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Studies on process standardization and organoleptic evaluation of sour cream

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Abstract
The present investigation focuses on standardizing the process for preparation of sour cream and its use in different food products. Sour cream was prepared by ripening of cream with the addition of lactic acid bacteria (*Lactobacillus acidophilus and Streptococcus lactis*) culture. The sensory characteristics of sour cream show that the sample with 6% culture (*L. acidophilus* & *S. lactis*) addition had highest overall acceptability and was better than other samples in terms of taste (8.5) and mouthfeel (8.5). Thus sample with 6% culture addition was selected for further research findings. Also, xanthan gum was added to the selected sample in various proportions i.e. 0.1%, 0.2%, 0.3% and 0.4%. The sample with 0.2% gum was rated high for overall acceptability. Hence, the sample of sour cream containing 6% culture and 0.2% gum was selected as the most acceptable. The microbiological characteristics of sour cream indicated that the total plate count of accepted sour cream sample was $2.7x10^8$, $4.3x10^8$, $5.8x10^8$, $7.5x10^8$, $8.6x10^8$ cfu/g for the sample on day of production and 8, 16, 24, 32 days after production respectively. Yeast and mold count was not detected till 8 days of storage period. The *coliform* was not detected in the sour cream throughout the storage period of four week. Further, the shelf life of sour cream is found to be for four weeks at the refrigerated storage condition.

Keywords: Sour cream, sour cream spread, sour cream salad, *Lactobacillus acidophilus, Streptococcus lactis*

Introduction
Milk provides essential nutrients and is an important source of dietary energy, high-quality proteins and fats. Milk can make a significant contribution to the required nutrient intakes for calcium, magnesium, selenium, riboflavin, vitamin B_{12} and pantothenic acid. India is the largest milk producing country in the world with 114 million tones milk production (Desai, 2010). Now India has been ranked as the first in total milk production. Out of the total milk produced, about 45 to 50 per cent is converted into indigenous dairy products. On the other hand, only 9 per cent of milk is converted into fermented type of milk products and this sector is showing an annual growth rate of more than 20 per cent per annum (Singh, 2006). Fermented milk products, known as cultured dairy products, or cultured milk products, are dairy foods that have been fermented with lactic acid bacteria. Fermented milk products, besides their nutritive value, have been reported to have therapeutic properties. They are supposed to be anticholesterolomic and anticarcinogenic. They are considered superior to non-fermented dairy products in terms of nutritional attributes as the micro flora present produce simple compounds like lactic acid, amino acids and free fatty acids that are easily assimilable. A lot of attention is being focused on fermentation technology with an aim to tap the possible health benefits conferred by microorganisms (Grajek *et al*., 2005) [5].

Sour cream is a smooth, heavy-bodied dairy product which is made by pasteurizing, homogenizing and ripening a light cream. The ripening is accomplished by means of a commercial starter containing *Streptococcus lactis*, together with other flavour-producing bacteria. The pleasant, mild-acid flavour and the smooth, firm body are mainly due to these microorganisms. This product is known on the market as cultured cream, cultured market cream, cultured sour cream and salad cream. Sour cream contains proteins that originate from milk. Consequently, all the goodness that is present in the case of milk proteins is also there in the case of sour cream proteins. Sour cream is good source of calcium, a mineral; body needs to boost bone health. Each half-cup serving of sour cream provides 13 percent of the daily recommended intake of calcium. In addition to its benefits to skeletal health, the calcium in this condiment is vital for the function of nerves, muscles and heart.

One serving of sour cream provides 12 percent of the daily recommended intake of riboflavin, also known as vitamin B_2, 13% of the phosphorus required each day. It is commonly used as a base for dips, salad dressings and sauces. It is eaten as a condiment on potatoes, chili, or with smoked salmon, as well as many other foods. Sour cream can be used in soups and works well in baked products like breads, cakes, pies and cookies. Sour cream has significantly less calories than mayonnaise and performs many similar functions. It has long been used in the culinary art in the preparation of many dishes and traditional foods.

Materials and Methods

Pure cultures of *Lactobacillus acidophilus and Streptococcus lactis* were purchased from National Chemical Laboratory, (NCL) Pune. The whole fresh and clean buffalo milk was obtained from local market.

Preparation of Cream

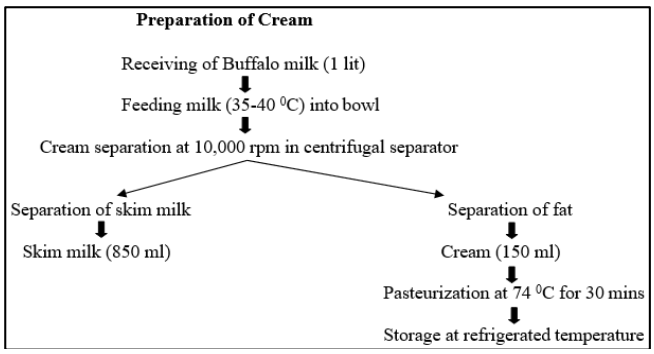

Chart 1: Preparation of cream using centrifugal separator

Standardization of cream

Fat content of cream obtained after the separation of skim milk was estimated by Gerber method. The standardization of cream fat to 19% was carried out by Pearson's square method (Sukumar de, 1991) [13].

Preparation of starter culture

The starter culture was prepared with the help of method described by Ghadge *et al*. (2008) [4] with suitable modifications.

Preparation of MRS medium Composition of MRS medium

All the ingredients were suspended in distilled water and heated to dissolve the medium completely. The medium was sterilized in autoclave at 15lbs pressure for 15 minutes (Deman *et al*., 1960) [3]. The Table.1 shows the composition of MRS medium.

Table 1: Composition of MRS medium

Ingredients	gms/lit
Protease peptone	10.0
Yeast extract	5.0
Beef extract	10.0
Dextrose	20.0
Polysorbate-80	1.0
Ammonium citrate	2.0
Sodium acetate	5.0
Magnesium sulphate	0.1
Manganese sulphate	0.05
Di-potassium phosphate	2
Distilled water	1 lit

Isolation of Lactic acid bacteria from curd

Serial dilutions (10 fold) were first made. Then the sample of curd after serial dilutions was inoculated into the nutrient broth and incubated at 37 ^{0}C for 24-48 hours. From nutrient broth the growth was transferred to the nutrient agar for separation of colonies. The selected colonies from nutrient agar were shifted to MRS broth subsequently to MRS agar for isolation and purification.

Purity of the cultures

The staining of the obtained pure cultures of *Lactobacillus acidophilus* and *Streptococcus lactis* was carried out by using Gram staining technique, catalase test, motility test and by determining the growth at 15 ^{0}C and 40 ^{0}C

Morphology and Biochemical Confirmation Tests

Table 2: Morphology and biochemical confirmation tests for *Lactobacillus acidophilus and Streptococcus lactis*

Biochemical Tests	*Lactobacillus acidophilus*	*Streptococcus lactis*
Morphology	Rods, pairs, chains	Cocci
Gram staining	+	+
Catalase test	-	-
Motility	-	-
Growth at 15 ^{0}C	-	+
Growth at 45 ^{0}C	+	-

Sub-culturing of pure culture

The pure cultures i.e. Lactobacillus acidophilus and Streptococcus lactis were sub-cultured on slants prepared from MRS media in a laminar air flow. The prepared slants were incubated at 37 ^{0}C for 24 hours. Growth of cultures was found on slants after 24 hours of incubation.

Preparation of inoculum

The inoculum for the development of sour cream was prepared with the help of method described in Beshkova *et al*. (1998) [2] with suitable modifications. The method involves the addition of pure culture to the buffalo milk. The loopful of cultures present on MRS slant were inoculated to the two different test tubes each containing of 10ml buffalo milk respectively. The test tubes were further incubated at 45 ^{0}C for 3 hours. Further the inoculum was added according to the formulation given in Table.3

Table 3: Standardization of LAB starter culture used in the preparation of Sour Cream

Ingredients	EC	A	B	C	D
Cream (g)	100	100	100	100	100
Milk (g)	48	48	48	48	48
Starter Culture	-	2	4	6	8

Table 4: Standardization of Xanthan Gum used in the preparation of Sour Cream

Ingredients	EC	A	B	C	D
Cream (g)	100	100	100	100	100
Milk (g)	48	48	48	48	48
Starter Culture	-	6	6	6	6
Xanthan Gum	-	0.1	0.2	0.3	0.4

Preparation of Sour Cream

Sour cream was prepared using mixed culture of *Lactobacillus acidophilus* and *Streptococcus lactis*. The formulation used for preparation of sour cream is mentioned in Table.3 which represents the variation in the concentration

of LAB cultures and Table.4 which represents the variation in the addition of xanthan gum in order to improve the texture of sour cream. Sour cream was prepared according to the procedure depicted by A.J. Kwan *et al*. (1982) [7] with suitable modifications and is presented in flow chart 2. The processing steps included- preparation of cream, standardization of cream fat to 18-19% fat, pasteurization, cooling, addition of culture and gum and incubation till the acidity of cream reaches upto 0.5%, packaging and storage at 2 ^{0}C. It required 20-22 hours to reach the acidity of sour cream upto 0.5%.

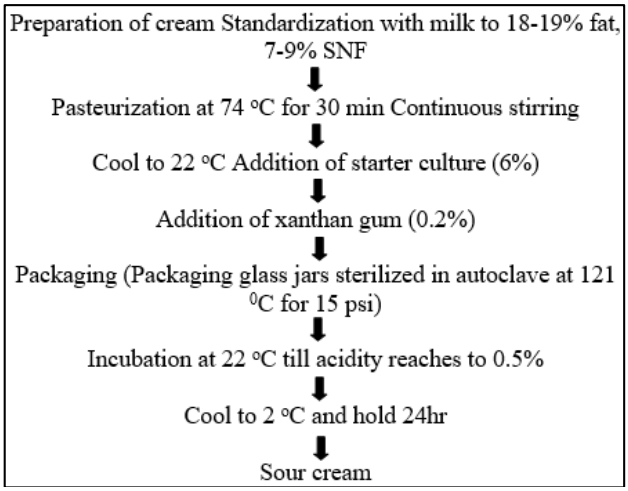

Chart 2: Preparation of Sour Cream

Results and Discussion

Proximate Analysis of Sour Cream

Table 5: Proximate Analysis of Sour Cream

Sr. No.	Chemical constituents	Cream	Sour Cream
1	Moisture	68.16	74.20 %
2	Crude fat	25	16 %
3	Crude protein	1.78	1.72 %
4	Ash	0.56	0.79 %
5	Carbohydrate	4.50	7.29 %
6	Calcium	111.03 mg/100g	111.10 mg/100g
7	Phosphorus	118.0 mg/100g	122.0 mg/100g
8	Magnesium	54.6 mg/100g	56.7 mg/100g
9	Potassium	90.7 mg/100g	104.5 mg/100g
10	Sodium	70.61 mg/100g	62.14 mg/100g
11	pH	4.0	4.5
12	Titratable acidity	0.3%	0.5%
13	Total solids	30%	25.8%
14	Solids-not-fat	6.8%	8.9%

The figures tabulated in Table 5 shows that the fat content of sour cream (16%) was less than the fat content of cream (25%). The reduction in fat may be due to the microbial activity of lactic acid bacteria. Also there was marginal change in protein content of cream and sour cream i.e. 1.78% and 1.72% respectively. Ash content indicates the mineral content of the food. The ash content of cream and sour cream was found to be 0.56% and 0.79% respectively. The moisture content of cream and sour cream was 74.20% and 68.16% respectively. Cultured products are digested more easily and, therefore, are more nutritious because the proteins, carbohydrates, and fats are predigested by bacterial cultures in their manufacture (Lipatov *et al*., 1978) [8].

It also indicates that cream contained calcium (111.03 mg/100g), phosphorus (118.0mg/100g), magnesium (54.6mg/100g), potassium (90.7 mg/100g) and sodium (70.61 mg/100g) while sour cream contained calcium (111.10 mg/100g), phosphorus (122.0mg/100g), magnesium (56.7 mg/100g), potassium (104.5 mg/100g) and sodium (62.14 mg/100g). Thus it was observed that sour cream contained higher amount of phosphorus followed by calcium, potassium, magnesium and sodium. Calcium content of cream and sour cream had marginal changes while sour cream contained higher amount phosphorus (122mg/100g) than cream (118.0 mg/100g) and higher amount of potassium (104.5mg/100g) than cream (90.7mg/100g). Sodium content of sour cream was reduced as compared to cream. Cream contained 70.61 mg/100g sodium while sour cream than 62.14mg/100g. The data obtained was in good accordance with the results reported by Khem *et al*. (1979) [6]. It has been observed that the pH, titratable acidity, total solids and solids-not-fat of prepared sour cream was found to be 4.5, 0.5 per cent, 25.8 per cent and 8.9 per cent respectively. The values recorded in the present study are in good accordance with the results patented by Pavey *et al*., (1976) [12].

Sensory Evaluation of Sour Cream

Sensory evaluation of the Sour cream prepared using different LAB culture concentration is tabulated in Table 6.

Table 6: Mean sensory values of Sour Cream prepared using different LAB culture concentration

Sample	Color	Taste	Flavour	Texture	Mouthfeel	Overall Acceptability
EC	8.2	8.0	8.0	8.0	8.1	7.8
A	8.3	8.0	8.1	8.2	8.2	8.1
B	8.2	8.3	8.2	8.2	8.3	8.3
C	8.3	8.5	8.4	8.3	8.5	8.4
D	8.2	8.0	8.1	8.1	8.2	8.0
SE±	0.0447	0.0418	0.0365	0.0329	0.0387	0.0274
CD @5%	0.0632	0.1259	0.1099	0.0991	0.1166	0.0824

It was found that there was no remarkable change in color of the sour cream samples. The mean score for color of the sour cream samples ranged from 8.2 to 8.3. It was observed that variation in LAB culture concentration does not affect the color of sour cream samples significantly. Taste in the food is usually affected by compositional changes during manufacture. It was observed that the mean score for the taste of sour cream samples varied in the range from 8.0 to 8.5. Sample C was rated high for taste parameter i.e. 8.5 followed by sample C (8.3). Rest of the samples were equally rated for taste parameter i.e. 8.0. Flavour means an overall integrated perception of taste and aroma associated with the product (Meilgaard *et al*. 2006) [10]. It was found that flavour was rated high for the sample C (8.4) followed by sample B (8.2). All the samples were rated high in flavour parameter as compared to experimental control. Texture is group of physical characteristics, sensed by mouthfeel. Sample C was rated highest in terms of texture parameter i.e. 8.4 followed by sample A (8.2) and sample B (8.2). Sample D was rated 8.1 followed by experimental control (8.0). The mean score for sample C was the highest i.e. 8.5 than the rest of samples. It was observed that the mouthfeel of sample C was 8.3 followed by sample A (8.2) and sample D (8.2) while the experimental control was rated 8.1. Overall acceptability is based on multiple organoleptic quality parameters i.e. color, flavour, taste, texture, etc and shows the accumulative

perception and acceptance by the panelist. Values tabulated in Table 7 indicates that the overall acceptability of sample C was the highest i.e. 8.4 followed by sample B (8.3), sample A (8.1), sample D (8.0). Experimental control was rated 7.8. Thus the overall acceptability of sample C (8.4) was found to be at par with the sample B (8.3) and significantly higher than sample A and sample D. Hence, sample C containing 6 per cent LAB culture was selected for the further investigation. The Figure 1 shows the graphical representation of sensory characteristics of sour cream prepared using different LAB culture concentration.

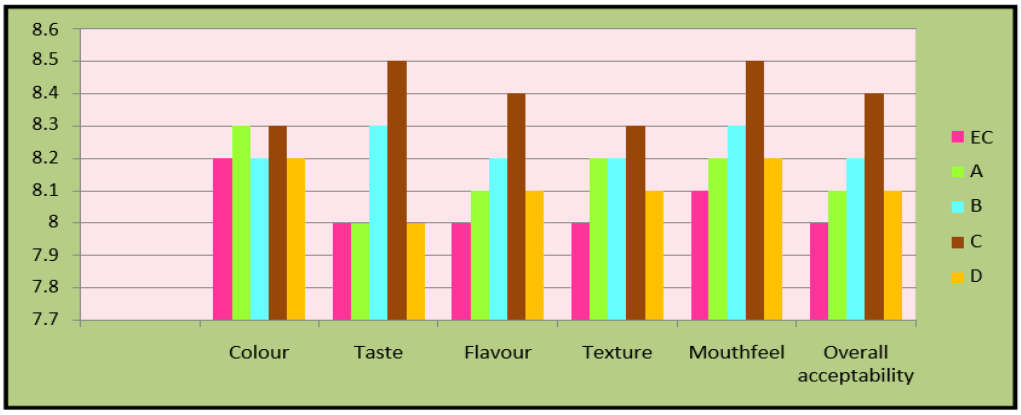

Fig 1: Sensory characteristics of Sour Cream prepared using different LAB culture concentration

Sensory Evaluation of Sour Cream with addition of Xanthan Gum

Sensory evaluation of the Sour cream prepared with addition of different concentrations of Xanthan gum is tabulated in Table 7.

Table 7: Mean sensory values of Sour Cream prepared with addition of Xanthan Gum

Sample	Color	Taste	Flavour	Texture	Mouthfeel	Overall Acceptability
EC	8.2	8.0	8.0	7.7	8.1	7.8
A	8.2	8.2	8.1	8.0	8.1	8.2
B	8.2	8.3	8.3	8.3	8.3	8.4
C	8.2	8.0	7.9	8.4	8.0	8.1
D	8.1	7.8	7.8	8.5	7.8	7.9
SE±	0.0428	0.0387	0.0447	0.0428	0.0447	0.0632
CD @ 5%	0.1289	0.1166	0.9658	0.1289	0.1346	0.1346

It was observed that there was no remarkable change in color of the sour cream samples with the addition of xanthan gum. The mean score was 8.2 for the experimental control, sample A, sample B and sample C respectively. The mean score for sample D was rated 8.1. It was found that the taste of sample B with 0.2% xanthan gum concentration was rated high i.e. 8.3 followed by sample A (8.2). The mean score for sample C and sample D were rated 8.0 and 7.8 respectively. Sample B was rated highest for the flavour parameter i.e. 8.3 followed by sample A (8.1), sample C (7.9), sample D (7.8). Experimental control was rated 8.0 for flavour. It was found that addition of xanthan gum enhanced the flavour upto the concentration of 0.2%. Texture was an important parameter to be considered when xanthan gum was being added to the sour cream. It was found that the sample D was rated the highest in texture parameter i.e. 8.5 followed by sample C (8.4), sample B (8.3), sample A (8.0). It was revealed that the texture was improved with the addition of xanthan gum in the sour cream. The sensory score was the highest for the sample B i.e. 8.3 while lowest for the sample D i.e. 7.8. It was found that the mean sensory score for sample A and sample C were 8.1 and 8.0 respectively. It was important to understand the overall acceptability of sour cream samples added with xanthan gum. The sensory score tabulated in Table 8 revealed that the sample B was rated highest for taste parameter while sample D was rated highest for the sample D among the rest of samples respectively. The changes in sensory score affected the overall acceptability of sour cream sample added with different concentration of xanthan gum. It was found that the overall acceptability of sample B was rated the highest i.e. 8.4 followed by sample A (8.2), sample C (8.1) and sample D (7.9). The Figure 2 shows the graphical representation of sensory characteristics of sour cream prepared with addition of xanthan gum.

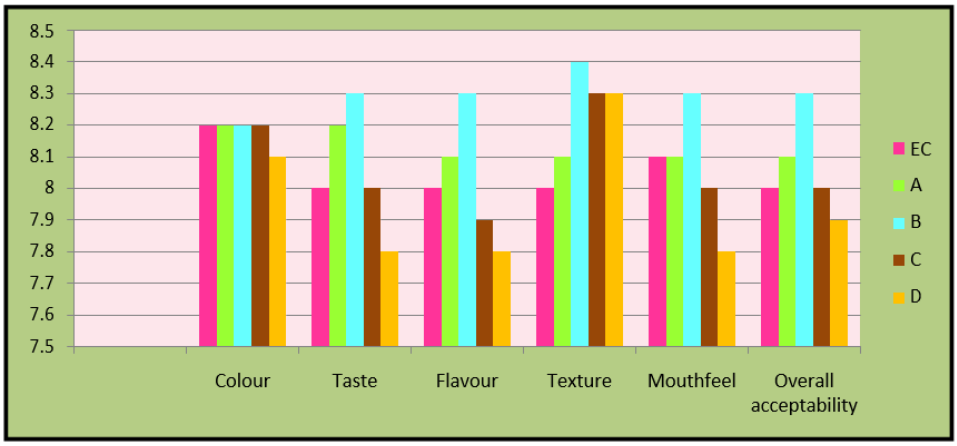

Fig 2: Sensory characteristics of Sour Cream prepared with addition of Xanthan gum.

Textural Evaluation of Sour Cream with addition of Xanthan Gum

Textural properties of sour cream prepared with addition of different xanthan gum concentration were studied. Textural characteristic i.e. hardness was evaluated using TA-XT Texture Analyzer. Hardness of sour cream samples is depicted in Table 8.

Table 8: Textural Evaluation of Sour Cream prepared with addition of Xanthan Gum

Sr. No.	Sour Cream samples	Hardness (kg)
1	EC	0.060
2	A	0.101
3	B	0.103
4	C	0.113
5	D	0.115

From Table 8, it has been revealed that the hardness of experimental control having no xanthan gum added had hardness 0.060 kg while sample D was 0.113 kg followed by sample C (0.115 kg), sample C (0.113 kg), sample B (0.103 kg), sample A (0.101 kg). It was observed that hardness of sample increased with addition of xanthan gum.

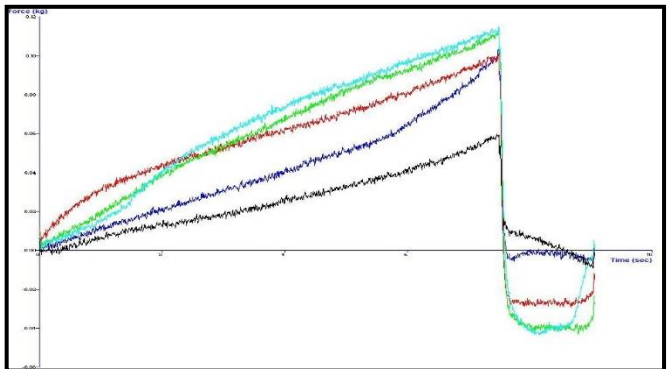

Fig 3: Textural Analysis of Sour Cream prepared with addition of Xanthan gum

Microbial characteristics of Sour Cream

The accepted sour cream sample was subjected to microbial studies for total plate count, yeast and mold count and *Coliform* growth after production and during the storage period as per the method given in the manual of methods of analysis of foods (2012). Microbial characteristic of accepted sour cream sample is tabulated in Table 9.

Table 9: Microbial characteristics of Sour Cream

Storage (in days)	Total Plate Count (CFU/g)x10^8	Yeast and Mold count (CFU/g)x10^3	Coliform Count
0	2.7	ND	ND
8	4.3	ND	ND
16	5.8	3	ND
24	7.5	5	ND
32	8.6	6	ND

The values of Table 9 shows the microbial characteristics of accepted sour cream sample during storage under refrigerated condition. It was revealed that total plate count of the accepted sour cream sample was the highest (8.6 x10^8) after the 32 days of storage at refrigerated condition while it was lowest (2.7 x10^8), on the production day. Data presented in Table 10 indicated that total plate count of accepted sour cream sample was 2.7 x10^8, 4.3 x10^8, 5.8x10^8, 7.5 x10^8, 8.6 x10^8 cfu/g on day of production, 8,16, 24, 32 days after production respectively. Yeast and mold count was not detected till 8 days of refrigerated storage condition while 3 x10^3, 5 x10^3, 6 x10^3 cfu/g was detected for 16, 24 and 32 days refrigerated storage condition. *Coliform* was not detected after production and throughout the refrigerated storage period of 32 days in acceptable sample of sour cream. It meant that the accepted sample of sour cream was safe for consumption for the 32 days with the total plate count of 8.6 x10^8cfu/g.

Theoretical energy value of Sour Cream

Theoretical energy value of acceptable sample of sour cream was determined by addition of energy value obtained from crude fat, crude protein and total carbohydrates. Table 10 summarizes the energy value i.e. 180.04 kcal of acceptable sample of sour cream.

Table 10: Theoretical Energy Value of Sour Cream

Parameter	Energy value (kcal)
Protein	6.88
Crude fat	144
Carbohydrate	29.16
Total energy	180.04

Conclusion

Sour cream was prepared by ripening of cream with the addition of lactic acid bacteria (*Lactobacillus acidophilus and Streptococcus lactis*). The sample of sour cream containing 6% culture and 0.2% gum was selected as the most acceptable. Sour cream thus produced was found to be high in nutritional content with respect to carbohydrates. Sour cream spread can be a good substitute for mayonnaise which is high in fat content. Further, the shelf life of sour cream is found to be for four weeks at the refrigerated storage condition.

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