Development of Dates (*Phoenix dactylifera*) Incorporated Probiotic Ice Cream

S.N.P Gunawardena, A.M.N.L Abesinghe
Uva Wellassa University, Badulla, SriLanka

and

K.I.U. De Silva
Ceylon Cold Stores PLC, Ranala, Kaduwela, SriLanka

Introduction

Ice creams are considered as sweetened frozen confectionaries. Today ice creams are modified as functional foods such as probiotic ice cream, low fat ice cream and ice creams with low sugar which deliver the nutritional and medicinal value to the consumer. However, ice cream that is enriched with nutritional and medicinal properties is rarely found in Sri Lankan food industry. Therefore, this study was conducted to fill the gap in Sri Lankan food industry by replacing the cane sugar in ice cream with Dates (*Phoenix dactylifera*) and by incorporating *Lactobacillus acidophilus* (LA-5 ,®CHR Hanson, Denmark) as the probiotic bacteria. Date fruits (*Phoenix dactylifera*) were incorporated in premium quality dairy ice cream as Cane sugar substitute with the aim of enriching the product with nutritional and medicinal values of Dates. Dates are having total sugar content of 60 -70 g/ 100 g with higher amount of fructose (Anne *et al.,* 2005). Fructose is known as high intensity sweetener (1.7 sweetening power compared to sucrose) with lower glycemic index (Batia et al., 2008). Dates are rich with dietary fiber, vitamin A, B_1, B_2, C, iron, potassium, calcium and polyphenols (FAO, 1993). Furthermore, *Lactobacillus acidophilus* is considered as a probiotic starter culture which confers many health benefits to the consumers by enhancing the microbial balance of the gastro-intestinal tract. Therefore, this study was carried out to develop a Dates incorporated probiotic ice cream.

Methodology

Research was carried out at Ceylon Cold Stores PLC (CCS), Ranala, Kaduwela. Laboratory analyses were done at CCS and Uva Wellassa University laboratories. Initially, the basic composition of the ice cream was determined. Three preliminary studies were performed to develop the structure of the ice cream as; selecting the best form and level of Dates incorporated in to ice cream and selecting the best level of fat and stabilizer/emulsifier. Three types of Dates were tested as Date pulp, powdered Dates and commercial Date syrup. Best combination of Dates and sugar for ice cream was determined by combining those in different combinations within the range of 13.3% and 28.52%. The best combination was selected by a sensory evaluation using seven trained panelists. After the preparation of ice cream with appropriate texture, two types of flavours; Date flavour (Akras ® AU 16668) and Rum flavour (Aromco ® NN15020)were incorporated in to Dates ice cream. Sensory evaluation was conducted to select the most preferred type of flavour in Dates incorporated ice cream. Selected ice cream was used to develop probiotic Dates ice cream by incorporating *Lactobacillus acidophilus* culture according to the method described by Hekmat and McMahon, 1992.

Probiotic culture was incorporated in to ice cream after ageing and heat treatment. Ice cream was aged at 4 °C for overnight. Then aged mix was subjected to heat treatment at 82 ºC for 30 seconds and allowed for cooling to 40 ºC. Then it was inoculated with 5-6 granules of freeze dried *Lactobacillus acidophilus* culture. Incubation was done at 37 °C for five hours in incubator. Incubated mix was then subjected for cooling process. When the temperature of the mix decreased to 4 °C, it was beaten until desired overrun was achieved. Finally, ice cream was filled into containers and hardened at -18 ºC. Total viable cell count of *Lactobacillus acidophilus* was determined to find out the survival rate under -18 °C using MRS agar (CM 0361, Oxoid Ltd, Hampshire, UK). Then, probiotic incorporated Dates ice cream and Date ice creams without probiotics were subjected to a sensory evaluation using seven trained panelists.

Selected type of Dates ice cream was further analyzed for its physicochemical properties and microbiological quality. Proximate composition of the final product was analyzed for fat, total solids, moisture content, crude protein, and ash. Furthermore, Milk Solid Non Fat (MSNF), Brix° and pH were measured. Microbiological analysis was done for *Escherichia coli,* Aerobic Plate Count (APC), Yeast and Mold. Date pulp was analyzed for physiochemical properties and microbiological quality. Melting rate for Dates ice creams were determined and the effect of percentage of Dates and percentage of stabilizer/emulsifier on melting rate were analyzed. Sensory data were analyzed according to the Friedman test using MINITAB 14 software package. Data obtained from melting tests were analyzed by analysis of variance (ANOVA) using SAS 9.1 software package. Complete Randomized Design was conducted for analysis at $p< 0.005$ level of significance.

Results and Discussion

Date pulp was selected as the best form of Dates to incorporate in ice cream. According to the sensory evaluation, there was significant difference ($p<0.005$) among treatments. Treatment consisted with 13.3% of Dates and 8% of Cane sugar was selected as the best combination since Sweetness and taste was accepted by the panelists. The level of fat and stabilizer/emulsifier which gave the desirable texture to the product was 12% and 0.25% respectively. There was a significant difference ($p<0.005$) among taste, texture and overall acceptability of ice cream incorporated with Date and rum flavor. However, panelists prefer ice cream without flavor (control) than with flavors.

According to the sensory evaluation, Dates incorporated ice cream without probiotics was preferred by the panelists over probiotic ice cream. There was a significant difference ($p<0.005$) among taste, aroma, texture and overall acceptability of two treatments. This may be due to the slight yoghurt flavor imparted on ice cream by fermentation of lactose during incubation. The composition of Date incorporated ice cream without probiotics is given in Table 1.

Table 1. Proximate composition of final Dates ice cream

Constituents	Composition (%) w/w
Fat	12.00
MSNF	8.01
Total solids	38.40
Moisture	68.60
Crude protein	3.50
Crude ash	0.966
pH	5.95
Brix°	30.95

Results obtained from Microbiological analysis of Dates incorporated ice cream, Date pulp and Probiotic incorporated Dates ice creams were within the SLSI requirements.

The study has proved that 13.3% of Dates may give the appropriate sweetness, taste and texture in ice cream. Other combinations were rejected because of extreme sweetness, higher viscosity in ice cream and undesirable color. Both overall acceptability and the survival of *Lactobacillus acidophilus* of probiotic ice cream under -18 C was low ($P<0.005$) compared to the recommended level. According to the results, average viable probiotic count was $5.5x10^4$ CFU/mL. Recommended minimum viable cell count to exert a health benefit on the host is 10^6 CFU/mL. Therefore, Dates incorporated ice cream without probiotic was selected as the best treatment. Furthermore, the composition of selected ice cream was 12% fat, 8.0% MSNF, 0.25% stabilizer/emulsifier, 13.3% Dates and 8% Cane sugar. According to the melting rate analysis, it was identified that melting rate of the ice cream has decreased with increasing of content of Dates in ice cream and stabilizer/emulsifier level. Cost analysis indicated that 1 L of Date incorporated ice cream can be manufactured at a cost of Rs. 213.74.

Conclusion

Dates incorporated ice cream can be manufactured with 13.3% of Dates and 8% cane sugar. Level of cane sugar can be replaced up to 7% from the 15% of total sugar requirement with Dates.

References

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