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Proximate Analysis and Bioactive Composition of Icecream Incorporated with Spices

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was carried out to determine the nutritional composition, bioactive compounds, and antioxidant properties of ice cream prepared by incorporating selected spices *viz.,* fenugreek, black cumin, coriander, and cinnamon in the form of powders at different equal levels of substitution (1%, 1.5%, and 2%). The spices incorporated in the ice cream were found to have dietary fibre content in the range of 0.81 to 2.02g/100g. The total flavonoid content was found to be in the range of 72.55 to 78.79mg/g of quercetin. The present study results revealed that the ice cream prepared by incorporating different spices showed good antioxidant properties.

Keywords: Ice cream; fenugreek; black cumin; cinnamon; flavonoids.

1. INTRODUCTION

Ice cream is a delicious, nutritious, relatively inexpensive frozen dairy product and is composed of milk ingredients, sugar, stabilizer, emulsifier, and flavouring materials. It is very popular among all sections of the people because of the food and health aspects ranging

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from 'taste delight to nutrient delivery' [1]. Several studies explored the possibility of improving the therapeutic attributes of ice cream using ingredients with health benefits, focusing on natural antioxidants, natural colorants, vitamins, low fat, low calorie, and free from artificial additives in the safety of consumers [2,3]. In addition, researchers have enriched ice cream with herbal teas [4], pomegranate by-products [5], and grape seed extracts [6] to improve the functional properties of ice cream. However, ice cream is one of the most consumed dairy products and is generally poor in natural antioxidants, flavonoids, and polyphenols. Hence, the present study was designed to develop ice cream by incorporating different spices *viz.,* fenugreek, cinnamon, black cumin, and coriander in powder form and evaluated their bioactive, nutritional composition, and antioxidant properties.

2. MATERIALS AND METHODS

Cow milk procured from the community cattle care center, College Food and Dairy Technology, Alamathi. Skim milk powder and butter were procured from Aavin milk parlor, Madhavaram milk colony. Glycerol monostearate and carboxymethyl cellulose were procured from Venus Essence Pvt. Ltd., Chennai. Spices *viz.,* fenugreek, coriander, cinnamon, black cumin, and sugar were purchased from Sri MRV supermarket, Redhills. The research was carried out in the College of Food and Dairy Technology, Alamathi, a constituent college of Tamil Nadu Veterinary and Animal Sciences University, Chennai.

2.1 Determination of Proximate Composition

Spice powders incorporated ice cream was analyzed for proximate composition *viz.,* moisture, protein, fat, crude fibre, total ash content according to the method described in AOAC [7], carbohydrate content was calculated by difference method as described by Muller and Tobin [8], total energy was calculated using the 'Atwater' factor method as described by Nwabueze [9] and total dietary fibre content was determined by the enzyme-gravimetric method as described in AOAC [10].

2.2 Estimation of Bioactive Compounds

2.2.1 Estimation of total phenols

The total phenolic content in the samples was carried out according to Chun *et al.* [11] by the Folin-ciocalteu test with some modifications. Gallic acid (4mg/100ml) was considered a phenolic standard. Different concentrations (10µg, 20µg, 30µg, 40µg, 50µg) of gallic acid were taken. The test sample contains 200µl of 80% methanol extract of different samples. This volume is made up of 3ml with deionized water and then to it, added 250µl of Folin-ciocalteu reagent (FCR) and 750µl of Na_2CO_3 solution. Then, the whole solution was vortexed and incubated for 8 minutes at room temperature. To the whole solution, added 1ml distilled water. Then, the mixture of solutions was incubated for about 2 hours in dark at room temperature. Absorbance was taken at 765nm and using the standard gallic acid. The total phenolic content in the methanol extract of different samples was expressed as gallic acid equivalents (GAE).

2.2.2 Estimation of total flavonoids

The total flavonoid content in samples was determined according to the method described by Lin and Tang [12]. The sample extracts (2ml, 0.3mg/ml) in methanol was mixed with 0.1ml aluminum chloride hexahydrate (10%), 0.1ml potassium acetate (1 M), and 2.8ml of deionized water. Keep the above solution for incubation for 40 minutes at room temperature. The absorbance of the reaction mixture was determined spectrophotometrically at 415nm. Quercetin (10mg/100ml) was considered as flavonoid standard. The total flavonoid content in the methanol extract of different samples was expressed as quercetin equivalents (QE).

2.3 Estimation of Antioxidant Activity

2.3.1 DPPH radical scavenging activity

The effect of DPPH radical scavenging activity on samples was determined according to the method described by Blois [13] with the modification described by Brand-Williams *et al*. [14]. A 100µM solution of DPPH in methanol was prepared and extracts of different samples (50, 100µl) containing 0.5 to 1mg GAE were mixed with 1ml of DPPH solution. Then, the mixture was shaken vigorously and left in the dark for 20 minutes at room temperature and the absorbance was measured at 517nm. The percentage inhibition of the DPPH radical by the samples was calculated as follow:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of the control } (A_o) - \text{Absorbance of the sample } (A_s)}{\text{Absorbance of the control } (A_o)} \text{ X } 100$$

2.3.2 Reducing power assay

The reducing power of the samples was determined according to the method given by Yen and Chen [15]. The extracts of different samples (50, 100µl) containing 50 to 100mg of GAE were made up to 500µl with 0.2 M phosphate buffer (pH 6.6) and mixed with 1ml of potassium ferricyanide (0.1%) and the mixture was incubated at 50°C for 20 minutes. Next, trichloroacetic acid (TCA) (500µl, 10%) was added to the reaction mixture and centrifuged at 8,000 rpm for 10 minutes. Finally, the supernatant obtained was mixed with an equal volume of distilled water, and 300µl of 1% ferric chloride was added and the absorbance was measured at 700nm. The increased absorbance of the reaction mixture indicates the increase in reducing power.

2.4 Statistical Analysis

All the experiments were carried out in six replicates, and results are expressed as mean ± SE. The statistical analysis was performed by ANOVA using SPSS®20.0 software for windows as described by Snedecor and Cochran [16].

3. RESULTS AND DISCUSSION

3.1 Proximate Analysis of Spices Incorporated Ice Cream

The proximate composition of spice powders incorporated ice cream (SPII) and control was presented in Table 1. On analysis, no significant differences (P>0.05) were observed in fat content for control (12.31%), SPII1 (12.74%), SPII2 (12.79%), and SPII3 (12.96%). It was observed that the carbohydrate content found decreased from 12.30 to 9.47% in spices incorporated ice cream. The protein, crude fibre, total ash, and total dietary fibre content were increased in the developed ice cream. The crude fibre and total dietary fibre were not detected in the control ice cream. The energy value of developed ice cream variants found in the range of 199.43 to 205.76 kcal/100g, whereas for control, it was 209.95 kcal/100g. The variations found in the quantity of nutritional composition of developed ice cream might be attributed to the addition of spices in different substitution levels.

3.2 Bioactive Compounds of Spices Incorporated Ice Cream

The bioactive composition of spice powders incorporated ice cream (SPII) and control was presented in Table 2. The total phenolic content was found to be higher in the developed ice cream, which was ranged from 9.76 to 14.27mg/g of GAE compared to control (8.75mg/g of GAE). The flavonoid content was also found to be higher and ranged from 72.55 to 78.79mg/g of quercetin compared to control (60.33mg/g of quercetin). The differences in values found between developed ice cream for polyphenols and flavonoids might be due to differences in the incorporation of spices in different levels of substitution.

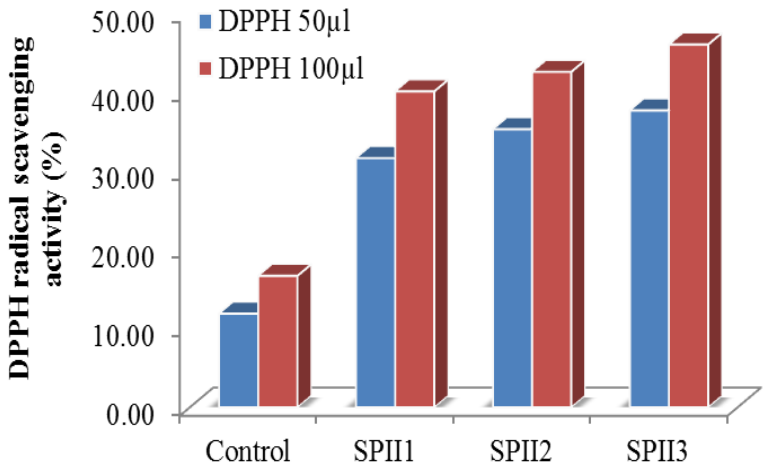

Fig. 1. DPPH radical scavenging activity of spice powders incorporated ice cream

Table 1. Nutritional composition of spice powders incorporated ice cream

Ice cream variants	Moisture (%)	Protein (%)	Fat (%)	Crude fibre (%)	Total ash (%)	Carbohydrate (%)	Total dietary fibre (%)	Energy (kcal/100g)
Control	61.09±0.516^{a}	10.06±0.213^{a}	12.31±0.011^{a}	ND	1.81±0.019^{a}	14.74±0.633^{c}	ND	209.95±2.101^{b}
SPII1	62.05±0.016^{ab}	10.48±0.014^{ab}	12.74±0.280^{a}	0.28±0.012^{a}	2.16±0.008^{b}	12.30±0.282^{b}	0.81±0.052^{a}	205.76±1.432^{ab}
SPII2	62.42±0.313^{ab}	10.90±0.030^{bc}	12.79±0.318^{a}	0.32±0.010^{b}	2.24±0.015^{c}	11.33±0.419^{b}	1.60±0.008^{b}	204.05±2.178^{ab}
SPII3	63.38±0.522^{b}	11.23±0.092^{c}	12.96±0.218^{a}	0.41±0.011^{c}	2.56±0.008^{d}	9.47±0.324^{a}	2.02±0.023^{c}	199.43±3.040^{a}
F-value	5.610**	18.864**	1.365^{NS}	336.539**	534.804**	25.298**	971.795**	3.709*

*Data expressed as Mean ± SE; n=6; * - Significant difference (0.01<P≤0.05); ** - Highly significant difference (P≤0.01); NS - Non-significant (P>0.05); ND – Not detected; Different superscripts within the same column differ significantly (P≤0.01)*

Table 2. Bioactive composition of spice powders incorporated ice cream

Bioactive compounds	Total phenolics (mg/g of GAE)	Total flavonoids (mg/g of Quercetin)
Control	8.75±0.085[a]	60.33±0.187[a]
SPII1	9.76±0.122[b]	72.55±0.165[b]
SPII2	12.76±0.054[c]	75.99±0.500[c]
SPII3	14.27±0.152[d]	78.79±0.342[d]
F-value	548.979**	616.721**

*Data expressed as mean ± SE; n=6; ** - Highly significant difference (P≤0.01); Different superscripts within the same column differ significantly (P≤0.01)*

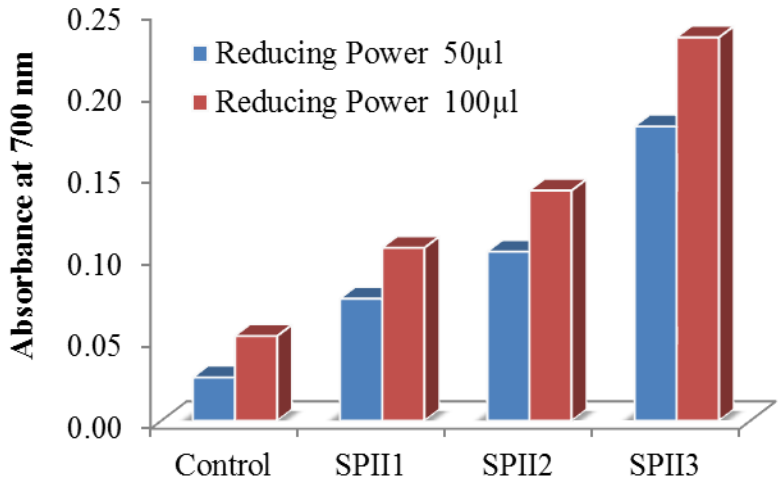

Fig. 2. Reducing power capacity of spice powders incorporated ice cream

3.3 Antioxidant Properties of Spices Incorporated Ice Cream

The antioxidant activities analyzed by DPPH free radical scavenging and reducing power capacity at 50µl and 100µl, the control and spice powders incorporated ice cream (SPII) concentration were illustrated in Fig 1 and 2, respectively. The % inhibition of DPPH of developed ice cream was found to be ranged from 32 to 38%, 40 to 46% in 50µl and 100µl concentration, respectively. The reducing power capacity in developed ice cream also showed an increasing trend in both the 50µl and 100µl concentrations. Increased absorbance in the developed ice cream indicates increased reducing power.

4. CONCLUSION

The present study indicated that the total phenols, flavonoids, and antioxidant properties showed an increasing trend as the inclusion of spices increased. Therefore, the components investigated in ice cream are largely dependent on the percentage of spices incorporated. Further, studies were carried out to confirm the health benefits of developed ice cream.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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