www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(6): 462-465

www.thepharmajournal.com
Received: 07-04-2021
Accepted: 18-05-2021

D Baskaran
Professor, Department of Livestock Products Technology (Dairy Science), Madras Veterinary College-TANUVAS, Chennai, Tamil Nadu, India.

Dhanavath Srinu
Ph.D., Scholar, Department of Food Processing Technology, College of Food and Dairy Technology-TANUVAS, Chennai, Tamil Nadu, India

Corresponding Author:
Dhanavath Srinu
Ph.D., Scholar, Department of Food Processing Technology, College of Food and Dairy Technology-TANUVAS, Chennai, Tamil Nadu, India

α-Glucosidase, α-amylase inhibition and glycemic index of ice cream incorporated with spices

D Baskaran and Dhanavath Srinu

Abstract
The present study was carried out to determine the α-glucosidase, α-amylase, sucrase inhibition and glycemic index 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 ice cream showed α-glucosidase inhibition in the range of 6.34-15.36%, 8.36-18.04% and 12.47-22.69% at 50µl, 100µl and 150µl respectively. The glycemic index of developed ice cream was found to be lower than the control ice cream. The results of the present study revealed that the ice cream prepared by incorporating different spices is low glycemic in nature.

Keywords: Ice cream, cinnamon, black cumin, glycemic index, α-glucosidase

1. Introduction
Ice cream is a frozen dessert made by mixing different ingredients including milk, cream, milk solids non-fat, sugar, stabilizers and emulsifiers, in addition to flavors and colorants. Composition of ice cream varies depending on markets and locations [fat 8-20%; milk solids non-fat 8-15%; sugar 13-20%; stabilizer and emulsifier 0-0.7% and total solids 36-43%] (Arbuckle, 2013) [5]. Ice cream is consumed by different age groups (Munhoz *et al.*, 2010) [14]. Due to the high prevalence of obesity and type-2 diabetes among children and adolescents, people are now more aware of their health and hence conscious of their diet. Several studies have been carried out in developing new functional ice creams with ingredients such as probiotics (Aboulfazli *et al.*, 2016; Ranadheera *et al.*, 2013; Da Silva *et al.*, 2015; Cruz *et al.*, 2009; Akin *et al.*, 2007) [1, 15, 8, 9, 4], prebiotics (Akalin *et al.*, 2008) [2], and dietary fibers (Akbari *et al.*, 2016; Hashemi *et al.*, 2015; dos Santos *et al.*, 2013; Comas *et al.*, 2013; Soukoulis *et al.*, 2009) [3, 11, 9, 6, 17]. There has been mounting evidence in recent years that food choices are an important factor in reducing the risk of developing heart disease, metabolic diseases, cancer and obesity. Hence, the present study was conducted to develop ice cream by incorporating spices and to evaluate their glycemic index and antidiabetic properties by in-vitro studies.

2. Materials and Methods
2.1 Materials
Fresh cow milk is procured from the community cattle care center, College Food and Dairy Technology, Alamathi. Butter and skim milk powder were purchased from Aavin milk parlour, Madhavaram milk colony. Carboxymethylcellulose and glycerol monostearate were purchased from Venus Essence Pvt. Ltd., Chennai. Spices *viz*., coriander, fenugreek, black cumin, cinnamon and sugar were purchased from Sri MRV supermarket, Redhills. The present 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.

2.2 Estimation of antidiabetic activity
2.2.1 α- glucosidase inhibition
α- glucosidase inhibitory effects in samples were determined according to the method given by Watanabe *et al.*, (1997) [18]. Yeast α-glucosidase (0.7 U) dissolved in 100mM phosphate buffer (pH 7.0) containing 2g/l bovine serum albumin and 0.2g/l sodium azide (NaN_3) which was used as enzyme source. Paranitrophenyl-α-D-glucopyranoside (PNPG) was used as substrate. The enzyme solution (1000µl) and 100µl of the test sample at various concentrations (50, 100 and 150µl) were mixed and incubated for 5 min.

After incubation, 50µl of the substrate was added and further incubated for 5 min at room temp and the absorbance was measured using a spectrophotometer at 405nm. The reaction is monitored by an increase in absorption at 405nm.Control was taken without the extract.

$$\% \text{ Inhibition } = \frac{\text{Absorbance of control at 405nm} - \text{Absorbance of sample at 405nm}}{\text{Absorbance of control at 405 nm}} \times 100$$

2.2.2 α-amylase inhibition

α-amylase inhibitory effects in samples were determined according to the method described by Jung *et al*., (2006). The assay mixture containing 200µl of 0.02M sodium phosphate buffer, 20µl of enzyme and the sample extracts in concentration range 50-150µl/ml were incubated for 10 minutes at room temperature. Then, add 200µl of starch in all test tubes. The reaction was terminated with the addition of 400µl dinitrosalicylic acid (DNS) reagent and placed in boiling water bath for 5 minutes, cooled and diluted with 15 ml of distilled water and absorbance was measured at 540nm. Control was taken without the extract.

$$\% \text{ Inhibition } = \frac{\text{Absorbance of control at 540nm} - \text{Absorbance of sample at 540nm}}{\text{Absorbance of control at 540nm}} \times 100$$

2.2.3 Sucrase inhibition

The effect of the sample on sucrase activity was analyzed according to the method described by Honda and Hara, (1993) [12]. The enzyme solution (10µl) and varying concentrations (50, 100 and 150µl) of the samples were incubated together for 10 minutes at 37ºC, and the volume is made up of 200µl with maleate buffer (pH 6.0). The enzyme reaction is started by adding a 100µl sucrose solution (60mM). After 30 minutes, the reaction is stopped by adding 200µl of 3, 5-dinitrosalysilic acid reagent and treating the mixture in a boiling water bath for 5 minutes. Then, the absorbance was taken at 540nm. Control was taken without the extract.

$$\% \text{ Inhibition } = \frac{\text{Absorbance of control at 540nm} - \text{Absorbance of sample at 540nm}}{\text{Absorbance of control at 540 nm}} \times 100$$

2.3 Estimation of glycemic index

The glycemic index of samples was determined according to the method given by Goni *et al.*, (1997) [10]. Samples of 50mg were prepared and 10ml of HCl-KCl buffer (pH = l.5) were added. Then, 0.2ml of a solution containing 1 g of pepsin in 10 ml of HCl-KCl buffer were added to each sample and incubated at 40 °C for 1 hr in a shaking water bath. Volume was make up to 25ml with Tris-Maleate buffer (pH = 6.9). A 5ml of a solution of α-amylase in Tris-Maleate buffer containing 2.6 UI were added to each sample. Then, the samples were incubated at 37°C in a shaking water bath. 1ml aliquot samples were taken from each tube every 90 min from 0 to 3 hours. These aliquots were placed in a tube at 100°C and were shaken vigorously for 5 minutes to inactivate the enzyme and refrigerated until the end of the incubation time. Then, 3ml of 0.4M sodium acetate buffer (pH = 4.75) were added to each aliquot and 60µl of amyloglucosidase were used to hydrolyse the digested starch into glucose after 45 minutes at 60°C in a shaking water bath. Volume was adjusted to 10-100ml with distilled water. The triplicated aliquots of 0.5ml were incubated with Peridochrom Glucose GOD-PAP. The HI was calculated as follows:

$$\text{HI} = \frac{\text{Area under the curve of the sample}}{\text{Area under the curve of white bread}}$$

The *in vitro* GI was determined by using the following equation as described by Goni *et al*., (1997) [10].

$$\text{GI} = 39.71 + 0.549\ \text{HI}$$

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 (Snedecor and Cochran, 1994) [16].

3. Results and Discussion

3.1 Antidiabetic activities of spices incorporated ice cream

The antidiabetic activities of spice powders incorporated ice cream (SPII) by α-glucosidase, α-amylase and sucrase inhibition was illustrated in Fig 1, 2 and 3 respectively.

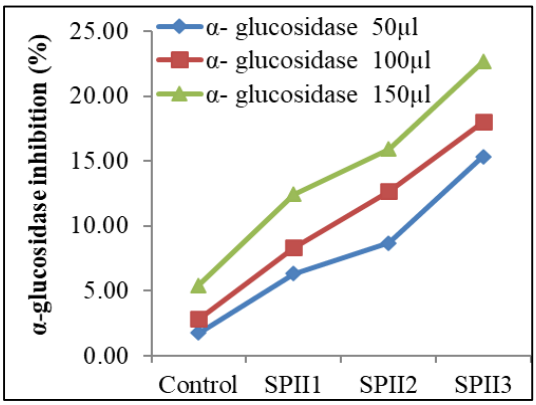

Fig 1: α-glucosidase inhibition of spice powders incorporated ice cream

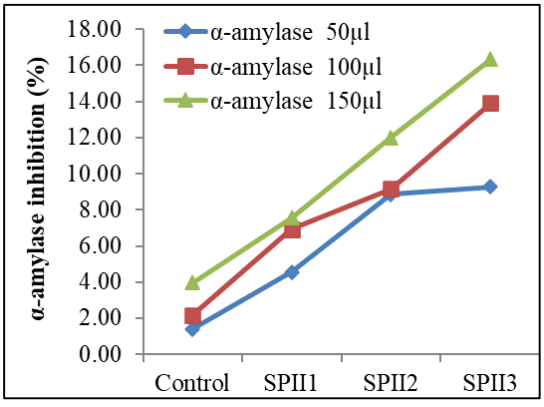

Fig 2: α-amylase inhibition of spice powders incorporated ice cream

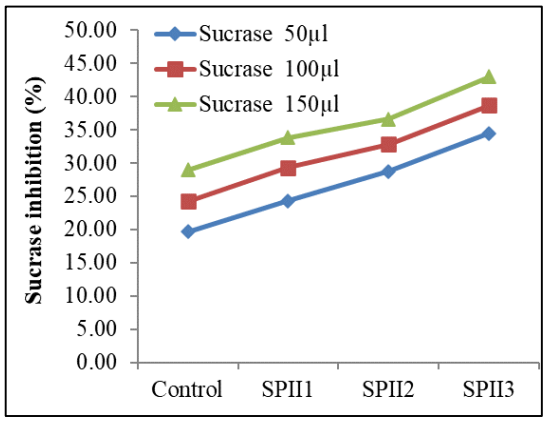

Fig 3: Sucrase inhibition of spice powders incorporated ice cream

On analysis, there was a highly significant ($P \leq 0.01$) difference observed in the control and developed ice cream. From the Fig 1, it was observed that the α-glucosidase inhibition was found to be in the range of 6.34-15.36%, 8.36-18.04% and 12.47-22.69% at 50µl, 100µl and 150µl respectively. The α-amylase inhibition was found to be in the range of 4.56-9.29%, 6.92-13.93% and 7.55-16.35% at 50µl, 100µl and 150µl respectively (Fig 2). The sucrase inhibition was found to be in the range of 24.30-34.49%, 29.31-38.68% and 33.82-43.01% at 50µl, 100µl and 150µl respectively (Fig 3). The variations found in the inhibition of α-glucosidase, α-amylase and sucrase in developed ice cream might be attributed to the addition of spices in different levels of substitution.

3.2 Glycemic index of spices incorporated ice cream

The glycemic index of spice powders incorporated ice cream (SPII) was shown in Table 1. The glycemic index of developed ice cream was found to be ranged from 43.32 to 45.18, 42.10 to 44.01 and 41.08 to 43.54 at 0, 90 and 180 minutes respectively. The glycemic index of control ice cream was found to be higher than the developed ice cream. The low GI of developed ice cream might be attributed to the inclusion of spices as they are low GI in nature.

Table 1: Glycemic index of spice powders incorporated ice cream

Glycemic index	0 min	90 min	180 min	F-value
Control	44.71 ± 0.389^{bA}	46.29 ± 0.338^{cB}	48.01 ± 0.296^{cC}	19.000**
SPII1	45.18 ± 0.258^{bB}	44.01 ± 0.227^{bB}	43.54 ± 0.345^{bA}	7.982**
SPII2	44.61 ± 0.332^{bB}	43.72 ± 0.398^{bB}	42.04 ± 0.244^{aA}	18.571**
SPII3	43.32 ± 0.343^{aB}	42.10 ± 0.172^{aA}	41.08 ± 0.225^{aA}	18.140**
F-value	4.000*	34.617**	78.804**	-

Data expressed as Mean ± SE; n=6; * - Significant difference ($0.01 < P \leq 0.05$);
** - Highly significant difference ($P \leq 0.01$);
Different superscripts within the same column (lowercase) and row (uppercase) differ significantly ($P \leq 0.01$)

4. Conclusion

The results reported in the present study indicated that the α-glucosidase showed increased inhibition as the inclusion of spices increased. The glycemic index values reported in the present study suggested that the developed ice cream falls in the category of low GI foods as the GI value is less than 55. Further studies were carried out to confirm the health benefits of developed ice cream.

5. Acknowledgements

Authors are thankful to The Dean, Faculty of Food Sciences, College of Food and Dairy Technology-TANUVAS, Chennai – 600 052 for his interest and providing facilities to carry out this work.

6. References

1. Aboulfazli F, Shori AB, Baba AS. Effects of the replacement of cow milk with vegetable milk on probiotics and nutritional profile of fermented ice cream. *LWT* - Food Science and Technology 2016;70(1):261-270.
2. Akalin AS, Karagozlu C, Unal G. Rheological properties of reduced-fat and low-fat ice cream containing whey protein isolate and inulin. European Food Research and Technology 2008;227(3):889-895.
3. Akbari M, Eskandari MH, Niakosari M, Bedeltavana A. The effect of inulin on the physicochemical properties and sensory attributes of low-fat ice cream. International Dairy Journal 2016;57(1):52-55.
4. Akin MB, Akin MS, Kirmaci Z. Effects of inulin and sugar levels on the viability of yogurt and probiotic bacteria and the physical and sensory characteristics in probiotic ice-cream. Food Chemistry 2007;104(1):93-99.
5. Arbuckle WS. Ice cream. 4th edition, USA: Springer Science and Business Media 2013.
6. Comas C, de Moraes Crizel T, de Araujo RR, de Oliveira Rios A, Flores SH. Development of chocolate ice cream using orange peel fiber as fat replacer. Ciencia Rural 2013;43(10):1892-1898.
7. Cruz AG, Antunes AE, Sousa ALO, Faria JA, Saad SM. Ice-cream as a probiotic food carrier. Food Research International 2009;42(9):1233-1239.
8. Da Silva PDL, de Fatima Bezerra M, dos Santos KMO, Correia RTP. Potentially probiotic ice cream from goat's milk: Characterization and cell viability during processing, storage and simulated gastrointestinal conditions. LWT-Food Science and Technology 2015; 62(1):452-457.
9. dos Santos Leandro E, de Araujo EA, da Conceicao LL, de Moraes CA, de Carvalho AF. Survival of *Lactobacillus delbrueckii* UFV H2b20 in ice cream produced with different fat levels and after submission to stress acid and bile salts. Journal of Functional Foods, 2013;5(1):503-507.
10. Goni I, Garcia-Alonso A, Saura-Calixto F. A starch hydrolysis procedure to estimate glycemic index. Nutrition Research 1997;17(3):427-437.
11. Hashemi M, Gheisari HR, Shekarforoush S. Preparation and evaluation of low-calorie functional ice cream containing inulin, lactulose and Bifidobacterium lactis. International Journal of Dairy Technology, 2015;68(2):183-189.
12. Honda M, Hara Y. Inhibition of rat small intestinal sucrase and α-glucosidase activities by tea polyphenols. Bioscience, Biotechnology and Biochemistry, 1993;57(1): 123-124.

13. Jung M, Park M, Lee HC, Kang YH, Kang ES, Kim SK. Antidiabetic agents from medicinal plants. Current Medicinal Chemistry 2006;13(10):1203-1218.
14. Munhoz CL, Silva TV, Teleginski F, Poposki M, Sanjinez-Argandona EJ. Development of soybean ice cream and crunchy coverage from okara. *Ambiencia*, 2010;6(3):493-500.
15. Ranadheera CS, Evans CA, Adams MC, Baines SK. Production of probiotic ice cream from goat's milk and effect of packaging materials on product quality. Small Ruminant Research 2013;112(1-3):174-180.
16. Snedecor GW, Cochran WG. Statistical methods, 8th edition, IOWA State University Press, USA 1994.
17. Soukoulis C, Lebesi D, Tzia C. Enrichment of ice cream with dietary fibre: Effects on rheological properties, ice crystallisation and glass transition phenomena. Food Chemistry 2009;115(2):665-671.
18. Watanabe J, Kawabata J, Kurihara H, Niki R. Isolation and identification of α-glucosidase inhibitors from tochu-cha (*Eucommia ulmoides*). Bioscience, Biotechnology and Biochemistry 1997;61(1):177-178.