

## Evaluation of Physico Chemical and Sensory Properties of Developed Probiotic Reduced Fat Cream Cheese

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### ABSTRACT

*Cream cheese is a soft, mild, rich, creamy white, slightly acidic, unripened cheese with diacetyl flavour. It can be used as a substitute for butter. The focus of the present investigation was to develop reduced fat probiotic cream cheese (RFCC) to increase health benefits and functionality by using *Lactobacillus helveticus* as the probiotic organism added at 1% and 2% rates. It has the potential to produce bioactive peptides or bacteriocins, and exert synbiotic effect when associated with prebiotics in fermented dairy products. Overall acceptability of RFCC with 1% probiotic was significantly ( $p < 0.05$ ) higher than 2% probiotic added cheese. As level of probiotic addition increased, the spreadability of cheese decreased significantly ( $p < 0.05$ ) and firmness increased significantly ( $p < 0.05$ ). It was also observed that acidity of cheese increased significantly ( $p < 0.05$ ) with increase in probiotic levels. RFCC with 4% inulin and 1% probiotic was selected as final developed product.*

**Keywords:** *Reduced fat Cream cheese, Probiotic, *Lactobacillus helveticus*, Overall acceptability, spreadability.*

### INTRODUCTION

Cream cheese is one of the most popular soft cheeses in North America. It is a soft, mild, unripened cheese and is a creamy white, slightly acidic product with a diacetyl flavor. It is usually manufactured by the coagulation of cream or mixture of milk and cream by acidification with starter culture (Phadungath, 2005). Cream cheese is a product which has potential of gaining popularity among the

Indian consumers. It is used widely as a spread to replace butter which contains min 80% fat. The high fat level in butter not only increases its cost but also makes it unsuitable for those who are fat conscious (Katsiari et al., 2002). Because of its lower cost of production and better nutritional value, there is a need to popularize the use of cream cheese among the health conscious consumers.

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To render the cream cheese healthier, reducing the fat content without compromising its typical flavour and texture using fat replacers is a better option (Huyghebaert et al., 1996; Akin et al., 2007). Addition of inulin to different kinds of cheese can be beneficial in the manufacture of a reduced or low-fat, texturized, symbiotic products (Karimi et al., 2015).

Probiotic foods are a group of functional foods with growing market shares and large commercial interest (Arvanitoyannis et al., 2005). The term probiotic means “for life” and it was defined by an Expert Committee as “live microorganisms which upon ingestion in certain numbers exert health benefits beyond inherent general nutrition” (WHO/FAO 2001). *Lactobacillus* and *Bifidobacterium* are most commonly used probiotics in food and feed. For the use of LAB as probiotics, some desirable characteristics such as low cost, maintaining its viability during the processing and storage, facility of the application in the products, resistance to the physicochemical processing must be considered. Probiotics can be found in a wide variety of commercial dairy products including sour and fresh milk, yogurt, cheese, etc. Dairy products play important role in delivering probiotic bacteria to human, as these products provide a suitable environment that support their growth and viability (Phillips et al., 2006). Several studies have demonstrated a high survival rate of probiotics in cheese at the end of shelf life and high viable cells (Phillips et al., 2006; Makelainen et al., 2009). Fresh cheese like cottage cheese, cream cheese has high recommended daily intake, limited shelf life with refrigerated storage temperature. It may, thus, serve as a food with a high potential to be applied as a carrier for probiotics (Makelainen et al., 2010).

*Lactobacillus helveticus* are gram positive, catalase-negative, non sporeforming, rod shaped (diameter from 0.5 to 1 micrometer) thermophilic lactobacilli and belongs to the group of acetic acid bacteria (LAB). *Lactobacillus helveticus* is traditionally used in the manufacture of Swiss-

type cheeses and long-ripened Italian cheeses such as Emmental, Gruyere, Grana Padano and Parmigiano Reggiano and it is the prevalent species recovered from natural lactic starter cultures used for the production of typical Italian cheese. It has the potential to produce bioactive peptides or bacteriocins, and exert synbiotic effect when associated with prebiotics in fermented dairy products. *Lactobacillus helveticus* can therefore be considered as a multifunctional LAB with increasing importance in the food industry (Giraffa, 2014). It is also known for its anti-hypertensive properties due to the production of significant levels of bioactive tripeptides that are known to inhibit the angiotension converting enzyme (ACE).

The objective of the present study was to investigate the possibility of using probiotic organism (*Lactobacillus helveticus*) in the manufacture of reduced fat cream cheese, and the effect of addition on sensory, textural and physico-chemical properties of the developed reduced fat cream cheese (RFCC).

## MATERIALS AND METHODS

### Materials

Skim milk and Cream (40% fat) were procured from experimental dairy plant SRS of ICAR-NDRI, Bengaluru. Freeze dried lactic mesophilic DVS starter culture (*Lactococcus lactis*, *Lactococcus cremoris*, *Lactococcus diacetylactis*) from M/s. DSM was used. Probiotic culture (*Lactobacillus helveticus* (NCDC 288)) was obtained from NCDC – NDRI, Karnal. Analytical grade (AR) chemicals obtained from various reputed companies were used for chemical analysis. Glassware of Borosil brand was used for the analysis of cream cheese.

### Preparation of Cream cheese

Cream cheese was prepared as per the method described by Guinee et al. (1993) with slight modifications. Reduced fat cream cheese (RFCC) was prepared by fermentation of cream (40% fat) and skim milk separately using 0.03% lactic mesophilic DVS culture and probiotic culture (*Lactobacillus helveticus*) at the rates of 1 and 2%

respectively followed by straining with muslin cloth and hanging them for 12-13 hours at 7-8°C. Curd mass and fermented cream were then mixed in 3:1 and 6:1 ratio for the preparation of control and reduced fat cream cheese respectively. Heated and cooled 4% inulin was incorporated. Common salt of 0.5% was added and the mix was mixed thoroughly. It was then packed in 100 ml polypropylene cups with lid and was kept in cold condition to study the effects of probiotic inoculum incorporation on sensory, textural and physico-chemical properties of cream cheese.

### Analyses

#### Sensory Evaluation

Cheese samples were evaluated for sensory attributes viz. flavour and taste, body and texture, colour and appearance and overall acceptability by sensory panellists (minimum of 6 members) on a 9- point hedonic scale (9 = like extremely; 1 = dislike extremely) (Amerine et al., 1965). Duo-trio tests were used to determine a candidate's ability to detect differences among similar products with different ingredients. The judged parameters were flavour; consistency; colour and appearance and overall acceptability. Water was provided for mouth washing between evaluations of samples.

#### Textural analysis

Textural properties of Cream cheese were determined using a TA.XT plus texture analyzer (Stable Micro Systems Ltd., Godalming, UK). The measurements were performed using a Perspex spreadability rig which consisted of a set of precisely matching 60° Perspex cone probe and the cone shaped sample holder. The cone sample holder was filled with about 20 g Cream cheese and the cone probe was allowed to penetrate into the sample @ 3 mms-1 to a depth of 18 mm and return back to the original position @ 10 mms-1 (post-test speed). During the penetration, the resistance force encountered by the probe in spreading the sample out of the cone sample holder was measured and plotted as a liner scale versus time taken by the probe. Maximum positive force on positive peak was measured as a Firmness (N). The area of the positive peak of the plot measured as N.s and

its inverse was taken as spreadability (N.s-1). Similarly, area of negative peak was recorded as Index of viscosity (g.s). The samples stored in refrigeration were tempered for 30 min at room temperature before performing the tests.

#### Acidity

Acidity in cream cheese was determined as described in AOAC 920.124 (2005).

#### pH

The pH of cream cheese was measured as described in this study (Awad et al., 2005).

#### Moisture

Moisture content of cream cheese was estimated by gravimetric method (IS, SP: 18 Part XI, 1981).

#### Statistical analysis

Data obtained during the present project work were subjected to one way ANOVA and computations were made by employing SPSS statistical software.

## RESULTS AND DISCUSSION

### Optimizations of Probiotic level for the preparation of reduced fat cream cheese

The effects of 1 and 2% probiotic organism (*Lactobacillus helveticus*) addition on sensory, texture and physico chemical properties were studied as mentioned below.

#### Effect on sensory attributes

Flavour and taste were maximum in control followed by RFCC with 1% and 2% probiotic (Table 1). The flavour and taste was significantly ( $p < 0.05$ ) different among all the cheeses. The body and texture of reduced fat cream cheese (RFCC) with 1% probiotic culture showed significantly ( $p < 0.05$ ) higher attributes than that of made with 2% probiotic. This may be due to excessive addition of probiotic culture causes localized coagulation resulting in granular and firmer texture of the product. Colour and appearance of the cheeses did not show any significant ( $p > 0.05$ ) difference. It was also observed that overall acceptability of RFCC with 1% probiotic was significantly ( $p < 0.05$ ) higher than 2% probiotic added cheese. However no significant ( $p > 0.05$ ) difference was observed between control and 1% probiotic incorporated cheese.

Table 1: Effect of probiotic level on the sensory attributes of cream cheese

Sensory attributes	Control	Probiotic levels	
		1%	2%
Flavour and taste	7.75±0.11 <sup>b</sup>	7.41±0.17 <sup>ab</sup>	7.08±0.23 <sup>a</sup>
Body and Texture	7.93±0.18 <sup>b</sup>	7.75±0.35 <sup>b</sup>	7.25±0.30 <sup>a</sup>
Appearance and colour	7.83±0.23 <sup>a</sup>	7.66±0.47 <sup>a</sup>	7.28±0.07 <sup>a</sup>
Overall acceptability	7.86±0.04 <sup>b</sup>	7.71±0.07 <sup>b</sup>	7.25±0.11 <sup>a</sup>

The decrease in the overall acceptability with 2% probiotic culture may be due to the higher acid production masking the typical diacetyl flavour and also increased granularity thereby reducing its textural appeal.

#### Effect on textural attributes

Firmness was observed to increase with the increase of probiotic level in cheese (Fig 1A). Firmness of 2% probiotic added cheese was significantly ( $p < 0.05$ ) higher than control while no significant ( $p > 0.05$ ) difference was observed between 1% probiotic added cheese

and control. As the level of probiotic increased, the spreadability (Fig 1B) of cheese decreased significantly ( $p < 0.05$ ). No significant difference was observed between 1% probiotic added cheese and control. Index of viscosity (Fig 1C) decreased with probiotic level but decrease was not significant ( $p > 0.05$ ). Similar observations were reported by Akin and Kirmaci (2007). This may be due to excessive addition of probiotic culture causing localized coagulation resulting in non-uniform, granular and firmer texture of the product.

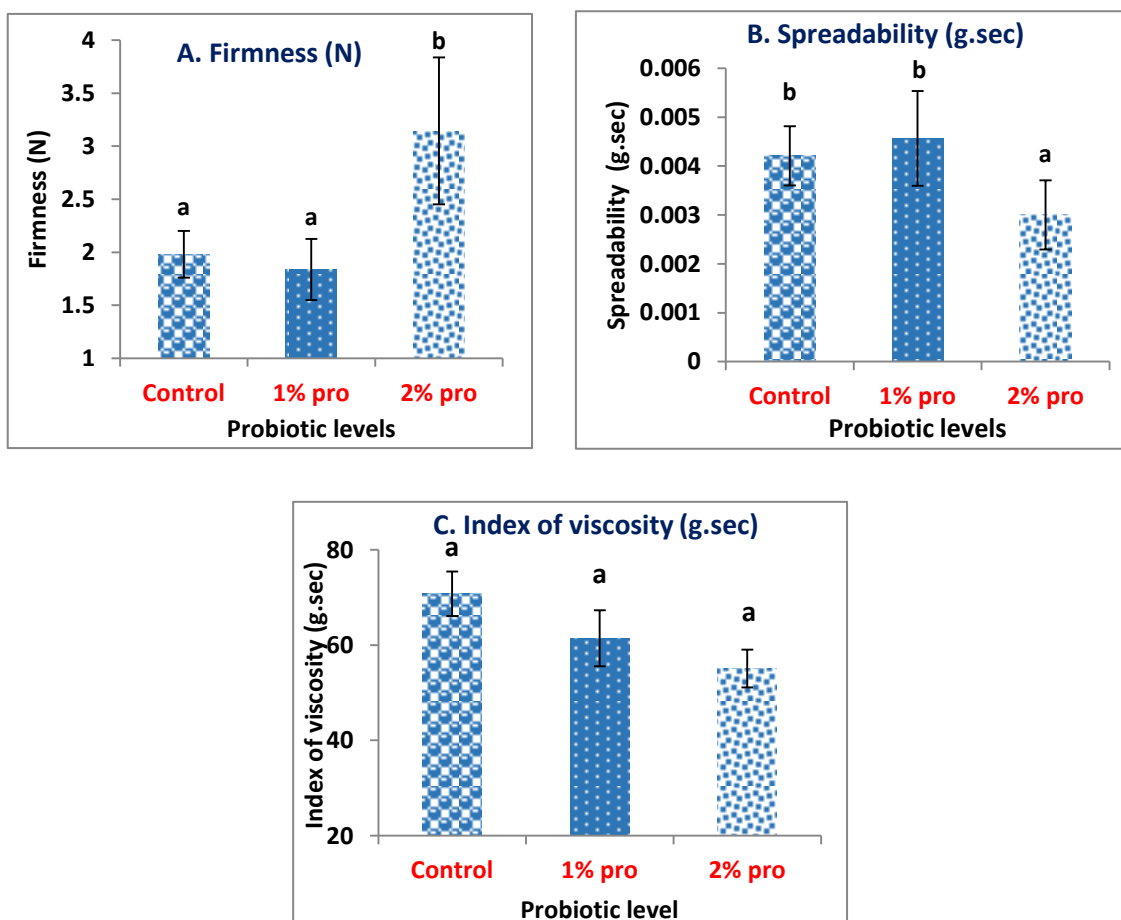


Fig. 1: Effect of probiotic level on the textural properties of cream cheese

The above observations implies that higher level of probiotic culture have significant effect on textural parameters of cheese. Similar results were observed in Minas fresh cheese where excessive level of probiotic causes increase in hardness, chewiness, and gumminess significantly ( $p < 0.05$ ) (Buriti et al., 2004).

#### Effect on the physico chemical attributes

Moisture content of developed RFCC decreased with the increase in probiotic levels

but decrease was non significant ( $p > 0.05$ ) between the two levels (Table 2). Probiotic incorporated cheese showed significantly ( $p < 0.05$ ) higher moisture content than control cheese. It was also observed (Table 2) that acidity of cheese increased significantly ( $p < 0.05$ ) and pH decreased significantly ( $p < 0.05$ ) with increase in probiotic levels. While no significant difference ( $p > 0.05$ ) was observed between 1% probiotic incorporated cheese and control.

**Table 2: Effect of probiotic level on the Physico-chemical attributes of cream cheese**

Physico-chemical parameters	Control	Probiotic levels	
		1%	2%
Moisture	75.98±0.15 <sup>a</sup>	78.53±1.02 <sup>b</sup>	76.54±0.38 <sup>b</sup>
Acidity	0.50±0.05 <sup>a</sup>	0.64±0.10 <sup>ab</sup>	0.86±0.10 <sup>b</sup>
pH	4.76±0.13 <sup>b</sup>	4.72±0.16 <sup>b</sup>	4.62±0.09 <sup>a</sup>

Fox et al., (2000) reported that decreases in pH and moisture are due to reduce micelle charge and increase hydrophobicity of casein. It has been proposed that hydrophobic and ionic interactions within the casein network are probably responsible for the advanced stages of syneresis.

#### CONCLUSION

The present study was successful in developing reduced fat probiotic cream cheese with the addition of 1% culture of *Lactobacillus helveticus*. The two levels of probiotic differed significantly ( $p < 0.05$ ) in flavour as well as body and texture. Overall acceptability of RFCC with 1% probiotic was significantly ( $p < 0.05$ ) higher than 2% probiotic added cheese. As level of probiotic addition increased, the spreadability of cheese decreased significantly ( $p < 0.05$ ) and firmness increased significantly ( $p < 0.05$ ). Index of viscosity decreased with probiotic level but the difference was non-significant ( $p > 0.05$ ). Probiotic incorporated cheese showed significantly ( $p < 0.05$ ) higher moisture than control cheese. It was also observed that acidity of cheese increased significantly ( $p < 0.05$ ) and pH decreased significantly ( $p < 0.05$ ) with increase in probiotic levels. Flavour, body and texture, overall

acceptability and spreadability of the cheese made with 1% probiotic were similar to that control cheese.

Based on the sensory, textural and physico-chemical characteristics, the cream cheese prepared with 1% probiotic was adjudged better than 2% probiotic. Addition of *Lactobacillus helveticus* as probiotic also exhibits health benefits such as anti hypertensive property. Therefore, use of 1% probiotic was selected and this can thus serve as a suitable healthy alternative to butter and spreads. Further studies can be conducted to establish the anti hypertensive properties of the product. This reduced fat probiotic cream cheese is thus a definitely a go to product for today's modern health conscious customers.

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#### Conflict of interest

The authors do not have any conflict of interests with the contents in the paper.

#### Ethics Statement

This research did not include any human subjects and animal experiments.

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