Research Article

α-Glucosidase, α-Amylase Inhibition and Glycemic Index of Noodles Incorporated with Various Spices

Dhanavath Srinu[1]* and D. Baskaran[2]

[1]Department of Food Processing Technology, College of Food and Dairy Technology-TANUVAS, Chennai, Tamil Nadu, India
[2]Department of Livestock Products Technology (Dairy Science), Madras Veterinary College-TANUVAS, Chennai, Tamil Nadu, India

Abstract

The present study was carried out to determine the α-glucosidase, α-amylase inhibition, and glycemic index of noodles prepared by incorporating different spices *viz.,* fenugreek, black cumin, coriander, and cinnamon in the form of powders at different equal levels of substitution (2%, 4% and 6%). The spices incorporated noodles showed α-glucosidase inhibition in the range of 17.68 to 36.82%, 25.19 to 45.89% and 32.47 to 56.40% at 50µl, 100µl and 150µl respectively. The glycemic index of developed noodles was found to be lower than the control noodles. The results of the present study revealed that the noodles prepared by incorporating different spices are low glycemic.

Keywords: Noodles, fenugreek, cinnamon, α-glucosidase, α-amylase

***Correspondence**
Author: Dhanavath Srinu
Email: dhansrinu@gmail.com

Introduction

Noodles are one of the most important traditional food products, which are consumed throughout the world because of their convenience, variety, versatility, nutrition, flavour, less cooking time and palatability [1]. Nowadays, a wide variety of Asian noodles are available, varying in their ingredients, processes applied and the form of the finished products [2]. The diversity reflects differences in culture, climate, region and several other factors [3]. Noodles consumption has increased considerably due to the changes in customer preferences and nutritional awareness [4]. In recent years, 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 noodles by incorporating spices and to evaluate their glycemic index and antidiabetic properties by *in-vitro* studies.

Materials and Methods

Materials

The raw materials such as coriander, fenugreek, black cumin, cinnamon and salt used in the development of noodles were purchased from Sri MRV supermarket, Chennai. Whole-wheat flour used for the preparation of noodles was obtained from Chennai roller flour mills. The present work was carried out in the College of Food and Dairy Technology, Alamathi, a constituent college of Tamil Nadu Veterinary and Animal Sciences University, Chennai.

Estimation of glycemic index

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

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

The *in-vitro* GI was determined by using the following equation as described by [5].

$$GI = 39.71 + 0.549\ HI$$

Estimation of antidiabetic activity

α- glucosidase inhibition

α- glucosidase inhibitory effects in samples were determined according to the method given by [6]. The yeast α-glucosidase (0.7 U) dissolved in 100 mM phosphate buffer (pH 7.0) containing 2 g/l bovine serum albumin and 0.2 g/l sodium azide (NaN_3) was used as an enzyme. Paranitrophenyl-α-D-glucopyranoside (PNPG) was used as a substrate. The enzyme solution (1000µl) and 100µl of the test sample at various concentrations (50, 100 and 150µl) were mixed and incubated for 5 minutes. After incubation, 50µl of the substrate was added and further incubated for 5 minutes at room temperature and the absorbance was measured using a spectrophotometer at 405 nm. The reaction is monitored by an increase in absorption at 405 nm. Control was taken without the extract.

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

α-amylase inhibition

α-amylase inhibitory effects in samples were determined according to the method described by [7]. The assay mixture containing 200µl of 0.02 M sodium phosphate buffer, 20µl of the enzyme and the sample extracts in concentration range 50 to 150µl/ml were incubated for 10 minutes at room temperature. Then, added 200µl of starch to all test tubes. The reaction was stopped by adding 400µl of dinitrosalicylic acid and heated in a boiling water bath for 5 minutes. Then cooled and diluted by adding 15 ml of distilled water. The absorbance was taken at 540 nm. Control was taken without the extract.

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

Sucrase inhibition

The effect of the samples on sucrase activity was analyzed according to the method given by [8]. 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. The absorbance was taken at 540 nm. Control was taken without the extract.

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

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 [9].

Results and Discussion

Glycemic index of spices incorporated noodles

The glycemic index of spice powders incorporated noodles (SPIN) were shown in **Table 1**. The glycemic index of developed noodles was found to be ranged from 42.54 to 45.29, 41.86 to 43.50 and 40.78 to 42.58 at 0, 90 and 180 minutes respectively. The glycemic index of control noodles was found to be higher than the developed noodles. The low GI of developed noodles might be attributed to the inclusion of spices as they are low GI in nature.

Antidiabetic activities of spices incorporated noodles

The antidiabetic activities of spice powders incorporated noodles (SPIN) by α-glucosidase, α-amylase and sucrase

inhibition were illustrated in **Figures 1-3** respectively. On analysis, there was a highly significant (P≤0.01) difference observed in the control and developed ice noodles. From Figure 1, it was observed that the α-glucosidase inhibition was found to be in the range of 17.68 to 36.82%, 25.19 to 45.89% and 32.47 to 56.40% at 50µl, 100µl and 150µl respectively. The α-amylase inhibition was found to be in the range of 5.23 to 9.40%, 7.92 to 13.93% and 9.20 to 18.44% at 50µl, 100µl and 150µl respectively (Figure 2). The sucrase inhibition was found to be in the range of 24.96 to 47.19%, 28.96 to 56.52% and 31.65 to 67.36% at 50µl, 100µl and 150µl respectively (Figure 3). The variations found in the inhibition of α-glucosidase, α-amylase and sucrase in developed noodles might be attributed to the addition of spices in different levels of substitution.

Table 1 Glycemic index of spice powders incorporated noodles

Glycemic index	0 min	90 min	180 min	F-value
Control	46.26 ± 0.378^{dA}	50.21 ± 0.372^{cB}	53.99 ± 0.165^{dC}	145.244**
SPIN1	45.29 ± 0.291^{cB}	43.50 ± 0.390^{bA}	42.58 ± 0.380^{cA}	9.325**
SPIN2	43.85 ± 0.185^{bC}	42.56 ± 0.295^{abB}	41.61 ± 0.315^{bA}	15.521**
SPIN3	42.54 ± 0.373^{aB}	41.86 ± 0.255^{aB}	40.78 ± 0.234^{aA}	9.062**
F-value	26.682**	109.368**	463.603**	-

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

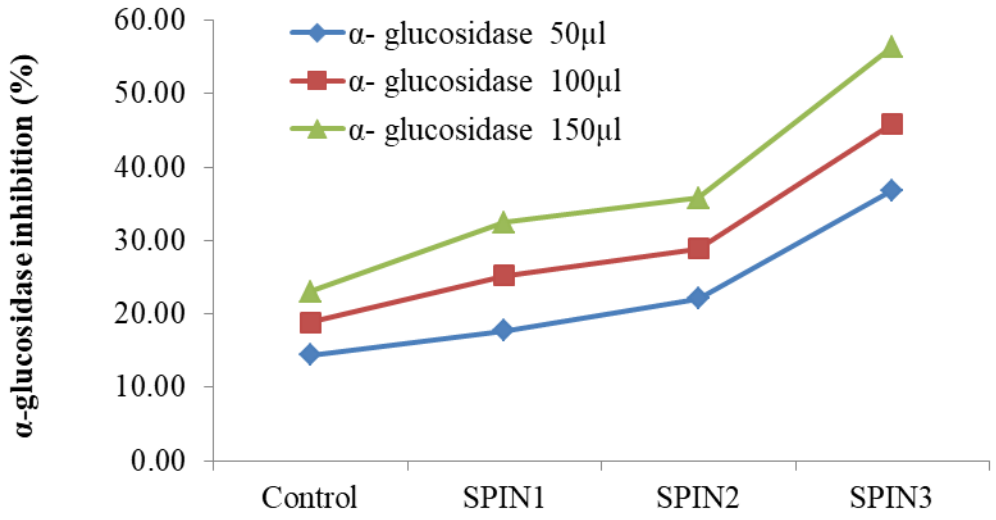

Figure 1 α-glucosidase inhibition of spice powders incorporated noodles

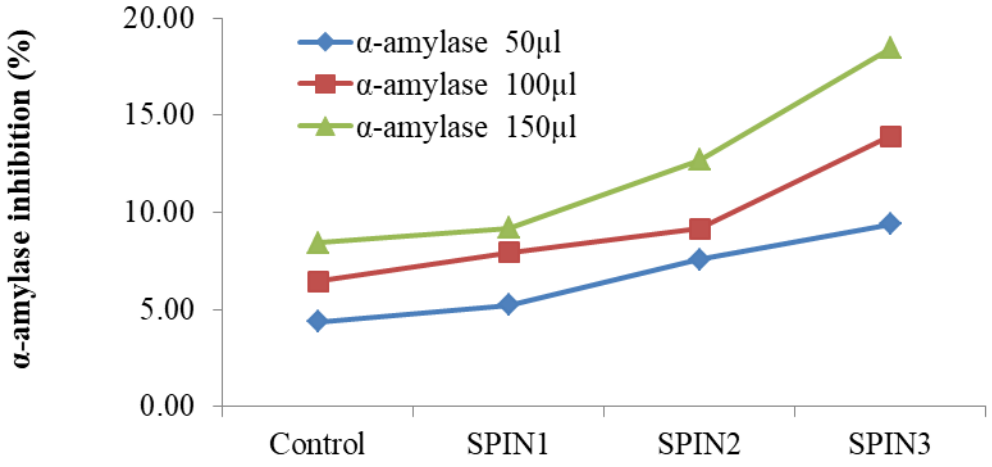

Figure 2 α-amylase inhibition of spice powders incorporated noodles

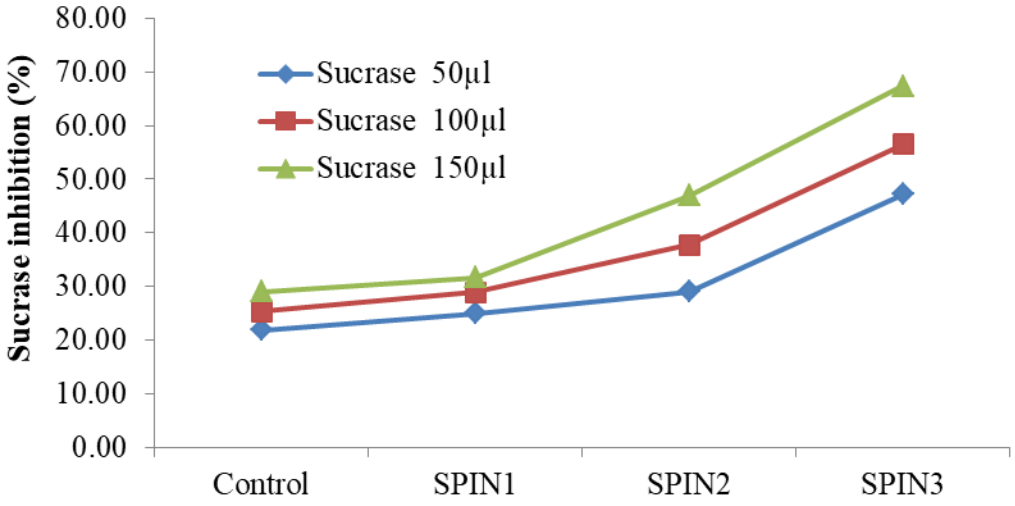

Figure 3 Sucrase inhibition of spice powders incorporated noodles

Conclusion

The results of the present study indicated that the α-glucosidase showed increased inhibition as the inclusion of spices increased. The glycemic index values reported in the study suggested that the developed noodles fall in the category of low GI foods. The results also revealed that the noodles prepared by incorporating different spices exhibited good antidiabetic properties.

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