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Qualitative study on the cottage cheese prepared from partially skimmed milk

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ABSTRACT

This experiment was conducted to evaluate and compare the physical, chemical and microbial quality of different types of cottage cheese made from skim milk (0.1% fat) and partially skim milk (1%, 2% and 3% fat) and to monitor the shelf-life of cottage cheese sample at room temperature (29.5-30^{0}C). For this purpose, four different types of cottage cheese were produced at the Dairy Technology and Microbiology laboratory at Bangladesh Agricultural University, Mymensingh. The physical parameter e.g. finish score of skim milk cottage cheese was higher and other physical parameters e.g. flavor and taste, body and texture and color were non-significant. In case of chemical analysis, among the four different cottage cheeses there were significant differences in case of fat content but other chemical parameters i.e. moisture, protein, carbohydrate, ash, total solids content were non-significant. In microbial analysis of different cottage cheese sample skim milk cottage cheese was able to confirm microbial standard. Shelf-life of cottage cheese at room temperature (29.5-30^{0}C) was only one day. The quality of cheese samples deteriorated rapidly at room temperature. In Bangladesh, milk production is very low in comparison with requirement. For this reason, whole milk is not available for cheese making. At the end it could be recommended that the skim milk (0.1% fat), could be used for manufacturing the cottage cheese and it will be economical and beneficial for industrialization of cottage cheese.

INTRODUCTION

Cheese is most popular dairy products all over the world. Today, the making of cheese in producing countries is a factory procedure, only small amounts being made on farm or local use. Many of the popular varieties that organized in Europe are now made in the United States. The leading cheese producing countries includes the United States, France, Italy, Germany, the Netherlands and the USSR. Cream cottage cheese production in the United State is highest. Creamed cottage cheese production in the United State, 1964 is 814 million pounds. There is no definite list of cheese varieties. Sandine and Elliker (1970) suggested that there are more than 1000 varieties of cheese. Walter and Hargrove (1972) described more than 400 varieties and listed the names of a further 400 varieties, while Burkhalter (1981) classified 510 varieties.

Cottage cheese, historically a popular food of central of Central Europe, was mad there in farm-houses. Modern, industrial cottage cheese originated in the United States 50 years ago. The new type of product, creamed, creamed and with a soft meaty body, has become a food staple of this country with a current annual consumption of almost one billion pounds (Kosikowski, 1966).
Cottage cheese is a soft, unripened, mild acid cheese with discrete curd particles of relatively uniform size. Creamed cottage cheese is dry-cure (uncreamed) cottage cheese covered with cream dressing. As the name implies, it was produced originally in homes (cottages) but industrial cottage cheese production began in the USA in 1916 (Reidy and Hedrick, 1970).

Codex Alimentarius official standard (Codex Stan C-16) for Cottage cheese and creamed Cottage cheese (Codex Alimentarius, 1968) lists the raw material for manufacture as pasteurized bovine skim milk, and the following authorized ingredients: harmless lactic acid and aroma-producing bacteria, rennet or other suitable coagulating agent, $CaCl_2$ (maximum of 200mg/kg

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milk), NaCl and water. Cottage cheese is produced by acid coagulation of pasteurized skim milk or reconstituted extra low-heat skim milk powder (RSM). The minimum heat treatment given to skim milk or RSM for cottage cheese manufacture is the minimum allowable pasteurization temperature 62.8^0C and time 30 min or temperature 71.7^o and time 15s.

Cultured Cottage cheese may be manufactured by three methods are designated short-long or intermediate-set methods (Emmons, 1963a,b; Emmons and Tuckey,1967; Kosikowski, 1982: Scott, 1986. Strains of *Lactococcus lactis subsp*. Lactis or subsp. cremoris, which are least susceptible to agglutination, are used as cultures for acid production during cottage cheese manufacture. Agglutination of starter bacteria in cottage cheese vats has been reviewed (Salih and Sandine, 1980). When Starter bacteria agglutinate, they form clumps and settle to the boeeom of the vat during manufacture (Emmons *et al*., 1966).
A very low level of milk-clotting enzyme (e.g., chymosin) is required for cottage cheese manufacture Emmons et al. (1959) recommended using 0.2 ml single strength rennet/454 kg skim milk for cultured cottage cheese manufacture in order to achieve a satisfactory coagulum ready to cut at pH 4.8. The pH at which the coagulum is cut is perhaps the most critical step in cottage cheese manufacture. The desired cutting and cooking pH during cottage cheese manufacture ate 4.75-4.8 and 4.55-4.6, respectively (Tuckey, 1964; Emmons and Beckett, 1984a).

Cheese yields reported for direct-set cottage cheese are generally slightly higher than for culture cottage cheese (Satterness *et al.*, 1978; Sharma *et al.*, 1980; Geilman, 1981). Cottage cheese has limited shelf-life (time from manufacture to unacceptability). Surveys of the shelf-life of cottage cheese in three countries show that it starts to deteriorate within 2 weeks of storage at $5\text{-}7^0$C, and is dependent show temperature (Schmidt and Bouma, 1992).

The most distinct flavor compound in cottage cheese is diacetyl which is produced by oxidative decarboxylation of a-acetolactic acid, an intermediate compound formed during citrate metabolism by micro-organisms that contain cirrate permease and citritase (Seitz et al., 1963), or by condensation of acetyl CoA (from acetic acid) and acetaldehyde, as a C_2-thiamine pyrophosphate (TPP) complex (Collins, 1972).

Cheese is a concentrated fermented food. Cheese, because of the selective concentration of components differs from milk in this respect. In addition, the microbial fermentation adds a new dimension of nutrition to both cheese and cultured milk foods. Cottage cheese contains 79-82.5% moisture, 12.5-17.5% protein, 0.7-1.4% ash 2.6-3.6% carbohydrate and 72-103 Kcal/100g energy when cheese contain 0.4-4.5% fat (Fox et al., 2004).

Cottage cheese is an economical source of high quality protein, minerals and Vitamins. Since the protein is of excellent quality, it is recommended as a valuable food for young and old alike. It is one of the foods that is rich in calcium and other Minerals so necessary in the structure of bones and teeth. Cottage cheese is not considered as a high energy food but contains nutrients which are necessary for growth and tissue repair. Very limited number of research was conducted in our country, at Dairy Technology and Microbiology Laboratory, BAU, Mymensingh on manufacture of cheese, Decca Cheese and Cheddar cheese and there was no experimental work has been carried out on cottage cheese. For this reason the present experiment was conducted on cottage cheese-i) to compare the physical, chemical and microbiological characteristics of cottage cheese prepared from skim milk and partially skim milk.; ii) to find out the suitable level of fat in the cottage cheese made from skim milk and partially skim milk and iii) to study the shelf-life of cottage cheese.

MATERIALS AND METHODS

Duration and site of the experiment

The experiment was conducted at Dairy Technology and Microbiology Laboratory of the Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Experimental procedure

Freshly drawn whole milk from Bangladesh Agricultural University (BAU) was collected. For each batch of cheese milking 8 liters of milk was used. Before preparation of cheese from skim milk, skim milk was separated from whole milk by a cream separator machine. 1.5 kg of skim milk was used separately for the preparation of each type of cheese and then standardized by Pearson square method by using different levels of fat (1%, 2%, 3% of fat). The desired levels of fat (cream) were mixed separately with the skim milk and properly blend by blending machine. Skim milk and partially skim milk was pasteurized by LTLT (low temperature and long time) method indirect heating at 63^0C for 30 minutes. After cooling I at 40^0 C, the selected bacterial culture was added to the pasteurized skim milk and partially skim milk.

Generally 3-5% starter culture was used by volume. After addition of the starter culture, the milk was mixed thoroughly. Ripening took from 45-60 minutes. After this step, rennet (Chymosin) was added @ 7g/100 lit skim milk. After addition of rennin, the milk vat was allowed to stand for 45 minutes to complete proper coagulation. After coagulation, the curd was cutted down by knife. The curd was cut into 1 to 3/4 inch cubes using stainless steel wire knife. After cutting the coagulated curd the temperature of the cheese vat was increased at 65^0C and it was allowed continuous stirring and scalding for removing whey water from the curd and gaining appropriate p^H. After stirring and scalding, the whey was allowed to drain out from the vat and coagulated curd was collected when most of the whey had drained out and the curd was racked. Then the curd was hooped and pressed into a wooden box to form cheese block by forcing pressure with weight and was allowed to stand for 12 to 18 hours.

Phase-I

Sampling

There were four samples in this phase -I of experiment. Cottage cheese sample made from skim milk (0.1% fat), cottage cheese sample made from partially skim milk (1% fat), cottage cheese sample made from partially skim milk (2% fat) and cottage cheese sample made from partially skim milk (1% fat).

Organoleptic examination

All experimental cheese was judged by a panel of judges for organoleptic evaluation using a score card. The principal object of judging was to evaluate whether there prevailed any significant differences in the cheeses of different groups in terms of flavor and taste, body and texture, finish and color to determine the total score, as a result of different types of cottage cheeses.

Chemical analysis of cheese

All cheese samples were chemically analyzed in the laboratory. The parameters like acidity, p^H, moisture content (g/kg), total solids content (g/kg), fat content (g/kg), protein content (g/kg), ash content (g/kg), and carbohydrate content (g/kg) were estimated.

Total solid content of the skim milk samples were determined by oven drying method according to AOAC (2003). Specific gravity was determined by using Qevence Lactometer, according to the method described by Aggarwala and Sharma (1961). Fat content was determined by (Official Method of Analysis of the Association of Official Agriculture Chemist, 1980). Acidity was determined by titrating with N/10 sodium hydroxide solution using the procedure of Aggarwala and Sharma (1961). Protein content was determined by Kjeldahl method (total nitrogen estimation method) and p^H was measured with the help of p^H meter. Moisture content was determined by oven drying method as described AOAC (2003). Details of procedures are given in Appendix section.

Microbiological analysis of cheese

All cheese samples were microbiologically analyzed in the laboratory. Coliform per gram and Total viable count (TVC) per gram were estimated in the laboratory

Phase –II

Shelf-life of cheese at room temperature

This was the second phase of the experiment. In this part, different types of cottage cheese were

stored at room temperature (29.5-30^{0}C) to monitor their shelf-life. Immediately after preparation of the cheese, their acidity, p^H and the organoleptic qualities were measured. In this phase of experiment the same four samples of phase-I were used

Qualities of the cheese kept at room temperature were measured every day, until the cottage cheese samples become unacceptable for human consumption. The parameters used to measure the quality of cottage cheese were p^H, acidity, coliform and total viable count (TVC) and flavor.

Statistical analysis

The Completely Randomized Design (CRD) was followed for phase -1 and Randomized block design for Phase–II. There were four treatment groups and three replications for each case. Analysis was performed by using computer based analytical package MSTAT, mean was expressed mean value±SEM.

RESULT AND DISCUSSION

The physical and chemical quality of skim milk and cream was monitored (Table 1) before preparation of the cheese in the "Dairy Technology and Microbiology Laboratory" in the Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202.

Table 1
Chemical composition of milk and cream**.**

Milk constituents	Skim milk (g/kg)	Cream (g/kg)
Total solids	83.03	599.00
Fat	1.83	560.00
Solids Not Fat (SNF)	81.20	39.66
Protein	32.00	15.00
Lactose	42.23	20.73
Ash	6.96	3.93

Source: Dairy Technology and Microbiology Laboratory

Phase –I

Physical parameters of cottage cheese

Flavor and Taste

In an ideal cottage cheese, the basic flavor should be similar to fresh, clean cultured milk or cream (if creamed). The flavor and taste score of the four different type of cottage cheese samples A, B, C and D made by using skim milk (0.1% fat), and partially skim milk (1%, 2%, and 3% levels of fat) were 38.70±1.54; 40.54± .68; 39.22±1.34 and 37.92±1.60 respectively (Figure 1) and which were showed no significant differences. Abu Donia (1981) found that the flavor score of Domiati cheese was 70 to 90 percent. From another study, Rastogi et al (1989) reported that the flavor score of cow's milk cottage cheese was 80 to 90 percent which is higher than the score obtained in this study. The reason is that the cottage cheese made in this study from the partially skim milk fat is obviously related to the flavor development.

Body and texture

The body and texture of cottage cheese should be uniform, smooth and meaty (not too firm or too soft and pasty). Body and texture score of four different types of cottage cheese samples did not differ significantly and the score of four different cottage cheeses (A, B, C and D) were 25.02±1.43, 25.32±1.16, 25.27±0.75 and 24.36±0.53 respectively (Figure 1). The result of the experiment agrees with the findings of Hossain (2006). He found that the body and texture score cheddar was 25-27.

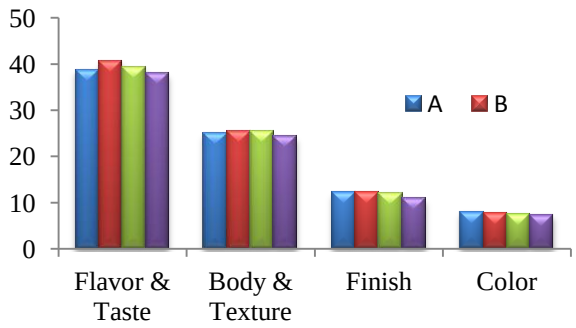

Figure 1
Comparative changes in physical parameters of different cottage cheese. Each bar represents mean ± SEM value

Finish

The finish score of different cottage cheese samples A, B, C and D were 12.23±0.11, 12.20±0.11, 12.08±0.14 and 10.90±0.76 respectively (Figure 1). There were significant differences (P<0.01) of finish score in different types of cottage cheese samples. The finish score of the experimental cheese was gradually decreased. The highest score was in sample A and Lowest in sample D. The gradual decrease of the finish score of cottage cheese samples was due to the effect of different levels of fat. Sample A earned best appearance, smooth surface, free from cracks and partially free from molds.

Color

The color score of four different types of cottage cheese samples A, B, C and D made by skim milk and partially skim milk were 7.92±0.63, 7.64±0.60, 7.55± 0.09 and 7.35±0.38 respectively (Figure 1) which were also showed no significant difference among the color score of different cheese sample. Rastogi *et al.*, (1989) reported that color score of cow's milk cottage cheese was 11.01 to 13.30 out of 15 (74-89%), which is higher in the present study. The result of the experiment agrees with the findings of Dharam and Grag (1989), they showed that appearance and color score of cheese was 7.91±0.22.

Chemical composition of the experimental cheese

Acidity content

The acidity (LA%) of the four different cottage cheese samples A, B, C and D were 0.333±0.02, 0.335±0.01, 0.335±0.01 and 0.036± 0.02 percent respectively (Figure 2). Statistical analysis showed that there was no significant difference in the acidity content of skim milk and partially skim milk.

P^H content

The p^H content of four different cottage cheese samples A, B, C and D were 5.40±0.10, 5.37±0.12, 5.37±0.12 and 5.33±0.06 respectively (Figure 2) and there were no significant differences in different cottage cheese samples. Comparatively highest p^H content observed in sample A and lowest in sample D. The p^H content of skim quark cheese, part skim milk ricotta cheese were 4.6 and 5.8 respectively and the data of p^H content of cottage cheese is not available (Boone, 2001; Fernandez-Albalat, 2001). Wilster (1969) reported that p^H content for cottage cheese not higher than 5.2 which is more or less similar to the experimental cheese.

Moisture content

The moisture content of four different cottage cheese samples A, B, C and D prepared from skim milk and partially skim milk were 611.43± 8.73, 598.06±63.20, 530.75± 121.69 g/kg respectively (Figure 2). Statistical analysis showed that there was no significant difference of moisture content in experimental cheese samples made by skim milk and partially skim milk. Wilster (1969) reported that moisture content for cottage cheese not more than percent. The result of this study agrees with the result of Hine (1994). They found that the moisture content of skim milk was within the range of 400-600 g/kg. The result of the study also agrees with the result of Zahan (2000). He found that whole milk cheese content 506.5 g/kg.

Total solids (TS) content

The average total solids content of four different types of cottage cheese samples A, B, C and D were 355.56±8.47, 401.94±63.20, 469.25±88.67 and 531.80±121.70 g/kg respectively (Figure 2). The total solids content among the different cottage cheese samples showed no significant difference. Similar types of result were reported by Ghose and Singh (1996). They found that the of total solids content of different types of cheese was 497.0 g/kg. Similar types of result also obtained by Zahan (2000). He found that whole milk cheese content 493.4 g/kg moisture.

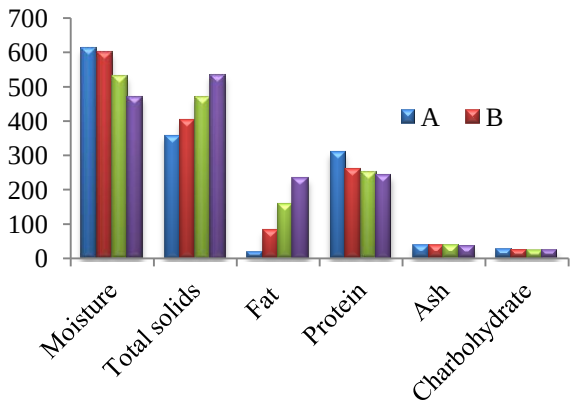

Figure 2
Comparative changes in chemical parameters of different cottage cheese samples. Each bar represents mean ± SEM value

Total solids (TS) content

The average fat content of four different types of cottage cheese samples prepared from skim milk (0.01% fat) and partially skim milk (1%, 2% and 3% fat) were 17.70±7.42, 81.47±16.06, 158.91±36.46 and 232.00±62.69 g/kg respectively (Figure 2). Statistical analysis showed that there was a significant difference (P<0.01) of cheese prepared from skim milk and partially skim milk. Ghosh and Singh (1996) found the amount of fat in cheese made from cow's milk was 248.0 g/kg which is higher than the cheeses prepared in this experiment. Zahan (2000) found that cheese made from cow's milk contain 235.5 g/kg fat, which is higher the control group of this experiment. The reason is that cottage cheese made from skim milk (0.1% fat) and partially skim milk (1%, 2% and 3% fat).

Protein content

The average protein content of four different types of cottage cheese samples (A, B, C and D) were 307.90±12.92, 259.07±52.24, 250.47±58.55 and 241.70±66.17 g/kg respectively (Figure 2). Statistical analysis showed that there was no significant difference among the protein content of different types of cottage cheese. Alcala *et al.* (1982) found that the protein content of whole milk cheese was 246.1 g/kg which is lower than the cheese made in the experiment. Zahan (2000) found the protein content of cheese made from cow's milk was 219.7 g/kg which is also lower than this experimental cheese. The possible reason is that protein content of skim milk is slightly higher than whole milk cheese.

Ash content

The average ash content of four different types of cottage cheese samples prepared from skim milk and partially skim milk) were 36.97±6.09, 36.67±6.17, 35.93±6.42 and 35.36±6.62 g/kg respectively (Figure 2). Statistical analysis showed that there was no significant difference (P>0.01) among the ash content of different types of cottage cheese prepared from skim milk and partially skim milk. Ghosh and Singh (1996) found that the amount of ash content in cheese was 27.6 g/kg which is slightly lower than cheese made from skim milk and partially skim milk of this study but similar result obtained by Zahan (2000), who found 24.6 g/kg ash content of the cheese made from cow's milk.

Carbohydrate content

The average carbohydrate content of four different types of cottage cheese samples A, B, C and D were 26.00±2.00, 24.67±2.08, 23.70±2.14 and 22.73±2.05 g/kg respectively (Figure 2). Statistical analysis showed that there was no significant difference of carbohydrate content in different types of cottage cheese samples. Similar types of result were reported by Fox *et al.* (2004). They found that the carbohydrate content of different cottage cheese samples (0.5%, 1%, 2%, 4% fat) were in the range of 18.5-26 g/kg.

Microbial parameters

Total viable count (TVC)

In microbial analysis, the total viable count (TVC) of four different types of cottage cheese samples A, B, C and D were 5.770±0.02, 5.79±0.02, 5.83±0.03 and 5.83±0.03 g/kg respectively. Statistical analysis showed that there was no significant difference (P>0.01) among cottage cheese samples (Table 2). Although the TVC value is non-significant but slightly higher value observed in D sample and lowest in A sample.

Table 2
Microbial parameters of different types of cottage cheese**.**

Parameter	A	B	C	D	LSD	Level of significance
Total viable count (TVC) per gram	5.77^{b}±0.02	5.79^{ab}±0.02	5.83^{a}±0.03	5.83^{a}±0.03	0.06	*

Mean with different superscripts within the same row differ significantly. * Significant at 5% level of significance. A. Cottage cheese made from skim milk (0.1% fat); B. Cottage cheese sample made from partially skim milk (1% fat), C. Cottage cheese sample made from partially skim milk (2% fat), D. Cottage cheese sample made from partially skim milk (1% fat)

Phase-II

In this part of experiment, shelf life of different cheese samples stored at room temperature (29.5-30^{0}C) was measured with the help of some physical, chemical and microbial parameters.

Acidity

Average acidity of different cheese samples, after preparation, after 24 hrs and after 48 hrs were 0.335±0.01, 1.22±0.15, 1.58±0.08 percent respectively (Figure 3). Statistical analysis showed that the acidity of various cheese samples increased gradually depending on storage time. At room temperature, the acidity of cheese samples increased very rapidly. Highest acidity observed in '0' hr. Arora and Gupta (1980) stated that paneer like other indigenous product is a highly perishable products and suffers from limited shelf-life that means titratable acidity is very rapidly increased on storage condition. On the other hand, the acidity percent of A, B, C and D cheese samples were 0.93±0.49, 1.06±0.56, 1.08±0.58 and 1.12±0.60 percent respectively (Table 3). There was a significant difference (P>0.01) among different cottage cheese samples. Acidity percent highest in D sample and lowest in A sample.

Table 3
Qualitative changes in different cottage cheese depending on treatment.

Parameters	A	B	C	D	LSD	Level of significance
Acidity	0.93^{c}±0.49	1.06^{b}±0.56	1.08^{ab}±0.58	1.12^{a}±0.60	0.042	**
p^{H}	4.37^{a}±0.81	4.20^{b}±1.37	4.18^{b}±0.91	4.10^{b}±0.94	0.102	**
Total viable count (TVC) per gram	7.31^{d}±1.16	7.34^{c}±1.17	7.38^{b}±1.17	7.41^{b}±1.18	0.008	**

Mean with different superscripts within the same row differ significantly, ** Significant at 1% level of significance. A. Cottage cheese made from skim milk (0.1% fat), B. Cottage cheese sample made from partially skim milk (1% fat), C. Cottage cheese sample made from partially skim milk (2% fat), D. Cottage cheese sample made from partially skim milk (1% fat)

p^{H}

The average p^{H} content of different cheese samples, after preparation, after 24 hrs and after 48hrs were 5.37±0.08, 5.37±0.79, 3.39±0.12 respectively (Figure 3). These was a significant difference (P<0.01) in p^{H} content depending on storage time. On the other hand the p^{H} content of A, B, C and D cheese sample were 4.37±0.81, 4.20±1.35, 4.18±0.91 and 4.10±0.94 respectively (Table 3). Statistical analysis showed that there was a significant difference (P<0.01) in different

cottage cheese samples. P^H content is highest in A sample and lowest in D sample.

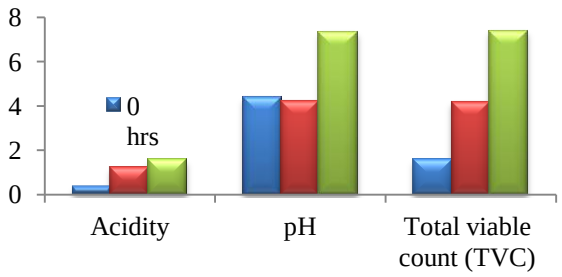

Figure 3
Qualitative changes of Acidity, p^H and TVC depending on over time. Each bar represents mean ± SEM value.

Total viable count (TVC)

Average TVC of different cheese samples after preparation, 24 hrs later and 48 hrs later were 5.81±0.37, 8.04±0.39, 8.26±0.05 per gram respectively (Figure 3) which was significantly differed. The data of TVC count of cottage cheese depending on storage time is not available. On the other hand, the TVC of A, B, C and D samples were 7.31±1.16, 7.34±1.17, 7.38±1.17 and 7.41±1.18 per gram respectively (Table 3) which was significantly differed in within treatment groups. Highest value observed in D sample and lowest in A sample.

From the concerning parameter studied, it was found that among the cheeses sample A yield good result. Considering the physical parameters finish score is distinctly more for sample A. There was no variation in Flavor and taste, Body and texture and color. Regarding chemical parameters sample A contains less fat.

SUMMARY AND CONCLUSION

This experiment was conducted to evaluate and compare the physical, chemical and microbial quality of different types of cottage cheese made from skim milk (0.01% fat) and partially skim milk (1%, 2% and 3% fat) and to monitor the shelf-life of cottage cheese sample at room temperature (29.5-30^{0}C). For this purpose, four different types of cottage cheese was produced at the Dairy Technology and Microbiology laboratory at Bangladesh Agricultural University and with the collection of Classic dairy Foods, Beg housing, Khagdohor, Mymensingh. In the production of cottage cheese standard methods for cottage cheese manufacturing was followed. For this purpose milk was collected from BAU Dairy Farm and other materials such as lactic acid culture and rennet were collected from Classic Dairy Foods.

From the results, it was found that the physical parameter e.g. finish score of skim milk cottage cheese (sample A) was higher and other physical parameters e.g. flavor and taste, body and texture and color were non-significant. The finish score of A, B, c and D samples were 12.23±0.11, 12.17±0.11, 12.08±0.14 and 10.90±0.76 respectively.

In case of chemical analysis four different cottage cheese, there was significant difference ($P<0.01$) of chemical parameters e.g. fat. Other chemical parameters moisture, protein, carbohydrate, ash, total solids content were non-significant. Fat content of A, B, C and D cheese samples were 17.70±7.42, 81.48±16.06, 158.91±36.46 and 232.00±62.69 g/kg respectively. A similar result was obtained of cottage cheese described by Ghosh and Singh (1996). Since experimental cottage cheese prepared from skim milk (0.1% fat) and partially skim milk (1%, 2% and 3% fat), fat content of experimental cottage cheeses are lower than that of cheese.

In microbial analysis of different cottage cheese sample skim milk cottage cheese (sample A) was able to confirm microbial standard. Total viable count of different cottage cheese samples were 5.77±0.02, 5.79±0.02, 5.83±0.03 and 5.83±0.03 respectively. There were a reduced number of bacterial counts in sample A, because of low fat content. The reason is that other chemical parameters were approximately same and similar in different cottage cheese samples.

Shelf-life of cottage cheese at room temperature (29.5-30^{0}C) was only one day. The quality of cheese samples deteriorated rapidly at room temperature. The shelf-life of cottage cheese from

skim milk (0.1% fat) and partially skim milk (1%, 2% and 3% fat) is approximately similar at room temperature.

In Bangladesh, milk production is very low in comparison with requirement. For this reason, whole milk is not available for cheese making. On the other hand, the small amount of high fat cheese in the markets and the difficulty distinguishing high fat cheese by analysis, have created no special reorganization or demand for consumers and no advanced price for such cheese.

It is recommended that the skim milk (0.1% fat), could be used for manufacturing the cottage cheese and it will be economical and beneficial for industrialization of cottage cheese.

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