

Manufacture of Cheese from Skim Milk with Addition of Different Levels of Vegetable Oil

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Abstract: The experiment was conducted to manufacture cheese from skim milk with 30, 40 and 50 g kg⁻¹ soybean oil and whole milk and to monitor the quality of different types of prepared cheese. It was observed that the flavour, taste, colour and appearance, body and texture, overall acceptability and final score were significantly higher in whole milk cheese than that of other types of vegetable oil based (30, 40 and 50 g kg⁻¹) skim milk cheese. Chemical analysis showed that there were significant differences ($P < 0.01$) in case of protein and fat contents of different types of cheeses. On the other hand there were no significant differences in moisture, total solids, ash and acidity content of different types of cheese. Although some chemical parameters showed that the quality of soybean oil based (30, 40 and 50 g kg⁻¹) skim milk cheeses were better than the whole milk cheese but expert judges gave their opinion in favour of whole milk cheese, on the basis of organoleptic evaluation. It may be concluded that cheese could be manufactured successfully from skim milk with 30, 40 and 50 g kg⁻¹ soybean oil and it will open a new door in business sector and experiment also could solve the protein deficiency of Bangladesh. According to panelists score 50 g vegetable oil based skim milk cheese was better than other types of skim milk cheese.

Key words: Soyabean oil, cheese, organoleptic test, skim milk

Introduction

Cheese a product of milk principally consist of fat, casein and insoluble salts, together with water in which small amounts of soluble salts, lactose and albumin are found. To retain these constituents in concentrated form, milk is coagulated either by means of lactic acid and produced bacteria or by addition of rennet or both. But rennet or commercial rennet are not always available. A number of coagulants viz hydrochloric, phosphoric, tartaric and citric acids; sour whey and acidophilus whey in various strength and proportions are reported to have been used for paneer (cheese) manufacture with varying consequence on the product characteristics. Sour whey, citric acid and lactic acid have been approved as coagulants for paneer (cheese) manufacture. The number of varieties of cheese made throughout the world today is very large. Sandine and Elliker (1981) suggested that there are more than 1000 cheese varieties. Walter and Hargrove (1972) described more than 400 varieties, while Burkhalter (1981) classified 510 varieties.

In Bangladesh sufficient quantity of whole milk is not available for human consumption. Per capita consumption of milk in Bangladesh is hardly 35 ml a day (Directorate of Livestock Services, 1998). Therefore, the available whole milk is not enough for manufacturing dairy products. For this reason, the cheese available in the market are of poor quality and lacking uniformity. Sweetmeat makers usually withdraw some portion of fat from their milk and use the remaining low quality milk for cheese making. As a result consumers are not getting quality product. This problem could be solved by using vegetable oil with skim milk for manufacturing cheese. In this way, soyabean oil could replace the milk fat. Soyabean oil is very popular in Bangladesh. It is cheap and always available in the market. For this reason an attempt was made to mix soyabean oil with skim milk for manufacturing cheese. The production of skim milk cheese offers great opportunities to market new products which are perceived as healthy due to their low-fat content. It is however, essential that the skim milk cheese are organoleptically acceptable. In Bangladesh no such type of research has been done to evaluate the feasibility of using vegetable fat with skim milk for manufacturing cheese. Hence, the present research project is designed to fulfill the knowledge of gap in the line. The main objectives of this were to study the quality of cheese manufactured from skim milk with

addition of different levels of vegetable oil and to find out the suitable level of vegetable oil to be used with skim milk for manufacturing acceptable quality of cheese.

Materials and Methods

This experiment was conducted at the Bangladesh Agricultural University Dairy and Poultry Science Laboratory during the period from 3 August to November 2000.

Chemical analysis of whole milk: For chemical analysis of whole milk and skim milk the following tests like specific gravity, total solids (TS) contents g kg⁻¹, solids-not-fat (SNF) g kg⁻¹, fat content (g kg⁻¹), acidity content (%), protein content (g kg⁻¹) moisture (g kg⁻¹) and pH were done in laboratory using different methods.

Preparation of different types of cheese

Preparation of skim milk and soyabean oil based cheese: Freshly drawn whole milk was collected from Bangladesh Agricultural University Dairy Farm. For the preparation of skim milk cheese, skim milk was separated from whole milk by cream separator machine. One kg of skim milk was used separately for the preparation of each type of cheese with different levels of vegetable oil (30, 40 and 50 g kg⁻¹) so, total of 3 kg skim milk was used for the preparation of 3 types cheese. The desired level of vegetable oil was mixed separately with skim milk. Then finally mixed samples were properly blend for by blending machine. Before blending the blender was cleaned and sterilized properly. To remove off-flavour of soyabean oil, 1-2 drops of orange flavour were mixed per kg of skim milk during blending of the sample. The skim milk with different levels of vegetable oil content was placed into 3 vats, each containing 1 kg of skim milk. The skim milk was heated at 85°C and at that time 10% sour whey was added. The acidity of the skim milk just after adding whey was recorded and the skim milk was allowed to ripen for 40-45 min (Schorder *et al.*, 1973) when coagulation was completed it was cut by knife. The curd was settled for 10-15 min and the whey acidity was determined. The acidity of whey was 0.18 to 0.20%. After complete curd formation the whey was separated by Muslin cloth and the resulting curd was put in a wooden box with 2% salt. Then it was kept in a refrigerator for at least 10-15 days, cheese

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prepared by adding 30, 40 and 50 g kg⁻¹ vegetable oil were designated as A, B and C type cheese for experimental purpose.

Preparation of cheese from whole milk: For the preparation of whole milk cheese after collection of whole milk same procedure was followed as it was used for making skim milk cheese. This type of cheese was designated as D type cheese for the experimental purpose.

Judging of different types of cheese sample: The samples were judged separately by a team of experienced judges for organoleptic parameters. The organoleptic parameters were: flavour, taste, colour and appearance, body and texture, overall acceptability and final score.

Chemical analysis of cheese: After organoleptic evaluations all cheese samples were chemical analyzed in the laboratory. The following parameters were determined in the laboratory. Moisture content (g kg⁻¹), total solids (TS) content (g kg⁻¹), protein content (g kg⁻¹), fat content (g kg⁻¹), ash content (g kg⁻¹) and acidity (%). The moisture, ash and titrable acidity of experimental cheese were determined according to the method described by AOAC (1984). Fat percent was determined by Ether-Extract method (Official Methods of Analysis of the Association of Official Agriculture Chemists, 1980) and protein content was determined by Kjeldahl method (Douglas *et al.*, 1982) (total N₂ estimation method).

Statistical analysis: Data collected from different parameters were subjected to statistical analysis and was done to find out the statistical difference (Significant or not) between different treatments. In this experiment all experimental materials were completely homogeneous and for this reason data were analyzed by using one way analysis of variance test (CRD) with four (4) replication and three treatments.

Results and Discussion

Physical parameters of different types of cheese: Three trials were done and after each trial sample of cheeses were examined by a group of judges for organoleptic tests.

Flavour: Flavour score of vegetable oil based skim milk (3, 4 and 5% level) and whole milk cheese was 17.500±0.65, 17.283±0.62, 17.383±1.04 and 19.00±0.15 respectively. Statistical analysis showed that there was significant difference (P<0.05) in respect of flavour of cheese prepared from skim milk and whole milk. Results indicated that the flavour score of cheese made from whole milk was higher than that of cheese made from skim milk with different levels of vegetable oil so it may be concluded that quality of cheese in respect of flavour, from both types, was not similar and cheese made from whole milk was better than cheese made from skim milk with vegetable oil (Table 2).

Taste: The taste score of cheese prepared from skim milk with different levels of vegetable oil (30, 40 and 50 g kg⁻¹) and whole milk were 27.063±0.41, 27.233±0.27, 27.620±0.34 and 29.060±0.53 respectively. Statistical analysis showed that there was significant difference (P<0.01) in respect of taste score of cheese prepared from skim milk with different levels of vegetable oil and whole milk. Taste score of cheese made from whole milk was higher than that of cheese made from skim milk. So, it may be concluded that quality of cheese in respect of taste, from both type, was not similar and cheese made from whole milk was better than cheese made from skim milk with different levels of vegetable oil (Table 2).

Colour and appearance: It was observed that the colour and appearance score of skim milk and whole milk cheese were 8.417±0.29, 8.180±0.28, 8.30±0.26 and 9.20±0.18 respectively. Statistical analysis showed that there was significant difference (P<0.01) in respect of colour and appearance score of

cheese prepared from skim milk and whole milk. It was clear from the Table 2 and that colour and appearance of whole milk cheese was higher than skim milk cheeses.

Body and texture: Body and texture score of vegetable oil based skim milk (30, 40 and 50 g kg⁻¹) and whole milk cheese were 7.633±0.42, 7.930±0.25, 8.353±0.15 and 9.17±0.29 respectively. Statistical analysis found that there was significant difference in respect of body and texture score of cheese prepared from skim milk with vegetable oil and whole milk. Body and texture of the cheese prepared from whole milk and skim milk differed widely.

The body and texture score was higher in whole milk cheese than that of skim milk cheese. From the score card which was judged by the respective teachers of the Department of Dairy Science, BAU, Mymensingh, it was observed that body and texture of cheese prepared from whole milk was better than cheese made from skim milk (Table 2).

Overall acceptability: The overall acceptability score of cheese prepared skim milk with 30, 40 and 50 g kg⁻¹ vegetable oil and whole milk were 22.297±1.14, 24.103±0.34, 25.057±0.30 and 28.103±0.19 respectively. Statistical analysis showed that there was a significant difference (P<0.01) in cheese prepared from skim milk and whole milk. It was observed from Table 2 that the overall acceptability of cheese made from whole milk was higher than other types.

Total score: The total organoleptic score for vegetable oil based skim milk (30, 40 and 50 g kg⁻¹) and whole milk cheeses were 82.910±2.80, 84.730±0.86, 86.713±1.56 and 94.533±1.14 respectively out of 100. There was significant difference in statistically (P<0.01) between the total organoleptic score of four type of cheese. Cheese made from whole milk was superior to cheese made from skim milk (Table 2).

From the above results it was concluded that whole milk cheese was more acceptable than skim milk cheese according to the comment of panelist.

Chemical parameters

Moisture: The moisture content of cheese prepared from vegetable oil based skim milk (30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk were 509.13±8.2, 509.45±4.6, 501.85±5.9 and 504.64±5.2 g kg⁻¹ respectively. Statistical analysis showed that there was non significant difference of moisture content in cheese made from skim milk and whole milk (Table 3). Results of this study agreed with the results of Ghosh and Singh (1996). They found that cow's milk cheese contain 503.0 g kg⁻¹ moisture. Hine (1994) found that the moisture content of skim milk cheese was within the range of 400-600 g kg⁻¹. The results of the study also agreed with the results of Zahan (2000). He found that whole milk cheese content 506.5 g kg⁻¹ moisture.

Total solids (TS): The average total solids contents of cheese prepared from skim milk (with 30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk were 490.87±8.2, 490.55±4.6, 498.15±5.9 and 495.36±5.2 g kg⁻¹ respectively. Statistical analysis (Table 3) showed that there was no significant difference within the total solids content of skim milk and whole milk cheese. Similar type of result were reported by Ghosh and Singh (1996). They found that the percentage of total solids content of different type of cheese was 497.0 g kg⁻¹. Similar type of result also obtained by Zahan (2000). He found that whole milk cheese content 493.4 g kg⁻¹ total solids.

Protein: The average protein content of cheese prepared from skim milk (with 30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk were 241.14±8.0, 232.01±3.8, 227.51±5.2 and 243.87±5.4 g kg⁻¹ respectively. Protein content of skim milk and whole milk cheese had a significant difference (P<0.01). Protein content of

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Table 1: Chemical composition of whole milk and skim milk sample

Constituent (g kg ⁻¹)	Moisture	TS	Fat	SNF	Protein	Ash	pH	Sp. gravity	Acidity (%)
Whole milk	872.67 ± 0.81	127.33 ± 0.77	40.6 ± 0.61	86.63 ± 0.32	37.10 ± 1.79	7.10 ± 0.10	6.493 ± 0.016	1.030 ± 0.001	0.151 ± 0.001
Skim milk	910.08 ± 6.06	89.92 ± 6.04	3.46 ± 0.39	86.47 ± 6.40	33.67 ± 0.97	7.12 ± 0.14	6.780 ± 0.114	1.037 ± 0.002	0.151 ± 0.001

Table 2: Physical parameters of different types of cheese

Types of cheese	Flavour score	Taste score	Colour and appearance score	Body and texture score	Over all acceptability score	Total score
A	17.50 ^a ± 0.65	27.06 ^b ± 0.41	8.41 ^b ± 0.29	7.63 ^b ± 0.42	22.29 ^a ± 1.04	82.91 ^b ± 2.80
B	17.28 ^b ± 0.62	27.23 ^b ± 0.27	8.18 ^b ± 0.28	7.93 ^b ± 0.25	24.10 ^b ± 0.34	84.73 ^b ± 0.86
C	17.38 ^b ± 1.04	27.62 ^b ± 0.34	8.30 ^b ± 0.26	8.35 ^b ± 0.15	25.05 ^b ± 0.30	86.71 ^b ± 1.56
D	19.00 ^a ± 0.15	29.06 ^a ± 0.53	9.2 ^a ± 0.18	9.17 ^a ± 0.29	28.10 ^a ± 0.19	94.53 ^a ± 1.14
Level of significance	**	**	**	**	**	**

Table 3: Chemical parameters of different types of cheese

Types of cheese	Moisture (g kg ⁻¹)	TS (g kg ⁻¹)	Protein (g kg ⁻¹)	Fat (g kg ⁻¹)	Ash (g kg ⁻¹)	Acidity (%)
A	509.13 ± 8.2	490.87 ± 8.2	241.14 ^a ± 8.0	200.98 ^a ± 2.1	24.57 ± 2.8	0.759 ± 0.05
B	509.45 ± 4.6	490.55 ± 4.6	232.01 ^{bc} ± 3.8	239.13 ^b ± 7.2	27.37 ± 0.8	0.793 ± 0.02
C	501.85 ± 5.9	498.15 ± 5.9	227.51 ^c ± 5.2	257.01 ^a ± 5.6	27.93 ± 1.2	0.754 ± 0.03
D	504.64 ± 5.2	495.36 ± 5.2	243.87 ^a ± 5.4	253.15 ^a ± 3.6	27.44 ± 0.9	0.753 ± 0.05
Level of significance	*	*	**	**	*	*

Treatment means bearing different types alphabets as superscripts in a row differ significantly (P < 0.01) ** Significant at 1% level of significance A = 30 g vegetable oil based skim milk cheese B = 40 g vegetable oil based skim milk cheese C = 50 g vegetable oil based skim milk cheese D = Whole milk cheese

whole milk cheese was higher than the other types (Table 3). Alcala et al. (1982) found that the protein content of whole milk cheese was 246.1 g kg⁻¹ which is similar to our experiment. Zahan (2000) found that the protein content of cheese prepared from cow's milk was 219.7 g kg⁻¹ which is lower than our control type.

Fat: The average fat content of cheese prepared from skim milk (with 30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk were 200.98 ± 2.1, 239.13 ± 7.2, 257.01 ± 5.6 and 253.15 ± 3.6 g kg⁻¹ respectively. Statistical analysis showed that there was significant difference (P < 0.01) in cheese prepared from skim and whole milk. Table 3 indicated that 50 g vegetable oil based skim milk cheese content higher fat than other types. El-Shibiny et al. (1983) found that replacement of milk fat with vegetable oil upto (100%) had no significant effect on the chemical composition of Cheese. Ghosh and Singh (1996) found the amount of fat in cheese made from cow's milk was 248.0 g kg⁻¹ which is lower than our control type. Zahan (2000) found that cheese made from cow's milk contain 235.5 g kg⁻¹ fat, which is lower than our control type. Hefnawy and Hafez (1986) also found that skim milk with 3.5, 4.5 and 6% soyabean oil, mean contents of fat were significantly higher when determined by the Soxhlet than by the Gerber method.

Ash: The average ash contents of cheese prepared from skim milk (with 30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk cheese were 24.57 ± 2.8, 27.37 ± 0.8, 27.93 ± 1.2 and 27.44 ± 0.9 g kg⁻¹ respectively. Statistical analysis showed that there was no significant difference in ash content of cheese prepared from skim milk and whole milk (Table 3). The finding of this experiment supports the result of Ghosh and Singh (1996). They found that the amount of ash content in cheese was 27.6 g kg⁻¹. Similar type of result also obtained by Zahan (2000). He found that the cow's milk cheese content 24.6 g kg⁻¹ ash.

Acidity: The acidity of cheese prepared from skim milk (with 30, 40 and 50 g kg⁻¹ vegetable oil) and whole milk were 0.759 ± 0.05; 0.793 ± 0.02; 0.754 ± 0.03 and 0.753 ± 0.05% respectively. Statistical analysis showed that there was no significant difference in acidity content of skim milk and whole milk cheese (Table 3). The results of this study agreed with the result of Ghosh and Singh (1996). They found that the acidity content of cheese was 0.75% which is similar to our experiment. Similar type of result also obtained by Zahan (2000) that acidity content of cheese prepared from cow's milk was 0.70% which is slightly lower than our control type.

Judging from the results of all parameters studied it is suggested that although quality of cheese prepared from whole milk showed

better performance but vegetable oil based cheese were also acceptable by the panelists for consumption. So, it is possible to prepare acceptable quality cheese by adding vegetable oil with skim milk and 50 g oil is optimum for making cheese.

In Bangladesh milk production is very short in comparison with requirement. For this reason whole milk is not available for cheese making. Sometimes, sweetmeat makers usually withdraw some portion of fat from their milk and use the remaining low quality milk for cheese making. As a results consumers are not getting quality product. This problem could be solved by using soyabean oil (30, 40 and 50 g kg⁻¹) with skim milk for manufacturing cheese. Soyabean oil is cheap and available in our market. By this way, the protein deficiency of Bangladesh could be solved and moreover it will open a new door in business sector.

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