



Evaluation of the quality of sweetened condensed milk of different brands available in local markets of Bangladesh

Md. Nure Alam Siddique¹, Md. Nurul Islam^{1*}, Md. Rezwatul Habib¹, Md. Harun-ur-Rashid¹, Md. Ahidul Islam², Samia Afrin¹

¹Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

²Department of Animal Science, Patuakhali Science and Technology University, Bangladesh

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*Corresponding Author

MN Islam

✉ mnislamds@yahoo.com

ABSTRACT

This experiment was conducted to evaluate the qualities of sweetened condensed milk of four different brands (Danish, No.1, Carnation and Goalini plus) available in local markets of Bangladesh. Each brand was considered as treatment and three samples as replications were taken for each brand. Parameters studied in this experiment were physical (flavour, body & texture, colour and taste), chemical (acidity, total solids, carbohydrates, fat, protein and ash) and microbiological (total viable count and coliform count). In case of physical quality, all the four brands possessed the good quality grade and no significant ($p > 0.05$) difference was observed. However, significant differences were revealed in case of total solids, carbohydrates, protein and ash content. On the other hand, insignificant differences were found ($p > 0.05$) in case of acidity and fat content. No coliforms were detected which indicated that good sanitary measures were adopted during the manufacture and storage of the sweetened condensed milk. In conclusion, it can be said that Danish and Goalini plus brands of sweetened condensed milk were found to be better than that of No.1 and Carnation condensed milk.

INTRODUCTION

Sweetened condensed milk (SCM) is concentrated milk in which sugar has been added that act as a preservative and which is preserved by sterilization at high temperature after packaging. Typically, SCM contains around 8% fat, 45% sugar and 20% solids-non-fat. Again, the United States Department of Agriculture defines sweetened condensed milk as the product resulting from the evaporation of a considerable portion of the water from the milk to which sugar and/or dextrose has been added. It contains not less than 28% of milk total solids (TS) and not less than 8.5% milk fat (Lampert, 1970). Condensed milk in a similar manner to fresh milk must comply with certain standards as regards fat content and percentage of total solids, this standard varying according to the country of origin. Typical composition of 100g sweetened condensed milk contain water 26.5g, total solids 73.5g, fat 8.1g,

protein 8.1g, carbohydrate 55.7g and ash 1.6g (Webb and Johnson, 1965).

Sweetened condensed milk is a very thick sweet product that are considered to be the most important food item of human being and its nutrient contents are essential to the growth and proper nourishment of human being. Condensed milk is one of the popular dairy products which are gaining popularity day by day in BD. The condensed milk industry did not develop in the same way as did the ice cream industry (Asaduzzaman et al., 2007). Olson (1956) reported that this industry developed rapidly during the latter half of the nineteenth century. Sweetened condensed milk is used in numerous dessert dishes in many countries (Ann & Beth, 2010). Condensed milk is a convenient product for household use, possessing as it does satisfactory keeping qualities; it is particularly useful on board ship and in the tropics. In the household, it is often used for infant feeding, preparation of tea, coffee, puddings and

baked dishes. SCM also used as a bulk product in chocolate and confectionery industries as well as in ice cream and frozen desserts as a retail-packed product (case goods). It is easily reconstructed by dilution with water to the equivalent concentration of raw milk. This type of milk is also extensively used by the chocolate and confectionery trades (Harvey and Hill, 1987). Sweetened condensed milk is preserved against deterioration through microorganisms and the principle upon which preservation of this product is well known. The addition of sugar increases the osmotic pressure to most microorganisms. Also, carbohydrate binds water and making it unavailable for metabolic functions and this binding may be thought of as a type of drying process (Foster et al., 1957).

In open marketing system of the world, a strong competition is prevailing among all the marketable dairy products. It is highly mentionable that condensed milk has taken a great place in Bangladesh out of all other dairy products. The Government is adamant to import huge amounts of milk products from abroad but we do not know whether the product is being adulterated by extravagant manufacturers or not. Consumers have no idea about the quality of the products which they are consuming at the cost of their money. It is noticeably imperative to have enough knowledge about the nutritive value and hygienic quality associated with the handling, processing, distribution and storage of this product in order to ensure the safe and sound health of the general people of our country (Asaduzzaman et al., 2007).

Successful manufacture of high-quality sweetened condensed milk that is stable during storage for at least 1 year at 15-20°C, thus calls for a stringent control of the manufacturing conditions in terms of the preheat treatment of milk, sugar incorporation, cooling and crystallization and packaging with particular attention to product hygiene. Obviously therefore, commercial production of sweetened condensed milk particularly the one meant for retail sale which is one of the most challenging propositions in dairy processing in Bangladesh. Although sweetened condensed milk is extensively used as nutritive food for the people of our country but the information is very much inadequate to monitor

the nutritive value and hygienic quality of sweetened condensed milk manufactured by different companies in our country. Like developed countries many developing countries have already been done ample research works to be acquainted with the quality of the product produced under various conditions prevailing in their respective environments. Hence, extensive research work in this field is obligatory to know the quality of sweetened condensed milk in Bangladesh aspects. That's why this study was undertaken to evaluate the physical, chemical and microbiological qualities of sweetened condensed milk of different brands available in local markets of Bangladesh.

MATERIALS AND METHODS

Site and period of the experiment

The experiment was conducted at the Dairy Technology and Dairy Microbiology Laboratory, Bangladesh Agricultural University, Mymensingh-2202 during the period of July to October, 2015.

Collection of Samples

Sweetened condensed milk samples of four brands were collected from local markets in and near Bangladesh Agricultural University, Mymensingh. The available sweetened condensed milk samples brands were: Danish, No. 1, Carnation and Goalini plus. A total of 12 containers of sweetened condensed milk were collected taking three containers from each brand.

Analysis of the sample

Samples were analyzed by a panel of experienced judges for organoleptic scores like flavor, body & texture, color and taste. Acidity percent in sweetened condensed milk samples were determined as described by Goss (1955). Percentage of total solids, fat (%) and ash (%) contents were estimated according to the methods described by AOAC (2003). Also, percentage of protein in sweetened condensed milk samples was determined by Kjeldahl method. Sweetened condensed milk samples were subjected to microbiological qualities in which total viable count was done according to APHA (1967) and

coliform count performed as described by APHA (2010).

Statistical analysis

The Analysis of variance was done as using completely Randomized Design (Steel et al., 1997) by the MSTATC statistical package. Duncun multiple range test (DMRT) was also done to compare the brands means.

RESULTS AND DISCUSSION

Physical parameters

Flavour

Flavour scores of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 35.50 ± 2.86 , 34.50 ± 2.36 , 35.20 ± 2.30 and 35.50 ± 2.86 , respectively (Table 1). Result revealed that there was non-significant

difference ($p > 0.05$) among the flavor score of all samples and this research finding is similar with Asaduzzaman et al. (2007). Again, Radaeva et al. (1965) reported that rancid flavor in sweetened condensed milk was caused by native lipase or lipase of bacterial origin when viscosity of the product remain low. Guthrie (1954) reported that flavour of condensed milk depends upon storage temperature and storage period.

Body and texture

Body and texture score of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 30.50 ± 1.20 , 31.00 ± 1.25 , 30.00 ± 1.35 and 31.00 ± 1.85 , respectively (Table 1). Results indicated that the highest body & texture score in Goalini plus sweetened condensed milk which is contradict with Asaduzzaman et al. (2007) who found highest score in Danish sweetened condensed milk.

Table 1

Physical parameters of sweetened condensed milks available in local market of Bangladesh.

Parameters	Brands of sweetened condensed milk				Level of significance
	Danish	No.1	Carnation	Goalini plus	
Flavour (40)	35.50 ± 2.86	34.50 ± 2.36	35.20 ± 2.30	35.50 ± 2.86	NS
Body & texture (35)	30.50 ± 1.20	31.00 ± 1.25	30.00 ± 1.35	31.00 ± 1.85	NS
Colour (15)	13.30 ± 1.31	13.00 ± 1.16	13.00 ± 1.16	13.30 ± 1.31	NS
Taste (10)	8.50 ± 1.34	8.40 ± 1.24	8.40 ± 1.29	8.50 ± 1.34	NS

NS indicates non-significant effect on the parameters.

Colour

Average colour score for Danish, No.1, Carnation and Goalini plus were 13.30 ± 1.31 , 13.00 ± 1.16 , 13.00 ± 1.16 and 13.30 ± 1.31 , respectively (Table 1). From the study of colour score of all brands samples, it was found that there was non-significant difference ($p > 0.05$) among the all samples. The highest colour score was recorded in Danish and Goalini plus sweetened condensed milk and little fluctuation present in scores with others. This finding is similar with Radayeva et al. (1965) who reported that sweetened condensed milk colour being white with creamy shade and gave a good score by judges. This result also agrees with the finding of Nelson and Trout

(1964), Brusentsev and Maslov (1982) who reported that condensing temperature gave minimum colour changes in condensed milk.

Taste

Taste scores of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 8.50 ± 1.34 , 8.40 ± 1.24 , 8.40 ± 1.29 and 8.50 ± 1.34 , respectively (Table 1). The highest taste scores found in both Danish and Goalini plus sweetened condensed milk. Results also revealed from the study that non-significant difference ($p > 0.05$) existed among the brands of sweetened condensed milk which is similar with Asaduzzaman et al. (2007) who does not found

any significant difference by studying available local market sweetened condensed milk.

Chemical parameters

Acidity (%)

Acidity percentages of the experimental brands are shown in Table 2. It was found that there was a non-significant difference ($p>0.05$) among the brands of sweetened condensed milk. The values of acidity of Carnation was slightly higher (0.145) than that of Danish, No.1 and Goalini plus sweetened condensed milk. According to Indian standard specifications for sweetened condensed milk, the acidity level of normal sweetened condensed milk was maximum 0.30 percent. So, the acidity values were within the normal range for the experimental samples and agree with research findings of Asaduzzaman et al. (2007). The results also agree with the findings of Mia (1995) who found that the average acidity percentage of sweetened condensed milk was 0.167 and that was less than the normal acidity content of sweetened condensed milk. Again, higher percentage of acidity in milk and milk products is related low microbial quality which supported by Khaleque et al. (1983) and Rahman et al. (1988).

Total solids content (%)

Total solids contents of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 71.90 ± 0.30 , 70.00 ± 0.33 , 70.60 ± 0.22 and 72.47 ± 0.25 , respectively (Table

2). There was a significant differences ($p<0.05$) among the total solids contents of collected condensed milk brands. It was founded that the values of TS content obtained from Goalini plus condensed milk brand was the highest and that of No.1 was the lowest. These findings are similar to Asaduzzaman et al. (2007) who found TS in Danish, Fresh milk, Starship and Goalini were 72.086 ± 0.60 , 70.638 ± 0.53 , 72.714 ± 0.52 and 71.584 ± 0.52 , respectively. Again, Webb and Johnson (1965) gave the composition of sweetened condensed milk where TS content was 73.5%.

Carbohydrate content (%)

Carbohydrate contents of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 54.70 ± 0.83 , 53.90 ± 0.65 , 53.95 ± 0.42 and 55.27 ± 0.45 , respectively (Table 2). It was found that there were significant differences ($p<0.05$) within the carbohydrate content of different types of sweetened condensed milk collected from local markets. It was observed that the average value of carbohydrate obtained from Goalini plus and Danish were significantly higher ($p<0.05$) than others (Table 2). According to Webb and Johnson (1965) the average carbohydrate content of sweetened condensed milk was 55.7% but average carbohydrate content of sweetened condensed milk was 54.6% (12.1% lactose and 42.5% sucrose). Eckles et al. (1951) also reported that carbohydrate content in sweetened condensed milk was 53.53% (12.94% lactose and 40.59% sucrose).

Table 2

Chemical parameters of sweetened condensed milks available in local markets of Bangladesh.

Parameters	Brands of sweetened condensed milk				Level of significance
	Danish	No.1	Carnation	Goalini plus	
Acidity (%)	0.144 ± 0.01	0.143 ± 0.01	0.145 ± 0.01	0.141 ± 0.01	NS
Total solids (%)	$71.90^a\pm 0.30$	$70.00^b\pm 0.33$	$70.60^b\pm 0.22$	$72.47^a\pm 0.25$	*
Carbohydrate (%)	$54.70^a\pm 0.83$	$53.90^b\pm 0.65$	$53.95^b\pm 0.42$	$55.27^a\pm 0.45$	*
Fat (%)	8.10 ± 0.34	8.00 ± 0.32	8.00 ± 0.32	8.10 ± 0.34	NS
Protein (%)	$7.50^a\pm 0.13$	$6.50^b\pm 0.45$	$7.15^a\pm 0.10$	$7.50^a\pm 0.13$	**
Ash (%)	$1.60^a\pm 0.05$	$1.60^a\pm 0.05$	$1.50^b\pm 0.03$	$1.60^a\pm 0.05$	*

^{a,b,c} In a row figures with different superscripts differ significantly. ** Significant at $p<0.01$, * significant at $p<0.05$ and NS indicates non-significant effects on the parameters.

Fat content (%)

Fat contents of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 8.10 ± 0.34 , 8.00 ± 0.32 , 8.00 ± 0.32 and 8.10 ± 0.34 , respectively (Table 2). There was non-significant difference ($p > 0.05$) among the fat contents of collected condensed milk sample. The fat content of Goalini plus and Danish brand were the highest and all brands were in almost perfect composition which is supported by Asaduzzaman et al. (2007). This study also agrees with Webb and Johnson (1965) who mentions the fat content of sweetened condensed milk was 8.1%. According to USDA (1947), minimum fat content of sweetened condensed milk ranges from 7.7 to 8.5%. BSTI (2000) also published the fat content of sweetened condensed milk should be $\geq 8\%$ but it was clear that all the brands were more or less trying to maintain the fat standard. Again, some company replaced milk fat with vegetable fat then it is called filled condensed milk.

Protein content (%)

The protein content of sweetened condensed milk obtained from different brands showed significant difference (Table 2). The highest (7.50 ± 0.13) protein percentage was found in Danish and Goalini plus condensed milk and the lowest (6.50 ± 0.45 %) in No.1 brand (Table 2). This finding was quite similar with Mhran (2011) who reported that average protein contents of sweetened condensed milk were 7.5 ± 1.0 and $8.2 \pm 1.1\%$ using traditional methods and Lactoscan, respectively. Similarly, Dydenkov (1966) reported the average value of protein content in sweetened condensed milk was 8.04% by Kjeldhal method and 8.03% by Kofranyi method.

Ash content (%)

Ash contents of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 1.60 ± 0.05 , 1.60 ± 0.05 , 1.50 ± 0.03 and 1.60 ± 0.05 , respectively (Table 2). It was found

that there were significant differences ($p < 0.05$) within the ash content of different brands of sweetened condensed milk collected from local markets in BD. It was observed that the average value of ash obtained from Danish, Goalini plus and No.1 were significantly higher ($p < 0.05$) and remains similar than Carnation brand. (Table 2). This research findings similar with Asaduzzaman et al. (2007) and Webb and Johnson (1965) who stated that ash content of sweetened condensed milk was 1.6%. Lampert (1970) also agree with these who mentioned that ash content of sweetened condensed milk was 1.7%. The variation in ash content between brands may be due to use of dried skim milk which fulfills the requirements of total milk solids and ash content in condensed milk.

Microbiological parameters

Total viable bacteria count

Total viable bacteria of sweetened condensed milk obtained from Danish, No.1, Carnation and Goalini plus were 14.30 ± 2.30 , 12.40 ± 2.16 , 13.00 ± 2.20 , 14.30 ± 2.30 , ($\times 10^2$ cfu/gm), respectively (Table 3). Statistical analysis revealed that there were no significant differences ($p > 0.05$) existed among the brands of sweetened condensed milk which is similar to Asaduzzaman et al. (2007). Ahmed et al. (1988) reported that the average total viable bacteria of sweetened condensed milk was 1.28×10^4 per g and ranged from 300 to 1.10×10^5 per gm. In case of sweetened condensed milk, pathogenic or spoilage microorganisms are unlikely to proliferate because of its high sugar content and thus low water activity (Nieuwenhuijse, 2003a; Nieuwenhuijse, 2003b). High sugar content appears as self preservative in sweetened condensed milk as well as increased concentration of milk solids also effective in rising osmotic pressure both are inhibitory to most microorganisms (Foster et al., 1957), perhaps these were the main reasons for satisfactory count in present studies.

Table 3
Microbiological parameters of sweetened condensed milks available in local markets of Bangladesh.

Parameters	Brands of sweetened condensed milk				Level of significance
	Danish	No.1	Carnation	Goalini plus	
Total viable bacteria $\times 10^2$ (cfu/gm)	14.30 \pm 2.30	12.40 \pm 2.16	13.00 \pm 2.20	14.30 \pm 2.30	NS
Coliform bacteria (cfu/gm)	Nil	Nil	Nil	Nil	NS

NS indicates non-significant effect on the parameters

Coliform count

In this study, there was no evidence of coliform bacteria in any brands of sweetened condensed milk (Table 3). According to BSTI (2000) & Yankov (1967), coliform count of sweetened condensed milk is nil. 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., 1979). No reported cases of foodborne disease outbreak have been attributed to the consumption of sweetened condensed milk or evaporated milk (ICMSF, 1998). These products generally do not support the growth of microorganisms and are shelf stable. Further, depending on the contamination during concentration, cooling, crystallization and packaging variable number of microbes including coliform, yeasts and mold may be present in it. From this study, it is clearly indicated that good sanitary measures were adopted during the manufacture of the sweetened condensed milk.

CONCLUSIONS

All the brands of sweetened condensed milk were good in terms of physical, chemical and microbial qualities. All the brands of sweetened condensed milk were acceptable in terms of acidity, fat and total solids contents. No coliforms were detected in this study and it was found that quality of all brands of sweetened condensed milk were more or less similar but some parameters of Danish and Goalini plus were slightly better than other condensed milk brands. Considering all the parameters, it could be concluded that the overall acceptability of sweetened condensed milk

supplied by Danish and Goalini plus were better than No.1 and Carnation.

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