of coconut milk

For the preparation of these types of *dahi*, at first skim milk was replaced with 5, 10, 15 and 20% of coconut milk, respectively. Other steps for the preparation of *dahi* were similar to skim milk *dahi*. These *dahi* samples were represented as B, C, D and E type of *dahi*, respectively.

Evaluation of Different Types of *Dahi* Samples

Physical, chemical and microbiological tests were done immediately after preparation of *dahi*. *Dahi* samples were observed and judged individually by a panel of expert judges according to the organoleptic parameters, like smell and taste (50 marks), body and consistency (30 marks), color and texture (20 marks). All *dahi* samples were chemically analyzed for measuring the pH value, acidity (%), total solids content (g kg^{-1}), moisture content (g kg^{-1}), fat content (g kg^{-1}), protein content (g kg^{-1}), carbohydrate content (g kg^{-1}), ash content (g kg^{-1}). Procedure used for chemical tests were similar to the procedure used to determine the composition of skim milk. Total viable bacterial count (by standard plate count method) and coliform count of different *dahi* samples were determined according to the method described in the "Standard Methods for Examination of Dairy products" American Public health Association (APHA 1998).

Statistical Analysis

Data collected from different parameters were analyzed statistically as per Completely Randomized Design (CRD) using the MSTAT-C statistical program. Analysis of variance (ANOVA) test was done to find out the statistical difference among the different treatments. Least significance difference (LSD) test was performed to rank the treatment means (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Initial Quality of Skim Milk and Coconut Milk

The initial quality of skim milk and coconut milk was investigated in laboratory by different chemical analysis before preparation of *dahi* (Table 1). The average chemical composition of the experimental skim milk (Saha et al. 2014 and Begum et al. 2011) and coconut milk (Saha et al. 2014) was within the normal ranges. The results indicated that the samples were in acceptable quality.

Table 1. Chemical composition of skim milk and coconut milk sample

Sample type	Sp. Gr.	Acidity (%)	pH	TS	Fat	SNF	Protein	Lactose/CHO	Ash
Skim milk	1.034 ± 0.0006	0.145±0.05	6.76±0.02	86.7±1.1	3.67±0.88	82.35±1.85	33.7±1.3	41.42±2.74	7.23±0.09
Coconut milk	1.008±0.01	0.13±0.01	6.4±3.0	291.05±11.0	210.0±8.0	81.0±5.0	22.0±4.5	52.3±3.0	7.0± 0.01

Sp. Gr.= Specific gravity, TS= Total solids, SNF= Solids-not-fat, CHO= Carbohydrate

Evaluation of Quality for Different Types of *Dahi*

Physical parameters

Smell and taste: Average smell and taste score of *dahi* samples containing 0, 5, 10, 15 and 20% coconut milk are shown in Table 2. Statistical analysis showed that there were significant differences within the smell and taste score of different *dahi* samples. The highest value was seen in sample C (90% skim milk + 10% coconut milk) followed by B (95% skim milk + 5% coconut milk), A (100% skim milk + 0% coconut milk) and D (85% skim milk + 15% coconut milk) and the lowest score was recorded in sample E (80% skim milk + 20% coconut milk). The variation in smell and taste score of *dahi* usually depends on type of milk, starter culture and manufacturing process involved (Younus 1998). The result is in agreement with the findings of Altaf (2007) and Saha et al. (2014).

Body and consistency: The body and consistency score of different *dahi* samples are given in Table 2. Statistically there were significant differences within the samples. Highest body and consistency score was seen in the sample B followed by C, A and D and the lowest score was seen in the sample E. This result is in agreement with the report of Altaf (2007) and Saha et al. (2014).

Color and texture: Statistical analysis showed that there was significant difference within the samples in terms of color and texture (Table 2). Although the color and texture score of *dahi* B was statistically similar with *dahi* C, the highest numerical score was found in the sample B followed by C, D and E and the lowest score in the sample A.

Overall score: Statistical analysis showed significant difference among the overall score of *dahi* samples (Table 2). Highest score was obtained by B sample followed by C, D and A, and the lowest was obtained by E sample. From our experiment, it was observed that *dahi* from skim milk in addition with 5% and 10% coconut milk were highly acceptable for organoleptic characteristics. The result of this experiment agreed with the work of Saha et al. (2014) who found that the addition of fruit juice improved the total score of *dahi*.

Table 2. Average physical parameters of different types of *dahi*

Physical parameters	Sample					LSD value	Level of Sig.
	A	B	C	D	E		
Smell and taste (50)	$41.33^{b}\pm1.15$	$42.67^{ab}\pm0.58$	$44.33^{a}\pm1.15$	$41.00^{b}\pm1.00$	$37.33^{c}\pm2.08$	1.36	**
Body and consistency (30)	$23.67^{bc}\pm0.58$	$26.00^{a}\pm1.73$	$25.00^{ab}\pm1.00$	$23.33^{bc}\pm0.58$	$22.33^{c}\pm0.58$	1.22	**
Color and texture (20)	$13.67^{c}\pm0.58$	$17.00^{a}\pm1.00$	$16.00^{ab}\pm1.00$	$14.67^{bc}\pm1.15$	$14.00^{c}\pm1.00$	1.01	**
Overall score (100)	$74.41^{c}\pm1.17$	$85.53^{a}\pm1.91$	$80.99^{b}\pm2.34$	$74.67^{cd}\pm3.75$	$72.22^{d}\pm2.34$	3.50	**

A= 100% skim milk +0 % coconut milk, B= 95 % skim milk + 5% coconut milk, C= 90% skim milk + 10% coconut milk, D= 85% skim milk + 15% coconut milk, E= 80% skim milk + 20% coconut milk

**= significant at 1% level of probability, ^{a,b,c,d} Means with different superscripts in the same row differ significantly

Chemical parameters

Acidity: The average percentage of acidity of *dahi* samples A, B, C, D and E is given in Table 3. Statistical analysis showed that there were significant differences among the different samples. Mean percentage of acidity was highest in sample E and lowest in sample A. Acidity increased slightly due to the addition of different levels of coconut milk. This result of acidity of *dahi* samples agreed with the findings of Desai et al. (1994) who found that the titrable acidity of fruit *dahi* was increased due to the addition of fruit juice/pulp.

pH: Statistically there were significant differences among the different samples due to pH level (Table 3). Mean percentage of pH value was highest in sample A and lowest in sample E. Addition of coconut milk slightly decreased the pH value of *dahi*. It is well known that when pH values decrease then acidity value will increase. Kosikowski et al. (1997) reported that the pH of normal *dahi* samples should be approximately 4.4 which nearly agree with the present findings.

Total solids: Statistical analysis showed that there were significant differences within the total solids content of different types of *dahi* samples ($P<0.01$) (Table 3). Total solids percent was highest in *dahi* E, followed by *dahi* D, C and B, and the lowest percent of total solids was seen in the A. It was observed that incorporation of coconut milk to the *dahi* might increase quality of *dahi* by increasing total solids content. The result of this experiment agreed with the work of Desai et al. (1994) who found that total solids content increased significantly due to the addition of fruit juice in yogurt. Mustafa (1997) also conducted an experiment with different types of fruit juice and found that addition of fruit juice significantly increased the total solids content of *dahi*. The total solids content in *dahi* could vary due to type of milk used, variation in manufacturing technology (Ghosh and Rajorhia 1990) or extent of concentration of milk during heat treatment (Ray and Srinivasam 1972). In this experiment variation in total solids content might be due to different level of coconut milk used.

Moisture content: There were significant differences in moisture content among the samples ($P<0.01$) (Table 3). Highest moisture percent was obtained in *dahi* A (control) and the lowest were in the E. This result showed that when fat content of *dahi* increased due to incorporation of coconut milk, water content in *dahi* decreased significantly. Avlesen et al. (1979) observed that a good flavor *dahi* had about 770 g kg^{-1} or less moisture. Gupta et al. (1993) reported that overall textural quality was significantly correlated with moisture content.

Fat content: Statistically there were significant differences in fat content among the *dahi* samples ($P<0.01$) (Table 3). Highest fat percent was obtained in *dahi* E and lowest was in the A (control). Fat content of different *dahi* samples increase due to the addition of different levels of coconut milk. Saha et al. (2014) studied the *dahi* from reconstituted skim milk replaced by coconut milk and found that fat content ranges from 1 to 65 g kg^{-1} which nearly agreed with the present findings.

Protein content: There was no significant difference within the protein percent of different types of *dahi* (Table 3). The highest numerical protein content was observed in the *dahi* A and the lowest in the E. Addition of coconut milk reduces the protein content of *dahi* samples, which is due to lower protein content in coconut milk compared to skim milk.

Carbohydrate content: Statistically there were no significant differences in carbohydrate content (Table 3) among the samples. Saha et al. (2014) studied the *dahi* from skim milk

replaced with coconut milk, and observed that carbohydrate content ranges from 167 to 182 g kg^{-1} which nearly agreed with the present findings.

Ash content: Statistical analysis showed that there were significant difference in ash content among the samples ($P<0.01$) (Table 3). The highest ash content was found in *dahi* E and the lowest was in *dahi* A (control). It was observed that ash value increased gradually due to the addition of different levels of coconut milk which agreed with the result obtained by Mustafa (1997), Yasmin (1999), Desai et al. (1994) and Altaf (2007).

Table 3. Average chemical parameters of different types of *dahi*

Chemical parameters	Sample					LSD value	Level of Sig.
	A	B	C	D	E		
Acidity (%)	$0.71^{c}\pm0.049$	$0.73^{bc}\pm0.009$	$0.74^{bc}\pm0.21$	$0.76^{ab}\pm0.022$	$0.79^{a}\pm0.022$	0.218	**
pH value	$4.53^{a}\pm0.010$	$4.43^{ab}\pm0.16$	$4.33^{bc}\pm0.20$	$4.23^{cd}\pm0.22$	$4.15^{d}\pm0.31$	0.058	**
Total solids (g/kg)	$221.25^{d}\pm9.33$	$237.13^{c}\pm3.65$	$249.05^{b}\pm4.16$	$263.88^{a}\pm7.63$	$272.93^{a}\pm4.98$	6.65	**
Moisture (g/kg)	$782.47^{a}\pm0.75$	$765.27^{b}\pm2.66$	$746.64^{c}\pm5.47$	$739.06^{c}\pm8.91$	$731.38^{c}\pm5.90$	9.60	**
Fat (g/kg)	$2.2^{e}\pm0.11$	$14.0^{d}\pm0.10$	$25.8^{c}\pm0.13$	$40.4^{b}\pm0.61$	$49.3^{a}\pm0.25$	3.24	**
Protein (g/kg)	35.3±0.667	34.92±0.729	34.53±0.833	34.13±0.814	33.71±0.973	-	NS
Carbohydrate (g/kg)	176.67±8.977	181.0±2.606	181.53±1.353	181.83 ±2.084	182.60 ±1.800	-	NS
Ash (g/kg)	$7.0^{e}\pm0.490$	$7.3^{d}\pm0.086$	$7.42^{c}\pm0.202$	$7.57^{b}\pm0.219$	$7.87^{a}\pm0.306$	0.218	**

A= 100% skim milk +0 % coconut milk, B= 95 % skim milk + 5% coconut milk, C= 90% skim milk + 10% coconut milk, D= 85% skim milk + 15% coconut milk, E= 80% skim milk + 20% coconut milk

**= significant at 1% level of probability, NS= Non-significant, ^{a,b,c,d} Means with different superscripts in the same row differ significantly

Microbiological parameters

Total viable bacterial count: Statistical analysis showed that there was significant difference among the different types of *dahi* samples due to total viable bacterial count (Table 4). Highest total viable bacterial count g^{-1} was recorded in E type *dahi* and lowest value was recorded in A type *dahi*. The differences in viable bacterial count might be due to variation in nutrient content of different *dahi* samples. The present result agreed with the findings of Saha et al. (2014).

Coliform count: There was no evidence of coliform bacteria in any of the *dahi* samples (Table 4). The presence of coliform bacteria indicates unhygienic conditions of *dahi* preparation. Coliform bacteria are usually present in fecal materials, contaminated water and feed stuffs used for feeding livestock (Sanderson et al. 2005). The absence of coliform bacteria indicate that hygienic measure was strictly maintained in this research, and there was no contamination.

Table 4. Average microbiological parameters of different types of *dahi*

Microbial parameters	Sample					LSD value	Level of Sig.
	A	B	C	D	E		
Total viable bacterial count (CFU/g)	82.67×10^{4}	85.67×10^{4}	84.67×10^{4}	91.00×10^{4}	94.67×10^{4}	25.34	**
Coliform count (CFU/g)	(-)*ve*	(-)*ve*	(-)*ve*	(-)*ve*	(-)*ve*	-	-

A= 100% skim milk +0 % coconut milk, B= 95 % skim milk + 5% coconut milk, C= 90% skim milk + 10% coconut milk, D= 85% skim milk + 15% coconut milk, E= 80% skim milk + 20% coconut milk

**= significant at 1% level of probability, ^{a,b,c,d} Means with different superscripts in the same row differ significantly

CONCLUSION

As per physical evaluation, replacement of skim milk with coconut milk (5% and 10%) improves the organoleptic qualities of *dahi* compared to skim milk *dahi*. According to chemical and microbial parameters, *dahi* prepared from skim milk with 5% and 10% replacement of skim milk with coconut milk gave better results. Therefore, it could be concluded that good quality *dahi* could be prepared successfully by partial replacement of skimmed milk with coconut milk and the level should be 5 to 10% of original volume of milk.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

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