



Study on the Quality of Market Dahi Compared to Laboratory Made Dahi

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ABSTRACT - Dahi is yoghurt like fermented dairy products available in Bangladesh made by traditional ways from raw milk. The aim of the present study was to check and compare the present quality status of the market dahi in reference to laboratory made dahi. For this, dahi was prepared in the laboratory (A) and collected from Kishoregonj district (B), Gazipur district (C), Bogra district (D) and Dhaka district (E and F). Consumer acceptance quality was judged on 100 point by a judge panel and chemical and microbiological quality test were done by established methods. 'A' type dahi was superior followed by E, D, F, B and C considering the consumer acceptance quality parameter. From chemical test, it appears that, B possess the lowest pH (3.75 ± 0.05) and highest was in C (4.46 ± 0.15). Total solids content of F type dahi (318.40 ± 4.44 g/kg) was highest and fat (52.00 ± 2.00 g/kg), protein (44.33 ± 2.00 g/kg) and ash (10.76 ± 0.31 g/kg) content were also higher in F type dahi. E and A type dahi were also with considerable figure in chemical quality parameter. Dahi B was inferior in respect of microbiological quality- total viable count (TVC) ($\times 10^5$ cfu/ml) content was 94.00 ± 4.58 , yeast (cfu/ml) content was 183.33 ± 15.28 and mold (cfu/ml) content was 53.33 ± 15.28 . The TVC ($\times 10^5$ cfu/ml), yeast (cfu/ml) and mold (cfu/ml) content of A type dahi were 39.67 ± 4.51 , 50.00 ± 10.00 and 20.00 ± 10.00 , respectively. Considering all the three major quality aspects dahi A was superior than others followed by F, D, E, C and B.

Key words: Physico-chemical, Microbial quality, dahi

There are several indigenous fermented dairy products available in Bangladesh made by traditional ways from raw milk namely- dahi, cheese, ghoor etc. Among the fermented products dahi is yoghurt like product but domestically it is known as such. Among all the fermented product available dahi is preferred by people of all class and age either as a part of the daily diet or as a refreshing dessert and 4% of the total milk production was used to prepare dahi and 10% of the milk used for the production of all other fermented products¹). It has been reported to exert a possible therapeutic effect by controlling bacterial growth and to cure some intestinal disease like constipation, diarrhea and dysentery, possibly because of its antibiotic effect^{2,3}). Nutritionally dahi is a nearly complete food since it is made from milk and additional nutritional feature also found due to the use of streptococcus and lactobacillus organism. The metabolic product of these organism also play role in different health

aspects like blood pressure, cholesterol content, antimutagenicity etc. In Bangladesh two types of dahi are available in local markets such as, sweetened/misti dahi (with added sugar) and sour dahi (without added sugar) and both of them are prepared by traditional method by using previously made dahi as a starter culture. Sweetened dahi has a characteristic brown color, a cooked and caramelized flavor and a firm body. The pronounced and intense heating causes the milk to brown and partially concentrated. Artificial color, sugar caramel and jaggery (gur) are also added during production and sometime some producer add tissue paper to improve the total solids content and artificial color to improve the color of the product. Most of the producer use earthenware to set the curd. The composition of milk and level of adulteration of market milk also causes to vary the quality of dahi from place to place, market to market, shop to shop. Though the traditional fermented dahi is prepared without any care of quality control and hygienic conditions, and contain a lot of contaminants which may not be friendly to the body; it still enjoys loyal following in rural communities in Bangladesh and a must after improved heavy meal. In addition to the poor quality control and hygiene during manufacturing, dahi are sold almost in open markets and

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products are kept on shelf at ambient temperature without any covering and very few retailers also kept their product in refrigeration. So the periodical inspection on the quality of the product is necessary but is not in practice. Very few research was conducted to study the market dahi quality on region basis and considering the above circumstances renowned brand dahi of Dhaka, Bogra, Kishoregonj and Gazipur district were chosen to check and compare their quality with the dahi prepared from fresh raw milk by following a standard procedure.

Materials and methods

Place of Experiment

This experiment was conducted at the Dairy Chemistry and Technology Laboratory (DCTL) and Dairy Microbiology Laboratory (DML) of Department of Dairy Science, Bangladesh Agricultural University (BAU), Mymensingh.

Preparation of dahi

For the preparation of dahi in the laboratory (A) raw milk was collected from the BAU Dairy Farm. Milk was heated to boil on an electric heater and during the course of boiling; the volume of milk was reduced by 15-20% (approximately). Sugar was added during boiling @12%. After boiling, milk was kept off heat to bring the temperature near about 40-45°C. At this temperature, 2% mixed market culture was added to the milk and it was mixed thoroughly. Then the milk was poured in several plastic cups and the cups were placed in an incubator at 37°C for incubation. After complete coagulation dahi was prepared and was kept in a refrigerator until analyzed.

The collected market dahi samples were Aftab dahi (B) from Kishoreganj District, Aarong dahi (C) from Gazipur District, Mahram dahi (D) from Bogra District, Bikrampur dahi (E) and Maranchad dahi (F) from Dhaka District. From the collection to analysis, cold chain was maintained for all the samples.

Physicochemical test

The laboratory made dahi and all the collected market dahi were subjected to the consumer acceptance quality- Smell and taste, Body and consistency and Color and texture, chemical quality- pH, Total solids%, Fat%, Protein% and Ash% and microbiological quality test- Total viable count cfu/ml, Yeast and mold count cfu/ml. Consumer acceptance quality was judged by an expert panel of judges of Department of Dairy Science using a 100 point score card. pH was measured by a pH meter, total solids by oven drying, fat by Babcock, protein by Kjeldahl and ash by incineration method.

Microbiological test

Microbial parameters (viable bacteria, yeast and mold counts) were determined by the standard plate count method according to APHA⁴. 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 hrs. 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 (25°C) for 3-5 days. The molds and yeast colonies were enumerated.

Statistical analysis

The data obtained, were analyzed in Completely Randomized Design (CRD) by MSTAT computer package and incase of significant difference mean separation was done by LSD value.

Results and discussion

Consumer acceptance quality

Smell and taste

The smell and taste score of A, B, C, D, E and F were 47.36 ± 1.07 , 38.42 ± 0.69 , 37.01 ± 0.99 , 43.48 ± 0.90 , 44.22 ± 1.16 and 42.21 ± 1.90 , respectively (Table 1). Statistical analysis revealed that there exists a significant ($p < 0.01$) difference among the mean and mean separation indicates that laboratory made dahi scored better than others. But other researchers found a non-significant difference among the dahi samples from different shops of Mymensingh district though they suggest the laboratory dahi as superior than others⁵. The smell of the product depends on the volatile constituents of milk and also influenced by the quality of the raw milk and fermentation pattern of the product. From BAU dairy farm fresh raw milk of good quality were used to make the dahi A whereas the several market raw milk samples have been accused for adulteration and they are also lack of freshness. Taste is also influenced by the quality of the raw milk and added materials to it. That is may be the cause of lower score of other samples. The smell and taste score of plain dahi was 37.54 ± 1.58 and dahi with 10% banana juice was scored 38.97 ± 1.43 but then after with the increase of the level of banana juice the score was diminishing⁶. A taste score of 4.57 ± 1.50 for market dahi using

Table 1. Consumer acceptance quality of dahi collected from different markets

Parameter	Type of dahi						LSD value	Level of significance
	A	B	C	D	E	F		
Smell and taste (50)	47.36 ^a ± 1.07	38.42 ^b ± 0.69	37.01 ^b ± 0.99	43.48 ^b ± 0.90	44.22 ^c ± 1.16	42.21 ^c ± 1.90	2.943	**
Body and consistency (30)	27.75 ^a ± 0.51	21.41 ^d ± 0.77	19.29 ^c ± 0.66	23.50 ^c ± 0.57	25.86 ^b ± 0.17	23.83 ^c ± 0.69	1.484	**
Color and texture (20)	17.97 ^a ± 0.73	13.81 ^c ± 0.44	11.83 ^d ± 0.37	15.58 ^b ± 0.51	16.64 ^b ± 0.36	15.59 ^b ± 0.58	1.281	**

** : significant at 1% level

Table 2. Chemical quality of dahi collected from different markets

Parameter	Type of dahi						LSD value	Level of significance
	A	B	C	D	E	F		
pH	4.40 ^a ± 0.10	3.75 ^c ± 0.05	4.46 ^a ± 0.15	3.96 ^{bc} ± 0.06	4.10 ^b ± 0.10	3.93 ^{bc} ± 0.06	0.23	**
Total solids (g/kg)	277.30 ^b ± 7.50	276.90 ^b ± 4.37	241.20 ^c ± 4.35	274.20 ^b ± 9.82	305.80 ^a ± 3.00	318.40 ^a ± 4.44	15.08	**
Fat (g/kg)	47.43 ^{ab} ± 2.97	47.00 ^{ab} ± 1.00	40.33 ^c ± 1.53	45.33 ^b ± 2.52	50.00 ^{ab} ± 1.00	52.00 ^a ± 2.00	4.93	**
Protein (g/kg)	39.20 ^{bc} ± 1.51	40.00 ^{bc} ± 1.00	36.17 ^c ± 1.26	40.33 ^{abc} ± 1.15	42.03 ^{ab} ± 2.05	44.33 ^a ± 2.00	3.90	**
Ash (g/kg)	9.20 ^b ± 0.36	9.33 ^b ± 0.21	7.73 ^c ± 0.21	9.26 ^b ± 0.06	10.37 ^a ± 0.55	10.76 ^a ± 0.31	0.80	**

** : significant at 1% level.

a nine point hedonic score card which was lower than the market yoghurts⁷. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the smell and taste of prepared dahi⁸.

Body and consistency

The body and consistency score of the dahi sample varied significantly ($p < 0.01$) with the average 27.75 ± 0.51 , 21.41 ± 0.77 , 19.29 ± 0.66 , 23.50 ± 0.57 , 25.86 ± 0.17 and 23.83 ± 0.69 in A, B, C, D, E and F, respectively (Table 1). The variation among the sample may be due to the variation in the strain of bacteria in the mixed culture and variation in the manufacturing techniques by the different manufacturers. Additional material may also have some influence and addition of increased level of banana juice during the manufacturing of the dahi improves the body and consistency score⁹. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the body and consistency of prepared dahi⁸.

Color and texture

From Table 1 it appears that laboratory made dahi (A) obtained the highest score for its color and texture score (17.97 ± 0.73). The mean for others were 13.81 ± 0.44 (B), 11.83 ± 0.37 (C), 15.58 ± 0.51 (D), 16.64 ± 0.36 (E) and 15.59 ± 0.58 (F). Statistically they varied significantly ($p < 0.01$). Whereas, it has been found a non-significant difference concerning the color and texture of the Mymensingh town dahi sample and the laboratory one⁵. Color of the dahi

depends on the color of milk or caramelized color obtained during heating of the milk or added coloring materials. It was described that addition of non-fat dry milk and vegetable oil to skim milk improves the color and texture of prepared dahi⁸. Texture of the dahi depends mainly upon the rate of development of the acidity i.e. type of organisms present in the starter culture. The wide variation in the quality parameter of mishti dahi can be attributed to the manufacturing conditions and type of organism used⁹. Other scientists found an improved score for the dahi made with 10% added banana juice but the laboratory made dahi score of the present study is higher than their report and only dahi B and C is near to similar to their findings⁶. In another study revealed that only the color score of market dahi of Rawalpindi and Islamabad was 6.78 ± 1.40 ⁷.

Chemical quality

pH

The pH of A, B, C, D, E and F types of dahi were 4.40 ± 0.10 , 3.75 ± 0.05 , 4.46 ± 0.15 , 3.96 ± 0.06 , 4.10 ± 0.10 and 3.93 ± 0.06 , respectively. There was a significant ($p < 0.01$) difference among the pH value of the dahi sample (Table 2). Mean separation indicates that Aarong dahi bears the maximum pH, whereas lowest in Aftab dahi. In the pH of dahi, along with acid tolerant bacteria present in the starter culture, duration of staying the product in the market before consumption is an important matter. Others recorded pH values 4.5, 5.0, 5.5 and 6.5 during storage of yoghurt for

six months and reported that pH of the dahi sample reduces with the advancement of storage time both at room temperature and refrigerator though the rate was higher at room temperature^{6,10}. Dahi prepared from *Lactococci* with two adjunct probiotic cultures of *Lactobacillus acidophilus* and *L. casei* also showed a significant decrease over storage (at 7°C) time in the pH value¹¹. In different study scientists found a pH of 3.81-4.19 in stirred yoghurt; the pH of the laboratory made dahi was 4.79 ± 0.01 ; a pH of 4.54 ± 0.24 for market dahi and pH > 5.00 was reported in yoghurt sold in Lahore and Hyderabad^{5,7,12,13}. Moreover, the results cited by other person are in contrast to the findings of the present research, who found non-significant differences in pH values of different yoghurt samples¹⁴. The pH value of traditionally fermented milk dahi influenced by the fermentation condition¹⁵.

Total solids

The total solids content of A, B, C, D, E and F differed significantly ($p < 0.01$) with the average 277.30 ± 7.50 , 276.90 ± 4.37 , 241.23 ± 4.35 , 274.23 ± 9.82 , 305.83 ± 3.00 and 318.43 ± 4.44 g/kg, respectively (Table 2). It has been published that dahi of Bogra area contains total solids of 38.24 ± 4.37 and for Mymensingh region it was $29.82 \pm 4.61\%$ ¹⁵. Level of added material, milk total solids content and level of volume reduction of milk during boiling and storage duration plays the key role in determining the total solids content of dahi. The total solids in all samples significantly increased during storage and addition of non-fat dry milk and vegetable oil to skim milk improves the total solids content of prepared dahi^{8,16}. From the report of others who found only $13.38 \pm 1.34\%$ total solids in market dahi whereas a total solids content in market yoghurt of Lahore ranges from 9.10 to 17.00 but the West Bengal dahi contains more total solids (average 40.27%)^{7,13,17}.

Fat

Statistically, the fat content of dahi samples differed significantly ($p < 0.01$). Highest fat content was found in F (52.00 ± 2.00 g/kg) followed by E (50.00 ± 1.00 g/kg), A (47.43 ± 2.97 g/kg), B (47.00 ± 1.00 g/kg), D (45.33 ± 2.52 g/kg) and C (40.33 ± 1.53 g/kg). The dahi of Mymensingh district contains $4.88 \pm 0.99\%$ fat¹⁵. The fat content of dahi depends upon the initial fat content of the milk used for dahi making or raw material used to prepare the dahi and level of volume reduction of milk during its boiling. Adulteration may also cause a reduction in the fat content of the dahi. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the fat content of prepared dahi⁸. Researchers found a $3.75 \pm .76\%$ of fat in market dahi which value is below than present study but agrees with the findings of others^{7,17,18}.

Protein

The average protein content was 39.20 ± 1.51 , 40.00 ± 1.00 , 36.17 ± 1.26 , 40.33 ± 1.15 , 42.03 ± 2.05 and 44.33 ± 2.08 g/kg in A, B, C, D, E and F, respectively. The means were significantly ($p < 0.01$) different. Mean separation reveals that F type dahi contains more protein but it did not differ significantly with D and E (Table 2). It was also found that though C contains less protein but it was also non-significantly different from A, B and D types of dahi. The value obtained in this study was closer to the findings of others^{19,20}. Total solids content of milk is an important factor to determine the protein content of dahi and level of volume reduction of milk also influence the value. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the protein content of prepared dahi⁸. However, the results of the present study are in concurrence with the findings of other, who mentioned that protein contents in yoghurt increased during different processes and storage period and during removal of lactose also experienced significant effect on protein content in storage yoghurt samples^{21,22}. In Lahore market yoghurt, protein content varies from 2.60-4.90% and found a significant difference in protein content of market and laboratory made dahi^{5,13}.

Ash

From table 2 it appears that, F type dahi contains maximum ash (10.76 ± 0.31 g/kg) which differs non-significantly with E (10.37 ± 0.55 g/kg). Dahi B (9.33 ± 0.21 g/kg), D (9.26 ± 0.06 g/kg) and A (9.20 ± 0.36 g/kg) jointly ranked second in this regard and C type dahi have the lowest (7.73 ± 0.21 g/kg). A significant difference was also found in the ash content of Dhaka, Bogra, Mymensingh and Jamalpur district dahi¹⁵. The finding was also closer to the report of others²⁰.

Microbiological quality

Total viable count (TVC)

The total viable count of A, B, C, D, E and F types of dahi samples were 39.67 ± 4.51 , 94.00 ± 4.58 , 52.00 ± 3.61 , 56.33 ± 5.03 , 58.33 ± 4.73 and 48.67 ± 3.51 ($\times 10^5$) cfu/ml, respectively (Table 3). Statistical analysis revealed that they vary significantly ($p < 0.01$) and dahi B contains the maximum number of bacteria. Some scientists found total viable count of 7.34 ± 1.57 ($\times 10^7$) cfu/ml in market dahi of Rawalpindi and Islamabad⁷. The result also confirms the findings of others but somebody found much lower TVC ($2.27 \times 10^5 \pm 4.44$ to $3.82 \times 10^4 \pm 2.98$) than the present study and the difference was non-significant^{15,23}.

Yeast and mould count:

The yeast count of the dahi samples vary significantly

Table 3. Microbiological quality of dahi collected from different markets

Parameter	Type of dahi						LSD value	Level of significance
	A	B	C	D	E	F		
TVC ($\times 10^5$ cfu/ml)	39.67 ^c \pm 4.51	94.00 ^a \pm 4.58	52.00 ^b \pm 3.61	56.33 ^b \pm 5.03	58.33 ^b \pm 4.73	48.67 ^{bc} \pm 3.51	10.89	**
Yeast (cfu/ml)	50.00 ^d \pm 10.00	183.33 ^{ab} \pm 15.28	80.00 ^{cd} \pm 10.00	103.33 ^{bcd} \pm 15.28	233.33 ^a \pm 57.74	150.00 ^{abc} \pm 50.00	82.09	**
Mould (cfu/ml)	20.00 ^{bc} \pm 10.00	53.33 ^{ab} \pm 15.28	20.00 ^{bc} \pm 10.00	76.67 ^a \pm 15.28	73.33 ^a \pm 15.28	30.00 ^b \pm 17.32	35.27	**

** : significant at 1% level.

($p < 0.01$) with the average 50.00 ± 10.00 , 183.33 ± 15.28 , 80.00 ± 10.00 , 103.33 ± 15.28 , 233.33 ± 57.74 and 150.00 ± 50.00 in A, B, C, D, E and F type dahi, respectively. Other researchers found a significant difference in the yeast content of dahi from Dhaka, Mymensingh, Bogra and Jamalpur district and the value ranges from $1.44 \times 10^4 \pm 1.03$ to $4.85 \times 10^3 \pm 6.48$ which was pretty higher than the present study¹⁵. It was reported that yoghurt should not contain any yeast cell but traditionally made dahi contained yeast cell of 10^2 cfu/ml^{24,25}. The mould count was also found to vary significantly ($p < 0.01$) and dahi from Bogra and Dhaka contains the maximum number and followed by aftab dahi (Table 3). The result is higher than the recommended standard of yeast and mould/g for dahi by FAO (personal communication) but agrees with other²³. The result indicates that the product has to stay for a considerable time to be sold or repeated use of the container may cause such a high count. The mould content of the dahi depends upon the preparation, handling and storage condition as they found more yeast and mould count in the dahi from large vendors compare to household sample²⁶. The mold content (cfu/ml) of traditionally fermented milk dahi of Bangladesh was 0 to 75 ± 1.38 ¹⁵.

Considering the three major quality aspects (consumer acceptance, chemical and microbiological) laboratory made dahi was superior than market dahi. The findings of this study are expected to contribute to the production of good quality dahi.

요 약

다히(dahi)는 원유를 이용하여 방글라데시 전통 방법으로 발효시킨 요구르트와 비슷한 발효 유제품으로 본 연구는 실험실에서 만든 다히(dahi)와 시장에서 판매되고 있는 다히(dahi)의 품질을 비교하기 위하여 수행되었다. 실험실에서 준비한 다히(dahi)는 (A), Kishoregonj 지역에서 수집한 다히(dahi)는 (B), Gazipur 지역의 다히(dahi)는 (C), Bogra 지역의 다히(dahi)는 (D), Dhaka 지역의 다히(dahi)는 (E, F)

로 각각 구분하였다. 소비자 만족 품질은 심사위원들에 의해 100점 만점으로 판단되었으며 화학적 미생물학적 품질 시험은 확립된 방법에 의해 수행되었다. 'A' 타입의 다히(dahi)가 소비자 만족 품질에 있어서 가장 우수한 것으로 나타났으며 그 다음으로 E, D, F, B, C 순으로 나타났다. 화학적 시험 결과, 'B'타입의 다히(dahi)가 가장 낮은 pH (3.75 ± 0.05)를 나타냈으며 'C'타입의 다히(dahi)가 가장 높은 pH (4.46 ± 0.15)를 나타내었다. 'F' 타입의 다히(dahi)의 총 고형물, 지방, 단백질, 회분이 각각 318.40 ± 4.44 g/kg, 52.00 ± 2.00 g/kg, 44.33 ± 2.00 g/kg, 10.76 ± 0.31 g/kg으로 가장 높게 나타났다. 'B'타입의 다히(dahi)에서 total viable count (TVC)는 94.00 ± 4.58 cfu/ml, 효모가 183.33 ± 15.28 cfu/ml, 곰팡이가 53.33 ± 15.28 cfu/ml로 미생물학적 품질 측면에서 가장 좋지 않은 것으로 나타났다. 'A' 타입의 다히(dahi)는 TVC, 효모와 곰팡이가 각각 39.67 ± 4.51 cfu/ml, 50.00 ± 10.00 cfu/ml, 20.00 ± 10.00 cfu/ml로 나타났다. 3가지 주요 품질을 고려하였을 때 'A'타입의 다히(dahi)가 가장 우수하였으며 그 다음으로 F, D, E, C, B 순으로 나타났다.

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