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Nutritional and microbiological quality assessment of commercial yogurt sold in different districts of Bangladesh: a food safety issue

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Abstract: The aim of this study was to investigate the nutritional and microbial quality of yoghurt from different districts of Bangladesh. Protein content was higher (4.56g/kg) in SB₂ (sample Bogura-2), fat content was also higher (5.67g/kg) in SB₃ (sample Bogura-3). The acidity found ranged from 0.77% to 0.98%, pH obtained ranged between 3.6 to 4.98 and total solid retained between 23.08 to 26.95 for all samples. Highest Total Viable count (TVC) value was found in SB₂ ($68.9 \times 10^4 \pm 0.23$ CFU/ml) and lowest value was observed in SJ₂ ($23.01 \times 10^4 \pm 0.43$ CFU/ml). No mold and yeast were found in the collected samples during study period that indicates all are follow hygiene procedure but all of the yogurt samples were contaminated with fewer amount (5.6 ± 0.66 to 12.56 ± 0.44 CFU/ml) of coliform. The mean value of acceptability score of yogurt sample was higher (99.2) in SB₂ (sample Bogura-2) during the study period. Organoleptically, the overall quality of all yogurt samples was good. Considering the pH, acidity, total solids, protein, fat, carbohydrate and ash values for all yogurt samples collected from Bogura had better quality as compared to other samples. From the present study, it was found that all of the samples collected from Bogura district were much better quality compared to other samples in terms of nutritional, biochemical and microbial aspect. All of the samples were found in contaminated with lower amount of coliform so necessary actions should be taken in every step of processing, maturing and marketing to overcome this problem.

Keywords: yogurt; nutritional; biochemical; microbiological; coliform; yeast

1. Introduction

Fermented milk products were introduced since the beginning of civilization (Mckinley, 2005). Yogurt is one of the important fermented milk products which is popular and nutritious all over the world (Hayaloglu *et al.*, 2007). Yogurts are considered as ready to eat, products commonly taken for energy production and for good health, throughout the world (Alli *et al.*, 2010). It can also be taken as a drink beverage to fulfillment of the thirsting (Alfa-Lawal, 1984). Yogurt contains good source of protein and beneficial for sound health (Cueva and Aryana, 2008). It is recognized as a balanced food which contains almost all of the nutrients founds in raw milk, it is also a good source of probiotics. Some people cannot digest raw or heated milk they can easily digest yogurt, some bacterial growth occur in this type products that can play vital role in digestive system of human

being. A wide range of flavoring compounds are found in this products to spice it (Anther, 1986; Oyeleke, 2009). For its physiological, nutritional and beneficial effects, it is considered as a popular drink and widely accepted that is in higher demand (De *et al.*, 2014).

As the number of dairy farms in Bangladesh is increasing, so is the production and marketing of dairy products. Yogurt is a fermented milk product prepared from fresh milk that can be easily contaminated. Yeast and mold are regarded as primarily contaminants in Nigeria (Suriarachchi and Fleet, 1981; Oyeleke, 2009). Acidic environment is suitable for growth and multiplication of fungi (De *et al.*, 2014). Some species of *Aspergillus* produces secondary metabolites such as aflatoxins which are toxic and carcinogenic (Issazadeh *et al.*, 2012). The yogurt of Bogura, Naogaon, Rajshahi, Jashore, Dinajpur and Dhaka are famous among the different types of yogurt available in Bangladesh. People in our country usually consume yogurt to increase their nutritional value and digestive power. The quality of yogurt differs due to differences in milk and processing. If a conscious citizen knows how nutritious yogurt is in any part of Bangladesh or what kind of microorganisms exist in yogurt, he can easily fulfill his desire. That is why the present study was drawn, to assess the nutritional and microbiological value of commercial yogurt collected from different districts of Bangladesh.

2. Materials and Methods

2.1. Experimental period

The experiment of this study was carried out to evaluate the nutritional and microbiological quality of commercial yogurt collected from different districts of Bangladesh. A total of 18 samples from 6 different district were collected during the experimental period of 15 march, 2020 to 22 September, 2020. Physical parameters were investigated by a skilled panel member, chemical and microbiological parameters were examined in Dairy Science laboratory of the Department of Dairy Science, Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka.

2.2. Sample collection and storage

Three of each yoghurt samples were collected from 6 districts such as Bogura (SB1, SB2, SB3), Rajshahi (SR1, SR2, SR3), Naogoan (SN1, SN2, SN3), Jashore (SJ1, SJ2, SJ3), Dhaka (SD1, SD2, SD3) and Dinajpur (SDj1, SDj2, SDj3) of Bangladesh. Collected samples were transported to the Dairy Science laboratory and stored under 4°C temperature for further analysis.

2.3. Organoleptic quality assessment

To examine the physiological parameters all the samples were judged by a skilled panel member to evaluate the smell/flavor, color, body and consistency and overall preferences by scoring method.

2.4. Nutritional quality assessment

After completing the organoleptic judgement; all the samples were chemically analyzed in the laboratory in terms of pH value, acidity percentage, total solids (TS) (g/kg) by standard method of determination. Nutritional composition *viz.*, protein, fat, ash and carbohydrate content were determined in the Fishing and Post-Harvest Technology laboratory at Sher-e-Bangla Agricultural University, Dhaka. The proximate composition of the samples was analyzed in triplicate according to standard procedure given in Association of Official Analytical Chemists (AOAC, 2000).

2.5. Microbiological quality assessment

Total Viable Count (TVC), Total Fungal Count (TFC), Total Coliform Count (TCC), yeast and molds of all the yogurts samples were determined by standard method and gram positive, cocci and rod were tested by staining method.

2.6. Statistical analysis

All the data collected from the experiments were carefully stored in a computer excel file for results preparation. The collected data were analyzed and graphically presented with the help of Microsoft Office Excel 2010 software and SPSS version 20.0, data were represented as the mean \pm SD (standard deviation).

3. Results and Discussion

Quality of yogurt collected from different district are the composite of all attributes which are tested.

3.1. Physical characters

Physiological parameters such as color and flavor, texture and taste, body and consistency and overall preferences are shown in Figure 1.

3.1.1. Color and flavor

Examination of color and flavor are the most important at the time of quality determination of yogurt. Color and flavor of yogurt samples were measured by scoring method and found that the values varied between 33 ± 0.17 to 39.6 ± 0.67 , where the score was 40 (Figure 1). Highest value was observed in SB₂ (yogurt collected from Bogura) and lowest value was obtained in SD₁ and SJ₃ (Yogurt collected from Dhaka and Jashore respectively). Addition of 10% jack fruit juice with dahi, smell and taste score were 41.44 ± 0.05 , which was more or less similar with the present study (Ara *et al.*, 2015).

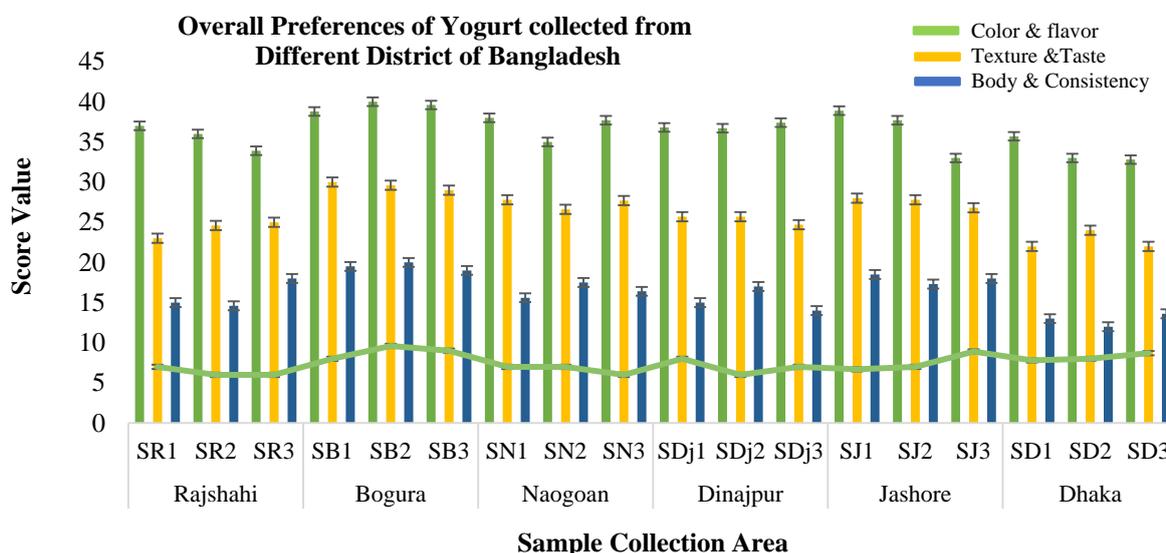


Figure 1. Physical characters of yogurt collected from different district of Bangladesh.

3.1.2. Texture and taste

Texture and taste are another important parameter for the determination of yogurt quality. The value of texture and taste of the yogurt samples was in the range of 22 ± 0.15 to 29.6 ± 0.28 out of 30; highest value was observed in SB₂ (29.6 ± 0.28) samples collected from Bogura and lowest value was observed in SD₁ and SD₃ samples collected from Dhaka (Figure 1). Drake *et al.*, (2000) was found that the textural quality of yogurt including firmness, viscosity, and creaminess, functional ingredients provide health benefits (Drake *et al.*, 2000). Similar results were showed by Afrin *et al.*, (2016) highest color and texture BAU dairy farm dahi (18.67 ± 0.58) and the lowest value was observed Shes moor dahi (13.67 ± 0.58).

3.1.3. Body and consistency

The scoring value of body and consistency of the samples examined was in the range of 12 ± 0.56 to 19.5 ± 0.19 out of 20, highest value was observed in SB₁ (yogurt collected from Bogura) and lowest value was found in SD₃ (Figure 1). Body and consistency score were found in higher in Maharam Ali dahi, Bogra and BAU Dairy Farm dahi, Mymensingh whereas the lowest value was in Shes Moor dahi (Afrin *et al.*, 2016). Mangashetti *et al.*, (2003) showed that, dahi produced from concentrated milk with 7.5% sugar showed smooth textural characteristics.

3.2. Results of nutritional quality

3.2.1. Protein content

Protein content of yogurt samples ranged from 2.7 ± 0.65 g/kg and 4.56 ± 0.11 g/kg; higher value was observed in SB₂ and lowest value was found in SJ₂ (Figure 2). Rashid and Miyamoto (2005) was found similar results, protein content of all dahi samples were in the range of 3.99-4.74%.

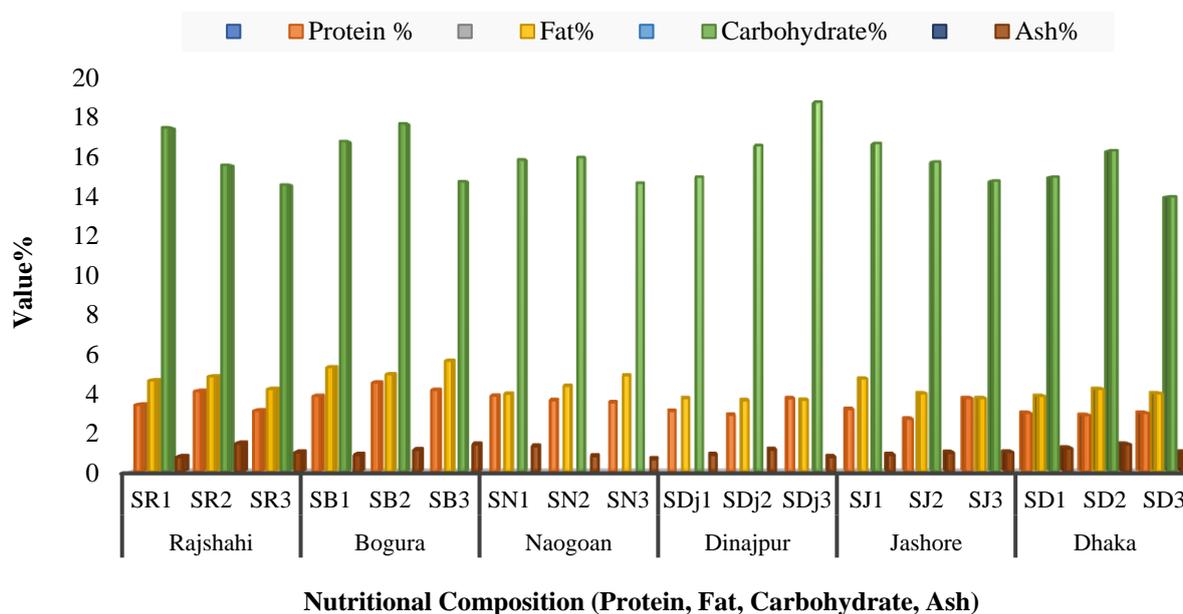


Figure 2. Nutritional composition of yogurt collected from different district of Bangladesh.

3.2.2. Fat content

Fat is one of the major constituents of yogurt, highest fat content was observed in SB₃ and value was 5.67 ± 0.43 g/kg and lowest value was found in SDj₂ and value was 3.65 ± 0.89 g/kg. Average fat content was 4.50 g/kg (Figure 2). This result agreed with the findings of Rashid and Miyamoto (2005) who reported that the samples from Mymensingh had the highest ($4.88 \pm 0.99\%$) fat content.

3.2.3. Carbohydrate content

Carbohydrate content of collected samples was in the range of 13.6 ± 0.67 g/kg to 18.8 ± 0.44 g/kg, highest value was observed in SD₂ and lowest value was found in SN₂. Similar findings were observed by Khan (2008), the carbohydrate content of dahi samples were in the range of 8.47 ± 0.12 .

3.2.4. Ash content

Ash content was higher in SD₃ and lower in SR₂ which varies with the range of 0.76 ± 0.65 g/kg to 1.4 ± 0.33 g/kg Similar findings showed in a research conducted by Haj *et al.*, (2007), ash content of all the dahi samples were agreed with the range of 0.73-0.91%) which ranges between 0.78-0.80% (Chandra *et al.*, 2013).

3.3. Chemical assessment

3.3.1. pH value

pH of the yogurts samples varies between 3.65 to 4.98 and highest and lowest value was found in SD₃ and SJ₂ respectively (Table 1). The pH value (4.53 ± 0.06) was observed in dairy farm dahi of BAU and the lowest value (3.93 ± 0.06) was found in Jamuna dahi Afrin *et al.*, (2016) which is more or less similar with the current study.

3.3.2. Acidity%

The percentage of acidity of the examined samples ranged between 0.77% to 0.98% has shown in (Table 1) supported by the finding of Alam (2014) that the acidity of dahi was 0.7%.

3.3.3. Total solids (TS)

TS content of the yogurt samples were highest in SR₁; 26.78 g/kg and lowest in SB₁; 23.08g/kg (Table 1). Generally, the total solids content of yoghurt ranges from 17.11 to 21.80% (Muhammad *et al.*, 2005). The TS content of different products deviate from the previous research findings due to the used of different concentration of sugar during products preparation.

Table 1. Chemical assessment of yogurt samples collected from different district of Bangladesh.

Yogurt samples		pH \pm SD	Acidity \pm SD %	Total solids \pm SD (g/kg)
Jashore	SJ ₁	4.56 \pm 0.14	0.87 \pm 0.1	23.76 \pm 0.23
	SJ ₂	3.65 \pm 0.6	0.86 \pm 0.34	25.63 \pm 0.24
	SJ ₃	4.25 \pm 0.46	0.87 \pm 0.35	24.7 \pm 0.35
	SR ₁	3.87 \pm 0.45	0.77 \pm 0.78	26.78 \pm 0.34
Rajshahi	SR ₂	4.15 \pm 0.35	0.98 \pm 0.32	23.57 \pm 0.24
	SR ₃	4.19 \pm 0.24	0.89 \pm 0.24	24.65 \pm 0.24
	SD ₁	4.85 \pm 0.17	0.88 \pm 0.24	25.78 \pm 0.33
Dhaka	SD ₂	4.0 \pm 0.8	0.78 \pm 0.23	24.56 \pm 0.63
	SD ₃	4.98 \pm 0.45	0.93 \pm 0.22	25.67 \pm 0.44
Naogaon	SN ₁	3.84 \pm 0.78	0.90 \pm 0.34	24.65 \pm 0.46
	SN ₂	4.09 \pm 0.34	0.98 \pm 0.13	26.67 \pm 0.35
	SN ₃	3.65 \pm 0.35	0.78 \pm 0.35	24.67 \pm 0.11
Bogura	SB ₁	4.76 \pm 0.35	0.84 \pm 0.36	23.08 \pm 0.09
	SB ₂	4.65 \pm 0.35	0.82 \pm 0.23	23.77 \pm 0.4
	SB ₃	4.24 \pm 0.34	0.88 \pm 0.24	25.67 \pm 0.08
Dinajpur	SDj ₁	3.85 \pm 0.56	0.79 \pm 0.48	24.57 \pm 1.08
	SDj ₂	3.98 \pm 0.34	0.77 \pm 1.34	26.75 \pm 0.56
	SDj ₃	3.86 \pm 0.13	0.81 \pm 0.67	26.95 \pm 0.25

3.4. Microbiological quality analysis

The results of microbiological assessment are shown in Table 2, where the value of TVC, TCC and Mold & Yeast are presented.

3.4.1. TVC (Total viable count)

In our study highest TVC value was found in SB₂ ($68.9 \times 10^4 \pm 0.23$ CFU/ml) and lowest value was observed in SJ₂ ($23.01 \times 10^4 \pm 0.43$ CFU/ml) which agreed with the previous findings of Sarker *et al.*, (2012) that Bogura region dahi showed the highest bacterial counts (Table 2).

3.4.2. TCC (Total coliform count)

In our study TCC value was in the range of 5.6 ± 0.66 to 12.56 ± 0.44 CFU/ml where highest value was found in SR₂ and SD₁ respectively, on the other hand lowest value was observed in SB₃ (Table 2). Higher TCC value indicates that the yogurt prepared under unhygienic condition and unsafe for human consumption. Value of TCC was higher (17.67 ± 2.51) in Shes Moor dahi, Mymensingh and the lowest value (9.00 ± 1.0) was found in BAU Dairy Farm dahi (Afrin *et al.*, 2016) which is more or less similar with the present study.

3.4.3. Mold and yeast

Presence of mold and yeast indicates the hygienic situation of that product, there was no mold and yeast in the collected yogurt samples that indicates the quality of yogurt from different districts were maintained hygienically (Table 2).

Table 2. Microbiological quality assessment of different yogurt samples.

Yogurt samples		TVC \pm SD (CFU/ml)	TCC \pm SD (CFU/ml)	Yeast & mold \pm SD (CFU/ml)
Jashore	SJ ₁	56.87 \times 10 ⁴ \pm 0.34	8.87 \pm 0.54	***
	SJ ₂	23.01 \times 10 ⁴ \pm 0.23	8.43 \pm 0.21	***
	SJ ₃	53.87 \times 10 ⁴ \pm 0.19	9.3 \pm 0.33	***
Rajshahi	SR ₁	66.09 \times 10 ⁴ \pm 0.8	11.34 \pm 0.34	***
	SR ₂	58.34 \times 10 ⁴ \pm 0.45	12.56 \pm 0.44	***
	SR ₃	45.87 \times 10 ⁴ \pm 0.34	9.56 \pm 0.19	***
Dhaka	SD ₁	35.23 \times 10 ⁴ \pm 0.22	12.56 \pm 0.27	***
	SD ₂	28.6 \times 10 ⁴ \pm 0.13	8.8 \pm 0.62	***
	SD ₃	48.56 \times 10 ⁴ \pm 0.54	12.08 \pm 0.87	***
Naogaon	SN ₁	37.68 \times 10 ⁴ \pm 0.9	9.8 \pm 0.76	***
	SN ₂	25.06 \times 10 ⁴ \pm 0.65	11.54 \pm 0.36	***
	SN ₃	25.6 \times 10 ⁴ \pm 0.23	7.9 \pm 0.44	***
Bogura	SB ₁	67.01 \times 10 ⁴ \pm 0.43	6.5 \pm 0.41	***
	SB ₂	68.9 \times 10 ⁴ \pm 0.34	5.9 \pm 0.43	***
	SB ₃	59.05 \times 10 ⁴ \pm 0.67	5.6 \pm 0.66	***
Dinajpur	SDj ₁	66.12 \times 10 ⁴ \pm 0.34	11.35 \pm 0.98	***
	SDj ₂	46.21 \times 10 ⁴ \pm 0.11	12.45 \pm 0.11	***
	SDj ₃	32.76 \times 10 ⁴ \pm 0.25	13.6 \pm 0.23	***

***Not detected

3.4.4. Ratio of cocci and rod

Ratio of cocci and rod in most of the yogurt samples collected from different district of Bangladesh were 2:1 to 4:1 which agreed with the findings of Afrin *et al.*, (2016).

4. Conclusions

The nutritional and microbial quality of yoghurt collected from different regions of Bangladesh was investigated. This study revealed that, yogurt collected from Bogura district had better quality in terms of nutritional, biochemical and microbiological aspects. No mold and yeast found in the collected samples that indicates all products are produced under sanitary conditions hence safe for human consumption. A few coliforms found in each sample which represent sample were contaminated so some necessary action needs to be taken in every step of processing and transportation.

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Conflict of interest

None to declare.

References

- Afrin S, MR Habib, MA Islam and MH Rashid, 2016. Physical, chemical and microbiological qualities of dahi collected from Bogra and Mymensingh district of Bangladesh. *Asian Australas. J. Biosci. Biotechnol.*, 1: 134-140.
- Alam, 2014. Quality evaluation of dahi available in Dhaka city, MS Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh
- Alfa-Lawal AB, 1984. Dairy and Food Engineering. Division Lund-Sweden, pp: 177
- Alli JA, A Oluwadun, IO Okonko, OE Fagade, AF Kolade, and VO Ogunleye, 2010. Microbial Assessment and Microbiological Quality of some Commercially Prepared Yogurt Retailed in Ibadan, Oyo State, Southwestern Nigeria. *British Journal of Dairy Sciences*, 1: 34-38.
- Anthar IH, 1986. Preparation of Cheese and Yogurt at Household level. Pakistan Agricultural Research Council, Islambad, pp. 390-391.
- AOAC, 2000: Official Method of Analysis. Association of Official Analytical Chemists. W. Horwitz (editor) 12 Edition. Washington, D.C.
- Ara A, JM Uddin, S Saha, MH Khan and MA Baset, 2015. Intervention of fruit juice in yoghurt reparation. *J. Sci. Techno.*, 11: 30-35.
- Chandra GS, R Islam and S Ghosh, 2013. Study on chemical and microbiological quality of Bogra dahi in Bangladesh. *Bang. J. Ani. Sci.*, 24: 129-132.
- Cueva O and KJ Aryana, 2008. Quality attributes of heart health yogurt. *L.W.T.- Food Sci. Technol.*, 41: 537-544.
- De N, TM Goodluck and M Bobai, 2014. Microbiological quality assessment of bottled yogurt of different brands sold in Central Market, Kaduna Metropolis, Kaduna, Nigeria. *International Journal of Current Microbiology and Applied Sciences*, 3: 20-27.
- Drake MA, XO Chen, S Tamarapu and B Leenanon, 2000. Soy protein fortification affects sensory, chemical and microbiological properties of dairy yogurts. *J. F. Sci.*, 65: 1244-1247.
- Haj MHM, AO Osman, EI Owni, EI Ibtisam and EM Zubeir, 2007. Assessment of chemical and microbiological quality of stirred yoghurt in Khartoum state. *S. Res. J. Anim. Vet. Sci.*, 2: 56-60.
- Hayaloglu AA, I Karabulut, M Alpaslan and G Kelbaliyev, 2007. Mathematical modeling of drying characteristics of strained yoghurt in a convective type tray-dryer. *J. Food Eng.*, 78: 109-117.
- Issazadeh K, RK Darsanki and K Pahlaviani, 2012. Occurrence of aflatoxin M1 Levels in local yogurt samples in Gilan Province, Iran. *Annals of Biological Research*, 3: 3853-3855.
- Khan K, SU Rehman, MA Khan, F Anwar and S Bhadar, 2008. Physical and chemical quality appraisal of commercial yoghurt brands sold at Lahore. *Asian Res. Publ. Network.*, 3: 14-20.
- Mangashetti L, BV Balasubramanyam, KJ Rao, BC Ghosh, S Kulkarni and L Mangashi, 2003. Suitability of concentrated milk for dahi preparation. *Indian J. Dairy Sci.*, 56: 359-362.
- Muhammed BF, MM Abubakar and O Onyawonye, 2005. Effect of culture concentration and inoculation temperature on physicochemical, micro biological and organoleptic props of yoghurt. *Nig. Food J.*, 23: 156-165
- Oyeleke SB, 2009. Microbial assessment of some commercially prepared yoghurt retailled in Minna, Niger State. *Afr. J. Microbiol. Res.*, 3: 245-248.
- Rashid MH and T Miyamoto, 2005. Quality evaluation of traditional fermented milk dahi in Bangladesh. *Milk Science*, 54: 29-36.
- Sarkar MM, TN Nahar and MK Alam, 2012. Chemical and bacteriological quality of popular dahi available in some selected areas of Bangladesh. *Bang. J. Anim. Sci.*, 41: 47-51.
- Suriyarachchi VR and GH Fleet, 1981. Occurrence and growth of yeast in yoghurt. *J. Appl. Environ. Microbiol.*, 42: 572-579.