Development of a Rice Based Ice Cream and Determination of Its Quality Parameters

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Abstract

Ice cream is a frozen dessert usually made from dairy products combined with sugars, emulsifiers, colours, and flavours. Soy ice cream is the only alternative non-dairy frozen dessert available in Sri Lanka and it is the alternative frozen dessert available for the people who are lactose intolerant or who do not eat dairy for other reasons. Since rice is the staple food of Sri Lankans and as the major food grain with high nutritive value, it is important to introduce a novel rice based food product with improved properties. Therefore, the objective of this study was to develop a frozen dessert using rice as the major ingredient. First experiment was conducted to evaluate the effect of total solid content of rice milk (4%, 6%, 8%, 10% w/w) on the organoleptic properties of rice ice cream while keeping other ingredients constant. Best treatment was selected through sensory evaluation using thirty untrained panellists. Sensory data revealed that consumer preferred the ice cream made with 6% total solid containing rice milk with respect to colour, creaminess, flavour, and melting quality. Based on the best formula of the first experiment, the effect of different types of oil/fat and their incorporation levels were evaluated by the second experiment. For this purpose, three types of oil/fat (coconut oil, sunflower oil, butter) with different incorporation levels (4%, 6% w/w) were tested. Sensory data revealed that consumer preferred 4% butter incorporated ice cream with respect to colour, creaminess, flavour, and melting quality. Final product was also compared with commercially available milk ice cream and soy ice cream in terms of physicochemical (total solid content, fat content and mass) and nutritional properties. The mass of the product was compatible with requirements of sri lanka standard for ice cream (SLS 223, 1889). According to the results a good qullity rice based ice cream could be produced using rice milk with 6% total solid content and 4% butter content.

Key words: Butter, Frozen dessert, Ice cream, Rice, Total solid

Introduction

Ice cream is frozen foam that consists of air cells dispersed in an aqueous matrix (Marshall *et al,* 2003). Usually ice cream is made from dairy product, such as milk and cream, and often combined with sugars, emulsifiers, colours, and flavours. Traditionally, it has been considered as a luxury product that is essentially eaten for enjoyment. However, today the dairy-based ice creams are very popular among all people in every community in Sri Lanka. Non-dairy ice cream is a common product in many countries. These are frozen products, which differ from ice cream in that the milk fat and milk solids are replaced with suitable vegetable fats and non dairy milk solids. Soy ice cream, made from soy milk is the only alternative non-dairy frozen dessert available in Sri Lanka and it is highly accepted by Sri Lankans. Since rice is the staple food of Sri Lankans and as the major food grain with high nutritive value, it is important to introduce novel rice-based food products with improved characteristics. Therefore, this study was carried out to develop a rice based frozen dessert with higher consumer preference.

Materials and Methods

The first experiment was carried out to determine the most appropriate total solid content of rice milk in the formulation of rice ice cream. Rice ice cream was prepared using rice milk with four different rice solid contents (4%, 6%, 8%, and 10% w/w) while keeping other ingredients of the mix constant. The mix composition was 100g rice milk, 6g coconut oil, 24g sugar, 2g glucose syrup 0.1g lecithin, 0.5g milk flavour, 0.5g vanilla flavour, 0.03g colouring.

Rice milk, oil and lecithin were mixed well and heated with sugar and glucose syrup while stirring. When the

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consistency of the mix became thick, heating was stopped and allowed to cool. As the temperature of the mix reached the room temperature (31±3 °C), colouring, flavourings were added and freeze at -20±3 °C for 2½h. Then it was mixed again and continued freezing and mixing twice at 30 min. intervals and finally before saving it was freeze for 1h. Products were evaluated using five-point hedonic test considering the sensory quality attributes of colour, flavour, creaminess, melting quality in the mouth, and overall acceptability.

According to the results of first experiment the effect of different types of oil/fat and their incorporation levels were evaluated by the second experiment. For these purpose three types of oil/fat (coconut oil, sunflower oil, butter) with different incorporation levels (4%, 6%) were prepared same as first experiment and products were tested based on the sensory quality attributes of colour, flavour, creaminess, melting quality in the mouth, and overall acceptability.

Selected product was also compared with commercially available milk ice cream and soy ice cream in terms of nutritive value AOAC(2000), total solid %(SLS 753,1988), fat % and mass(g/l)(SLS 223,1989).

Randomized complete block design was used to evaluate the sensory effects and data were analyzed by the Friedman test of the MINITAB statistical package. Mean comparisons were done by using Duncan's multiple rang tests. Completely randomized design (CRD) was used to evaluate the physicochemical parameters and data were analyzed by SAS statistical package (SAS Institute Inc. 2000) using ANOVA.

Results and Discussion

The total solid content of rice milk significantly ($p<0.05$) affected the organoleptic properties namely creaminess and melting quality. The physical, functional, and sensory properties of ice cream influence the consumer's perception and acceptance of an ice cream. According to Rothwell (1985) a desirable ice cream should have good flavour, body and texture, colour, and melting characteristics. The formula with the rice milk of 6 % total solid content gave the most satisfactory results for all quality attributes (Fig. 1). The level of total solid content of rice milk couldn't be increased more than 6% because of the starchy nature may affect the mouth feel.

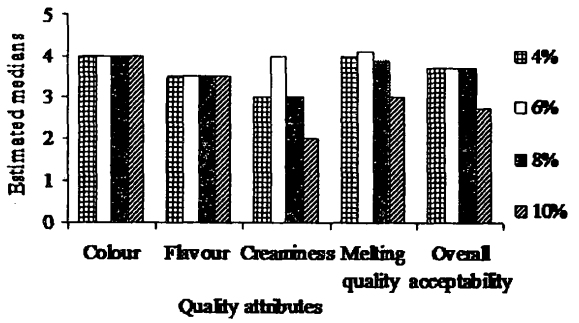

Figure. 1. Effect of total solid content of rice milk on the sensory quality of rice ice cream

The type and level of the fat/oil did not affect the sensory properties such as colour, creaminess, and melting quality but they affected the flavour and overall acceptability of the product. The samples with butter had the highest sum of ranks, but they were not significantly different ($p>0.05$) from sun flower oil for the quality parameters of flavour and overall acceptability (Fig. 2). However the samples with 6% fat /oil gave oily mouth feel compared to the 4 % fat/oil level. It has been reported that ice cream prepared from 100% coconut oil as the fat phase and found that, although the ice cream was processed well, had a waxy texture making it unpleasant to eat. Considering all these facts 4 % butter level was selected for the product and the final formulation was selected as 100g rice milk with 6% total solid, 4g butter, 24g sugar, 2g glucose syrup 0.1g lecithin, 0.5g milk flavour, 0.5g vanilla flavour, and 0.03g colouring.

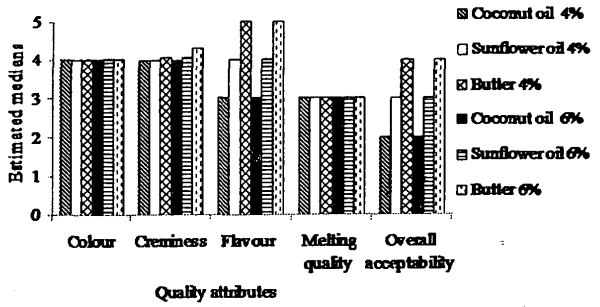

Figure. 2. Effect of different types of oil/fat on the sensory quality of rice ice cream

Table 1 represents nutritional and physico-chemical properties of rice ice cream compared to the commercial soya and milk ice cream. The total solid content of the rice ice cream was significantly ($p<0.05$) lower than that of milk ice cream but higher than soya ice cream. According to the SLS specifications (SLS 223, 1989) for milk ice cream the minimum level of total solid is 32% and according to this, except milk ice cream others were bellow the limit. However according to the sensory results the rice content, fat content or sugar content that affect to the total solid contents couldn't be increased higher than the acceptable level. The fat and protein contents of the developed product were also lower than those of the milk ice cream. The mass of the developed products were within the SLS requirement (min. 475 g/l) for milk ice cream (SLS 223, 1989). The milk ice cream showed least mass and soya ice cream showed highest mass compaired to the developed product. This revealed that the developed product was not airaited as milk ice cream.

Rice based ice cream could be prepared using rice milk with 6% total solid content and 4% butter content with highly acceptable sensory characteristics. Mass of the rice ice cream was 720 g/l, and was in agreement with SLS standard for ice cream. Further studies should be carried out using commercially available soft ice cream machines in order to evaluate the effect of the mechanization on the quality of the product.

Table 1. Nutritional and physico-chemical properties of rice ice cream compared to soy and milk ice cream

Ice cream type	Total solids (%)	Fat (%)	Protein (%)	Ash (%)	Mass (g/l)
Rice	29.3 ^{b}	3.6 ^{b}	0.47 ^{c}	0.05 ^{b}	720 ^{b}
Soy	24.9 ^{c}	2.1 ^{c}	0.99 ^{b}	0.33 ^{b}	817 ^{a}
Milk	37.2 ^{a}	9.6 ^{a}	3.64 ^{a}	0.89 ^{a}	627 ^{c}

Values followed by different letter within each column are significantly different at $p< 0.05$, according to least significant difference test.

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