



Qualities of full-cream powdered milk of different brands available in retail markets of Bangladesh

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Abstract

The present experiment was conducted to evaluate the physical and microbiological qualities of whole powdered milk of six different brands (Kwality, NIDO, Diploma, Anchor, Farmland and Starship) available in retail market at Mymensingh town. Each brand was considered as treatment and three samples (replications) were taken for each brand. For this purpose, powdered milk samples were collected and analyzed to know the physical parameters mainly color, flavor, taste, solubility, appearance and specific gravity, and microbiological qualities such as total viable bacterial count and coliform count. In case of physical quality, all the six brands possessed the good quality grade and no significant difference was observed except that of specific gravity which varied significantly among the brands. Specific gravity was almost similar to the normal cow milk when the dried milk was reconstituted. Significant variations ($p < 0.01$) in total viable counts among different powdered milk brands was observed. No coliforms were detected which indicated that good sanitary measures were adopted during the manufacture and storage of the powdered milk samples. In conclusion, it can be said that all brands of powdered milk possessed the recommend suggested standard in terms of both physical and microbiological qualities.

Key words: Powdered milk, physical quality, microbial quality

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Introduction

Milk is the most unique and ideal food for all mammals including human. It meets the nutritional requirement of the body more perfectly than any other single food. In Bangladesh, the production of milk takes place in a very disorganized way, although there are few milk pocket areas where surplus milk is readily available. Surplus milk which could be utilized by converting it into various milk products such as ghee, butter, yoghurt (dahi), powdered milk, cheese, cream, condensed milk and various other fermented dairy products should be taken into consideration. Dry milk or powdered milk is a product obtained by the removal of water from whole milk, partially skim milk or skimmed milk. Usually fat percent of whole milk powder is minimum 26% and maximum 40%, for partially skimmed milk powder minimum 1.5% and maximum 2.5%. For all types powder milk water content ranges from 3-5% (Spreer 1995). Under any circumstances water per cent of dry milk should not exceed 5%.

The removal of water from the milk takes place in two stages. The first stage is concentration by vacuum evaporation and the second stage is

drying. Ninety percent of the water in the milk is removed in the evaporator and only ten percent in the spray dryer (Robinson, 1994a). The two principal processes for the manufacture of powdered milk are the roller or the drum process and the spray drying process. Other systems are the form mat process and the freeze drying process. More recently, equipment in which combinations of these fundamental processes are found has been developed (FAO/WHO 1973). Modern technologies are focused on minimizing the loss of nutritive value, improving microbiological quality and improving the rehydration properties of the milk powder. Now-a-days optimal design by using predictive process and product models and advanced automation are the ingredients for producing high quality product for the food market (Jong and Verdurmen 2001).

The whole milk powder shall be of uniform light cream and dried skim milk shall be of uniform light color free from any brownish color and shall show no firm lumps or caking. The flavor of the dried or reconstituted milk shows no firm lumps or caking. The flavor of the dried or reconstituted milk shall be sweet and clean, free from any rancid, oxidized, scorched, tallowy, unclean,

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foreign or other objectionable flavors or odors (Nelson and Trout, 1955). It should be free from vegetable fat and any non-milk-fat. It shall also be free from dirt and extraneous matter, preservatives and added color, pathogenic microorganisms and from any materials, which are harmful to human health. Dry milk (whole and non-fat) are used in manufacturing ice-cream, infant foods, bakery goods, confection, sausages, sweetmeats, tea stalls and they are utilized by flour millers and cheese processors.

Very few studies have so far been done in this country on quality of powdered milk. Consumers do not have good idea about the quality of powdered milk that they are purchasing from the market. For this reasons present study was designed to evaluate the qualities of powdered milk available in local market.

Materials and Methods

Experimental site and samples collection

The present experiment was conducted in the Dairy Technology and Microbiology Laboratory under the Department of Dairy Science, Bangladesh Agricultural University, Mymensingh. To perform the experiment, six well known commercial brands of powdered milk (Kwality, NIDO, Diploma, Anchor, Farmland and Starship) were chosen. A total of 18 poly packets of powdered milk were collected from retail shops at Mymensingh town, taking three packets from each brand.

Preparation of reconstituted milk

For the physical and microbial examination of powdered whole milk it is preferable to reconstitute the milk maintaining 3.5% milk fat basis. For 400 ml reconstitute milk, 51.16 g Kwality, 51.52 g Nido, 48.92 g Diploma, 49.24 g Anchor, 53.44 g Farmland and 55.48 g Starship of representative well mixed sample of dried whole milk powder was taken in a sterile beaker having a capacity of 500 ml. Then, 348.84 ml, 348.48 ml, 351.08 ml, 350.76 ml, 346.56 ml and 344.52 ml of distilled water having a temperature of 75°C and pH 7 ± 0.02 respectively for Kwality, NIDO, Diploma, Anchor, Farmland & Starship was added and agitated for 90 seconds with a stirrer (American Dry Milk Institute, 1942). Then, the milk samples were subjected to analyze.

Preparation of dilution

A quality of 1.1 g of milk powder was weighed out in a sterile stoppered bottle having 99 ml of distilled water to get 1:10 dilution according to the "Laboratory manual: methods of analysis of milk and its products"(1964a). The bottle was shaken vigorously 25 times up and down in a period of 7 seconds over a distance of about 30 centimeter. Then the sample was subjected for microbial assessment and analysis.

Physical analysis

Organoleptic test was done visually, nasally, lingually by a panel of experts. The judging was carried out according to the standard dry milk score card recommended by "Judging of Dairy Products" (Nelson and Trout, 1955). By the solubility test, the amount of insoluble matter was estimated in the reconstituted milk. The procedure was modified after ADMI (1971) method for determining insolubility of milk powder. Specific gravity test was performed by using Quenvenne lactometer and floating dairy thermometer according to the method described by Aggarwala and Sharma (1961).

Microbiological analysis

The experimental procedure followed for the determination of the number of total viable bacteria in a sample and the detection and enumeration of coliform bacteria were as per recommendation of American Public Health Association (1998).

Statistical analysis

Data were analysed by CRD (Steel and Torrie, 1980), using MSTATC statistical package. Ranking was done by using Duncan Multiple Range Test (DMRT).

Result and discussion

Physical Parameters

The physical parameters studied on milk powder samples in local market of Bangladesh, were organoleptic tests (flavor, taste, solubility, color, appearance) and specific gravity.

Flavor

Average scores of flavor of dry milk obtained for Kwality, NIDO, Diploma, Anchor, Farmland and StarShip were 43.75 ± 3.5 , 43.5 ± 2.88 , 40.5 ± 7.59 ,

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42.25±4.34, 42.25±4.03, 39.75±7.93, respectively (Table 1). Statistically, no significant differences were found within the flavor of different brands of powdered milk collected from local market (Table 1). The main defect in flavor is caused by rancidity. Any considerable amount of rancidity renders powder unfit for human food (Majonnier and Tory 1925). The flavor of dry whole milk should be clean, rich, sweet and very pleasant not unlike that of fine pastry (Porcher, 1929). Oxidized totally flavor is the most troublesome flavor defect of dry whole milk (Nelson and Trout 1955).

Taste

Taste score of powdered milk obtained for Kwalita, NIDO, Diploma, Anchor, Farmland and StarShip were 17±2, 17±1.41, 14±2.44, 15.75±2.63, 15.75±2.63, 16.25±1.25, respectively (Table 1). Statistically it was found that there were non-significant differences within the taste score of different types of milk powder collected from local market (Table 1). Dry milk solids may be unduly criticized as having a heated or a cooked taste (Porcher, 1929). Dry whole milk should have a pleasant taste, somewhat sweetish and with a slight suggestion heated milk (Eckles et al., 1951).

Solubility

Solubility score of milk powder for Kwalita, NIDO, Diploma, Anchor, Farmland and StarShip were 8.25±1.70, 8.25±1.25, 7.5±2.08, 8±1.63, 8±1.63, 8.5±1 respectively (Table 1). Statistically it was found that there were non-significant differences within the solubility of different types of milk powders collected from local market (Table 1). The insolubilization of a fraction of the milk powder is related to heat coagulation. Consequently, the extent to which it occurs greatly depends on the time during which is drying material is at high temperature and on the degree of a concentration during drying. Moreover, homogenization of the concentrate may increase the insolubility but this may hardly be noticeable because considerable homogenization occurs during evaporation and automatization. According to the ADMI standard (1971), solubility index of whole milk powder was maximum 0.5 ml.

Color

Score of color of dry milk powder obtained from Kwalita, Nido, Diploma, Anchor, Farmland and

Starship were 7.75±2.06, 7.5±1.0, 7.5± 1.73, 7.5±1.73, 7±1.41, 7.25±1.5, respectively (Table 1). There were no significant differences within the color of different brands of milk powders collected from local market. The color of Kwalita was golden yellow and other samples were light yellow color. Color of dry milk is influenced by the carotene content of the milk. If the milk from which the dry milk made is rich in carotene, the resulting product will possess a darker yellow color than that made from milk lacking carotene. When milk of a relatively high acidity is dried, the resulting material appears dark in colour (Eckles et al. 1951).

Appearance

Appearance score of powdered milk from Kwalita, Nido, Diploma, Anchor, Farmland and starship were 8.25±1.25, 8.5±1.0, 7.5± 1, 7.75±1.25, 7±1.41, 7.25±1.5, respectively. It was found that there were no significant differences within the appearance of different brands of milk powder collected from local market (Table 1). No dark lumps or specks power is to be homogeneous throughout (Mojonnier and Troy 1925).

The powders prepared by spray process are extremely fine and very homogenous (Porcher, 1929). Certain physical changes take place which cause the dry milk to form very hard lumps if it is permitted to take up moisture from the air (Eckles et al., 1951). A lump powder definitely lacks homogeneity. Hard lumps ranging in size from a grain of wheat upwards may be interspersed throughout the solids and caked dry whole milk has lost its powdery consistency and has become a rock like solid" (Nelson and Trout, 1955).

Total score

The total organoleptic score of powdered milk obtained for Kwalita, NIDO, Diploma, Anchor, Farmland and StarShip were 85±7.53, 84.75±3.95, 77±9.90, 81.25±9.81, 80±9.38, 79±9.56, respectively (Table 1) which also varied insignificantly among different brands of milk powder collected from local market. Kadian et al. (1988) found that the organoleptic quality of majority samples of milk powder was graded good (80-89) while three brands of milk powder were graded fair (60-79) as per Bureau of Indian Standard. Ghodekar, et al. (1978) graded of the total spray dried and infant milk powder samples were as excellent, good, fair, and poor.

Table 1. Organoleptic test score of powdered milk samples collected from Mymensingh town

Maximum score	Grading score	Score (mean±SD) obtained by different Brands					
		Kwality	NIDO	Diploma	Anchor	Farmland	Starship
Flavour 50	No criticism 40-50	43.75	43.50	40.50	42.25	42.25	39.75
	Range 30-40	±3.50	±2.88	±7.59	±4.35	±4.03	±7.93
Taste 20	No criticism 15-20	17.00	17.00	14.00	15.75	15.75	16.25
	Range 10-15	±2.00	±1.41	±2.44	±2.63	±2.63	±1.25
Solubility 10	No criticism 8-10	8.25	8.25	7.50	8.00	8.00	8.50
	Range 5-7	±1.70	±1.25	±2.08	±1.63	±1.63	±1.00
Colour 10	No criticism 8-10	7.75	7.50	7.50	7.50	7.00	7.25
	Range 5-7	±2.06	±1.00	±1.73	±1.73	±1.41	±1.50
Appearance 10	No criticism 8-10	8.25	8.50	7.50	7.75	7.00	7.25
	Range 5-7	±1.25	±1.00	±1.00	±1.25	±1.41	±1.50
Total 100		85.75	84.75	77.00	81.25	80.00	79.00
		±7.53	±3.95	±9.90	±9.81	±9.38	±9.56

Means of scores between different brands were not statistically significant ($p>0.05$); Grading score: Excellent 91-100%; Good 75-90%; Fair 61-74%; Poor Below 60%

Table 2. Mean±SD of specific gravity and microbiological parameters of powdered milk samples collected from Mymensingh town

Parameters	Kwality	NIDO	Diploma	Anchor	Farmland	Starship
Specific gravity	1.03 ^d ± 0.00	1.03 ^c ± 0.00	1.02 ^e ± 0.00	1.03 ^d ± 0.00	1.03 ^a ± 0.00	1.04 ^b ±0.00
Total viable bacteria	3366 ^e , (3.53±0.21)	3933 ^d , (3.60±0.21)	3100 ^e , (3.49±0.21)	8400 ^b , (3.92±0.04)	9166 ^a , (3.96±0.06)	7500 ^c , (3.88±0.04)
Caliform bacteria	Nil	Nil	Nil	Nil	Nil	Nil

Means with different superscript in the same row differ significantly ($p<0.01$); Total viable bacteria count in the bracket are expressed in logarithm

Specific gravity

Specific gravity of reconstitute powdered milk obtained from Kwality, NIDO, Diploma, Anchor, Farmland and StarShip were 1.03±0.00, 1.03±0.00, 1.02±0.00, 1.03±0.00, 1.03±0.00, 1.04±0.00, respectively (Table 2). It was found that there were highly significant differences ($P<0.01$) within the specific gravity of different types of reconstituted powdered milk collected from local market. It is observed that the average value of specific gravity obtained from Starship (1.04±0.00) was significantly higher ($P<0.01$) and Diploma (1.02±0.00) was significantly ($P<0.01$) lower than the specific gravity of powdered milk of other five samples (Table 2). We know that the normal range of specific gravity of whole milk is 1.027 to 1.035 with an average of 1.032 (Eckles et al. 1951). It is well known that additional of water decreases the specific gravity of milk. Islam et al. (1984) reported that the mean of specific gravity of milk of BAU, Dairy Farm was 1.031 and milk from local market was 1.026. Alam (1998) milk samples from Aftab fresh raw milk was 1.036. From the present study it was observed

that the specific gravity of reconstitute powdered milk were within the normal range.

Total viable bacterial count

Total viable bacteria of powdered milk obtained for Kwality, NIDO, Diploma, Anchor, Farmland and Starship were 3.53±0.21, 3.60±0.21, 3.49±0.21, 3.92±0.04, 3.96±0.06, 3.88±0.04, per g, respectively (Table 2). Significant differences ($P<0.01$) were observed within the total viable bacteria count of different brands of powdered milk collected from local market. It was also found that the average value of total viable bacteria obtained for Farmland (3.96±0.06) was significantly ($p<0.01$) higher and Diploma 3.49±0.21 was significantly ($p<0.01$) lower than the total viable bacteria of powdered milk of other five samples (Table 3). Maximum bacterial count of dried whole milk contains 31,000/g (American Dry Milk Institute, 1971). According to BSTI, bacterial count of dried whole milk is maximum 20,000/g. Bacterial population of all samples were below the maximum range of BSTI standard. Arora (1989) found that the spray dried skim milk bacterial

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count was 2000 to 160,000/g. Total viable count of powder milk ranged from 200,000 to 4,30,000/g (Rahman et al., 1988). Kumar and Murthy (1992) found that the total bacterial counts of buffalo whole powdered milk packed were 8566.67/g. In another experiment, Sanjeeb-Bhange et al. (2003) found that the total viable count on the spray dried soya milk was 1.1×10^4 .

Coliform count

In this study, there was no evidence of coliform bacteria in any of the samples. Kumar and Murthy (1992) reported that total bacterial count of buffalo whole powdered milk was nil. According to BSTI, coliform count of powdered milk is nil. From this study it is clearly indicated that good sanitary measures were adopted during the manufacture of the powdered milk. The incidence of coliforms in any processed food is related to the unhygienic manufacturing techniques including poor plant sanitation and post processing contamination (Arum et al. 1970).

Conclusion

From the above discussion, it was found that the total score of Kwality was highest followed by other samples. Color of Kwality was apparently best of all powdered milk samples. All samples were graded acceptable. Significant difference was not found in all physical parameters. Specific gravities of all samples were almost similar to the normal cow milk when powdered milk was reconstituted. Statistical analysis showed significant variations in specific gravity. Microbial counts among different dried milk brands had significant variations. No coliforms were detected in this study hence all the brands were hygienic. All powdered milk companies are following the legal standard.

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