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Study on the Quality Assessment of Curd (Dahi), Locally Available In Bangladeshi Market

[1]Nurul Abadin Chowdhury, [2]Kamruzzaman Paramanik and [1]W. Zaman

[1]Department of Food Engineering & Tea Technology, School of Applied Science & Technology,
Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
[2]Microbiology & Industrial Irradiation Division, Institute of Food & Radiation Biology,
Atomic Energy Research Establishment, Dhaka, Bangladesh

Abstract: Curd samples were collected from five popular brands i.e. Bogura, Bonoful, Arong, Muslim and Grameen Soktee[+] and coded as Bg, Bo, A, M and G, respectively. Then the microbiological quality assessment was done by determining Standard Plate Count (SPC), Total Coliform Count (TCC) and Total Fungal Count (TFC) of the collected curd samples using Nutrient Agar, Mac Conkey Agar and Potato Dextrose Agar, respectively. Curd samples Bg, Bo and M showed the standard plate count 7.70, 2.88 and 7.30×10^7 cfu/g, respectively which exist in the permeable limit of SPC for curd. But, in the sample A, number of SPC (2.24×10^8 cfu/g) exceed the standard level ($\geq 10^7$ cfu/g). It is interesting that the sample-G showed no microbial growth on nutrient agar. All the samples Bg, Bo, A, M and G showed no coliform. Total fungal count (TFC) in the curd samples Bg, Bo and M showed 4.60, 2.87 and 3.90×10^4 cfu/g, respectively which are in the range of acceptable or standard TFC ($\geq10^4$ cfu/g) for curd. But, in sample-A the TFC (7.04×10^5 cfu/g) exceeded the standard level. The sample-G did not show any fungal count. The titrable acidity, pH, protein, fat, ash and total solid of the collected curd samples were also measured. The titrable acidity values of the samples collected from Bg, A, G, Bo and M were 0.83, 0.95, 0.93, 0.75 and 0.62%, respectively. The pH value of the collected samples Bg, A, G, Bo and M were 3.80, 3.20, 3.50, 4.00 and 4.80, respectively. Curds were evaluated for their organoleptic characters by sensory evaluation methods (Hedonic Scale). Curd Bg was evaluated as excellent, Bo and M were considered as very good. Curd A and G were considered as acceptable. In conclusion the findings of this study are expected to contribute to the production of good quality curd in future.

Key words: Dahi (Curd) · Microbial quality · Organoleptic quality · Physicochemical · Cultural · Morphological · Biochemical

INTRODUCTION

Fermented milk products are milk substrates that are invaded or overgrown by edible microorganisms whose enzymes, particularly amylases, proteases, lipases hydrolyze the polysaccharides, proteins and lipids to nontoxic products with flavors, aromas and textures pleasant and attractive to the consumers. Fermented milk products i.e. curd, yoghurt, cheese are consumed often in preference to fresh milk. The more friable curd of the acid product presumably makes it easier to digest. Fermented milk products are safer than fluid milk in many countries whereas transport, pasteurization and refrigeration facilities are inadequate. The introduction of fermented milk products such as cheeses and yogurts in to the diet of man is thought to date back to the dawn of the civilization [1]. Consumption of fermented-milk products is associated with several types of human health benefits partly because of their content of lactic acid bacteria. Several experimental observations have indicated a potential effect of lactic acid bacteria (LAB) against the development of colon tumors [2]. Recently, the role of fermented milks containing lactic acid bacteria (LAB), such as *Lactobacillus, Bifidobacterium* and *Streptococcus thermophilus*, have been studied [2]. A wide range of other health benefits, including improved lactose digestion, diarrhea prevention, immune system modulation and serum cholesterol reduction, have been ascribed to fermented milk consumption. Curd, a popular fermented dairy food is made by curdling milk with lactic

Corresponding Author: W. Zaman, Department of Food Engineering & Tea Technology,
School of Applied Science & Technology, Shahjalal University of Science and Technology,
Sylhet-3114, Bangladesh, E-mail: wahidanft@yahoo.com.

acid produced by sufficient numbers of lactic acid bacteria (LAB) grown in milk. Curdling can occur by the development of bacteria (e.g. *Lactobacillus, Streptococcus*) as predominant flora already present in the milk as natural souring agent. For satisfactory large scale production, fermentation is carried out by added cultures of LAB. Beside lactic acid bacteria, other microorganisms can also be present in the curd which may affect the curd quality. In Bangladesh curd (Dadhi) is one of the most popular fermented milk product which is made in mud pots, usually from cow's milk, sometimes from buffalo milk. The bacteria used are *Lactobacillus bulgaricus*, *Lactobacillus plantarum* and *Streptococcus thermophilus* and/or *Streptococcus lactis*. In making curd the inoculum is higher than is usual for other fermented milk products (approximately 5%-8%) [3]. 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 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 researches were conducted to study the market dahi quality on region basis and considering the above circumstances renowned brand dahi of Bogura, Muslim, Bonoful, Arong and Grameen Sokthe^{+} were chosen to check and compare their quality with the dahi prepared from fresh raw milk by following a standard procedures.

MATERIALS AND METHODS

Place of Experiment: This experiment was conducted at the Microbiology and Industrial Irradiation Division (MIID) of Institute of Food and Radiation Biology (IFRB), Atomic Energy Research Establishment (AERE), Savar, Dhaka, Bangladesh.

Collection and Preparation of Dahi (Curd) for Test: The collected market curd samples were Bogura curd (Bg), Bonoful curd (Bo), Arong curd(A), Muslim curd (M), Grameen Soktee^{+}(G). From the collection to analysis, cold chain (4°C) was maintained for all the samples.

Ten gram of sample was weighed and poured into the 90 ml diluents. The diluent used was 0.85% NaCl solution. It was selected for the preparation of initial 10^{-1} diluation of fermented milk (Curd) emulsion. The diluents facilitated dispersal of the curd and consequent release of microorganisms. Emulsification of cards and yoghurts was achieved by shaking by hands. When curd sample were dispersed simultaneously in the diluents then they became ready for serial dilution. For microbiological quality assessment 10^{-1} to 10^{-6} dilution were made.

Physicochemical Test: All the collected market curds were subjected to the consumer acceptance quality-Smell, taste, body, consistency, color and texture, chemical quality- pH, Total solids%, Fat%, Protein% and Ash%. pH was measured by a pH meter, total solids by oven drying, fat by Babcock, protein by Kjeldahl and ash by incineration method.

Microbiological Quality: Microbiological quality assessment of the collected curd samples were done by determining the Standard Plate Count, Total Coliform Count and Total Fungal Count according to APHA. Different types of media were used for the microbiological quality assessment, i.e., Nutrient agar (NA), Mac-Conkey agar (MAC) and Potato Dextrose agar (PDA). For microbiological quality assessment here we used spread plate technique. Firstly, approximately 25 ml media was poured in Petri dishes (90mm diameter, sterile). When media was turn to cool and semisolid then 100µl different curd diluents are placed on the surface of the media. Then glass rod was used to spread the inoculums on the surface. All of the work was done in aseptic condition. The plates were incubated at 37°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 incubated at 30°C for 2-3 days. The molds and yeast colonies were enumerated.

Quality Assessment by Oraganoleptic Test (Hedonic Scale): Various methods have been used to measure food preferences. The most common method is a questionnaire of generated foods or food categories in which a hedonic scale is used to rate the degree of liking [4- 6]. Hedonic scale is an organoleptic quality rating scale where the judge expresses his degree of liking. A 5 to 9 point balanced scale is used, usually a 9-point scale. This test has been used by experts and untrained consumers, but it is felt to be more effectively applicable to the latter [7].

In hedonic scaling, responses, i.e., states of like and dislike, are measured on a rating scale. The essential features of the hedonic scale are its assumption of a continuum of preferences and the direct way it defines the categories of response in terms of like and dislikes [6].

RESULT AND DISCUSSION

Organoleptic Quality Assessment

Color Acceptability: It appears that Bogura curd (Bg) obtained the highest score for its color (mean is 8.50). The mean for others were 8.06 for Bonoful curd (Bo), 6.13 for Arong curd (A), 8.19 for Muslim curd (M) and 5.31 for Grameen Soktee^{+} (G). Color of curd depends on the color of milk or caramelized color obtained during heating of the milk or added coloring materials [8]. In the color acceptability test, Hedonic scale showed that the curd sample Bg was excellent, curd samples Bo and M considered as very good, curd sample A considered as acceptable and curd sample G had poor color quality.

Flavor Acceptability: The flavor 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. The flavor mean score of Bg, Bo, A, M and G were 8.37, 8.13, 5.31, 8.50 and 6.13, respectively. In the flavor acceptability test, Hedonic scale showed that the curd sample M was excellent, curd samples Bg and Bo considered as very good, curd sample G considered as acceptable and curd sample A had poor flavor quality.

Taste Acceptability: 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 taste score of Bg, Bo, A, M and G curd were 8.69, 7.94, 6.13, 8.19 and 5.31, respectively. In the taste acceptability test, Hedonic scale showed that the curd sample Bg was excellent, curd samples Bo and M considered as very good, curd sample A considered as acceptable and curd sample G had poor taste quality.

Texture Acceptability: Texture of the curd 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 curd can be attributed to the manufacturing conditions and type of organism used [9]. Other scientists found an improved score for the curd made with 10% added banana juice [10].The texture means score of curd Bg, Bo, A, M and G were 8.60, 8.13, 5.65, 8.50 and 6.13, respectively. In the texture acceptability test, Hedonic scale showed that the curd sample M was excellent, curd samples Bg and Bo considered as very good, curd sample A and G considered as acceptable texture quality.

Consistency Acceptability: The consistency score of the curd samples varied significantly with the average 8.69, 8.50, 6.13, 8.19 and 5.71 in Bg, Bo, A, M and G, respectively. 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 curd improves the body and consistency score [11]. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the body and consistency of prepared curd [9]. In the consistency acceptability test, Hedonic scale showed that the curd samples Bg and Bo was excellent, curd sample M considered as very good, curd sample A considered as acceptable and curd sample G had poor consistency quality.

Chemical Quality Assessment

pH and Acidity: The pH of Bg, Bo, A, M and G types of curd were 3.80, 4.80, 3.20, 4.00 and 3.50, respectively and acidity of the curd samples Bg, Bo, A, M and G were 0.83, 0.62, 0.95, 0.75 and 0.93%, respectively. There was a significant difference among the pH value of the curd sample. Mean separation indicates that Bo curd bears the maximum pH, whereas lowest in A curd. In the pH of curd, 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 curd sample reduces with the advancement of storage time both at room temperature and refrigerator though the rate was higher at room temperature [11, 12]. Curd 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 value [13]. In different study scientists found a pH of 3.81-4.19 in stirred yoghurt; the pH of the laboratory made curd was 4.79 0.01; a pH of 4.54 0.24 for market curd and pH 5.00 was reported in yoghurt sold in Lahore and Hyderabad [14-17]. 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 samples [18]. The pH value of traditionally fermented milk curd was influenced by the fermentation condition [19].

Table 1: Organoleptic quality assessment of curd collected from different brands

	Types of curd				
Parameter	Bg	Bo	A	M	G
Color	8.50	8.06	6.13	8.19	5.31
Flavor	8.37	8.13	5.31	8.50	6.13
Taste	8.69	7.94	6.13	8.19	5.31
Texture	8.60	8.13	5.65	8.50	6.13
Consistency	8.69	8.50	6.13	8.19	5.71

Table 2: Chemical quality assessment of curd collected from different brands

	Types of curd				
Parameter	Bg	Bo	A	M	G
pH	3.80	4.80	3.20	4.00	3.50
Acidity	0.83%	0.62%	0.95%	0.75%	0.93%
Protein(g/kg)	40.43	42.30	36.37	42.47	40.00
Fat(g/kg)	45.35	50.08	40.23	51.02	47.05
Ash(g/kg)	9.32	10.82	7.82	10.62	9.54
Total solid(g/kg)	274.30	305.94	245.55	303.22	281.80

Table 3: Microbiological quality of curd collected from different brands

	Types of curd				
Parameter	Bg	Bo	A	M	G
SPC (cfu/ml)	7.70×10^{7}	2.88×10^{7}	2.24×10^{8}	7.30×10^{7}	nil
TCC (cfu/ml)	nil	nil	nil	nil	nil
TFC (cfu/ml)	4.60×10^{4}	2.87×10^{4}	7.04×10^{5}	3.90×10^{4}	nil

Protein Analysis: The average protein content was 40.43, 42.30, 36.37, 42.47 and 40.00 g/kg in Bg, Bo, A, M and G, respectively. The means were significantly different. Mean separation reveals that M type curd contains more protein but it did not differ significantly with Bo (Table 2). It was also found that though A contains less protein but it was significantly different from Bo and M types of curd. The value obtained in this study was closer to the findings of others [13, 17]. Total solids content of milk is an important factor to determine the protein content of curd 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 curd [16]. 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 [20, 21]. In Pakistan market yoghurt, protein content varies from 2.60-4.90% and found a significant difference in protein content of market and laboratory made curd [9, 15].

Fat Analysis: Statistically, the fat content of curd samples differed significantly. Highest fat content was found in M (51.02 g/kg) followed by Bo (50.08 g/kg), G (47.05g/kg), Bg (45.35 g/kg) and A (40.23 g/kg). The fat content of curd depends upon the initial fat content of the milk used for curd making or raw material used to prepare the curd and level of volume reduction of milk during its boiling. Adulteration may also cause a reduction in the fat content of the curd. It was reported that addition of non-fat dry milk and vegetable oil to skim milk improves the fat content of prepared curd [16]. Researchers found a 3.75 to3.76% of fat in market curd which value is below than present study but agrees with the findings of others [11, 22, 2].

Ash Analysis: From Table 2, it appears that, Bo type curd contains maximum ash (10.82 g/kg) which differs none significantly with M (10.62 g/kg). Curd Bg (9.32 g/kg) and G (9.54 g/kg) jointly ranked second in this regard and C type curd have the lowest (7.82 g/kg). No significant difference was also found in the ash content of Bo, M, Bg and G brand curd. The finding was also closer to the report of others [17].

Total Solid Analysis: The total solids content of Bg, Bo, A, M and G differed significantly with the average 274.30, 305.94, 245.55, 303.22 and 281.80 g/kg, respectively (Table 2). 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 curd. The total solids in all samples significantly increased during storage and addition of nonfat dry milk and vegetable oil to skim milk improves the total solids content of prepared curd [16, 23]. From the report of others who found only 13.38 % total solids in market curd whereas a total solids content in market yoghurt of Pakistan ranges from 9.10 to 17.00 but the West Bengal curd contains more total solids (average 40.27%) [9, 11, 22].

Microbiological Quality Assessment

Standard Plate Count (SPC): The SPC of Bg, Bo, A, M and G types of curd samples were 7.70×10^{7}, 2.88×10^{7}, 2.24×10^{8}, 7.30×10^{7} cfu/ml and nil, respectively. Some scientists found total viable count of 7.34 1.57 (10^{7}) cfu/ml in market curd of Rawalpindi and Islamabad [17]. The highest SPC was recorded in the sample A (2.24×10^{8} cfu/g) and the lowest SPC was recorded in the sample Bo (2.88×10^{7} cfu/g). Noted that SPC was nil in the sample

G. As per microbiological standard sample A exceeded permissible limit. Count of other samples remained in the acceptable range and thus these curd samples were considered as safe for consumption.

Total Coliform Count (TCC): The total coliform count of a curd samples gave an indication of the total number of coliform bacteria present in the curd. TCC was nil in all the curd samples. Count of all samples remained in the acceptable range and thus these curd samples were considered as safe for consumption.

Total Fungal Count (TFC): The total fungal count procedure selects mainly for yeast that are most commonly associated with poor starter culture contamination. TFC of a curd samples gave an indication of the total number of fungus and molds present in the curd, the highest TFC was recorded in the sample A (7.04×10^5 cfu/g) and the lowest SPC was recorded in the sample Bo (2.87×10^4 cfu/g). Noted that TFC was nil in the sample G. As per microbiological standard sample A exceeded permissible limit. Count of other samples remained in the acceptable range and thus these curd samples were considered as safe for consumption. 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 curd depends upon the preparation, handling and storage condition as they found more yeast and mould count in the curd from large vendors compare to household sample [22]. The mold content (cfu/ml) of traditionally fermented milk curd of Bangladesh was 0 to75±1.38 [19].

In conclusion, considering the three major quality aspects (Organoleptic quality, chemical quality and microbiological quality) Bg means Bogura curd was superior than other market curd. The findings of this study are expected to contribute to the production of good quality curd.

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