คุณสมบัติการต้านอนุมูลอิสระและการยับยั้งกิจกรรมเอนไซม์ย่อยสลายคาร์โบไฮเดรตของข้าวสีและข้าวขาว

Antioxidant and Inhibitory Activity of Carbohydrate Hydrolyzing Enzymes of Colored Rice and Non-colored Rice

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บทคัดย่อ

เมล็ดข้าวมีสารพฤษเคมีได้แก่ฟีนอลิกและฟลาโวนอยด์ ข้าวสีมีแอนโทไซยานิน การศึกษาวิจัยนี้เพื่อ (1) ตรวจวิเคราะห์ปริมาณแอนโทไซยานินและวัดสารประกอบฟีนอลิกและฟลาโวนอยด์ (2) เพื่อตรวจวิเคราะห์สารต้านอนุมูลอิสระและกิจกรรมการยับยั้งเอนไซม์ย่อยสลายคาร์โบไฮเดรตของข้าวมีสีและข้าวไม่มีสี สารประกอบฟีนอลิกตรวจวัดโดยวิธี Folin-Ciocalteu ในขณะที่การตรวจวัดความสามารถในการต้านอนุมูลอิสระทำโดยวิธี 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging activity และ radical cation ABTS•+ scavenging activity จากการศึกษาข้าวสีได้แก่ข้าวเหนียวดำมีปริมาณสารประกอบฟีนอลิกสูงกว่า ข้าวไม่มีสีได้แก่ข้าวชัยนาท1 และข้าวสุพรรณ1 11.94 และ 2.75 เท่าตามลำดับ ข้าวเหนียวดำมีปริมาณสารประกอบฟลาโวนอยด์สูงกว่าข้าวชัยนาท1 และข้าวสุพรรณ1 2.10 และ 2.62 เท่าตามลำดับ ข้าวเหนียวดำมีแอนโทไซยานิน 11.04 มิลลิกรัมต่อกรัมและไม่พบแอนโทไซยานินในข้าวไม่มีสี ข้าวเหนียวดำมีความสามารถต้านอนุมูลอิสระสูงกว่าข้าวชัยนาท1 และข้าวสุพรรณ1 5.22 และ 18.42 เท่าตามลำดับข้าวเหนียวดำมีความสามารถยับยั้งกิจกรรมเอนไซม์กลูโคอะไมเลสสูงกว่าข้าวชัยนาท1 และข้าวสุพรรณ1 6.35 และ25.89 เท่าตามลำดับจึงสรุปได้ว่าข้าวสีมีความสามารถในการต้านอนุมูลอิสระและคุณสมบัติการยับยั้งกิจกรรมเอนไซม์สูงและสามารถนำไปใช้เป็นอาหารที่เป็นประโยชน์ต่อสุขภาพได้

คำสำคัญ: ข้าวสี การต้านอนุมูลอิสระ เอนไซม์ย่อยสลายคาร์โบไฮเดรต

Abstract

Rice grain contains phytochemicals including phenolics and flavonoids. Colored rice also contains anthocyanins. The present study was designed to (i) quantify the anthocyanins and measure the total phenolic content (TPC) and flavonoid content (FC), (ii) evaluate the antioxidant and inhibitory activity of carbohydrate hydrolyzing enzymes of colored rice and non-colored rice. The TPC was measured using a Folin-Ciocalteu assay, while the total antioxidant activity was determined by a method based on the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging activity and radical cation ABTS•+ scavenging activity. From the study, colored rice; black glutinous rice, possessed the higher TPC, which was about 1.94 and 2.75

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times greater than that of non- colored rices; Chai Nat 1 and Supan 1, respectively. Black glutinous rice possessed the higher FC, which was 2.10 and 2.62 times greater than that of Chai Nat 1 and Supan 1, respectively. Black glutinous rice contained anthocyanin of 11.04 mg/g while anthocyanin was not found in non-colored rices. Antioxidant activity determined by DPPH of black glutinous rice was 5.22 and 18.42 times greater than that of Chai Nat 1 and Supan 1, respectively. Alpha-glucoamylase inhibitory activity of black glutinous rice was 6.35 and 25.89 times greater than that of Chai Nat 1 and Supan 1, respectively. It is concluded that colored rice contains high anthocyanin and possesses the high antioxidant activity with inhibitory activity of carbohydrate hydrolyzing enzymes than that of non-colored rice and can be further explored as a functional food.

Keywords: colored-rice, antioxidant, carbohydrate hydrolyzing enzyme

Introduction

Diabetes mellitus (DM), commonly referred to as diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period.[1] Type 2 diabetes is complicated byseveral factors inherent to the disease process, including insulin resistance, hyperinsulinemia, impaired insulin secretion, reduced insulin mediated glucose uptake, and utilization. One of the therapeutic approaches is to decrease the postprandial hyperglycemia by delaying absorption of glucose by using α-amylase and α-glucosidase inhibitors.[2]

Many diverse therapeutic approaches for the treatment of Type 2 diabetes are in use. The conventional available therapies for diabetes include stimulation of endogenous insulin secretion, increase of the action of insulin at the target tissues, oral hypoglycemic agents, such as biguanids and sulfonylureas and the inhibition of degradation of dietary starch by glycosidases such as α-amylase and α-glucosidase.[3]

α-Amylase (E.C. 3.2.1.1) is a key enzyme in the digestive system and catalyses the primary step in degradation of starch to oligosaccharides consisting of maltose, maltotriose, and of α-(l-6) and α-(1 - 4) oligoglucans. α-Glucosidase (EC 3.2.1.20,) is a glucosidase located in the brush border of the small intestine that acts upon 1,4-α-bonds. Degradation of starch keeps human pancreatic α-amylase relates to an increase in post-prandial glucose levels, the control of which is therefore an important aspect in treatment of type 2 diabetes.[4] Hence, delay of starch degradation by inhibition of α-amylase and α-glucosidase plays an important role in the control of diabetes. Inhibitors of pancreatic α-amylase delay starch degradation causing a decrease in glucose absorption rate and dropping the glucose levels in the serum.[5]

Some inhibitors presently in medical use are acarbose and miglitol which inhibit glycosidases such as α-glucosidase and α-amylase. However, these synthetic hypoglycemic agents have their limitations, are non-specific, produce side effects and unsuccessful to increase diabetic problems.[6]

So far, reports on the systematic evaluation and scientific investigation of anti-diabetic plants or their phytoconstituents pancreatic α-amylase and α-glucosidase inhibitors are limited. During rice milling, the endosperm, bran and husk are separated with the bran accounting for 8 to 10% of the grain.[7] The endosperm is widely consumed in the world diet, but the bran and husk are underutilized, this has demanded the search for innovative solutions to use these portions efficiently in a nutritional, functional and economical manner. Thus, the presence of enzyme inhibitors in fractions of rice milling to contribute as an alternative to the valuation of co-products and also to treat DM, since the inhibitors are natural substances found in cereals and do not cause side effects. The aim of this study was to investigate the phytochemicals and α-amylase and α-glucosidase inhibitory effects of extracted from white rice brans and pigmented rice bran and related to their bioactive properties.

Materials and Methods

Rice bran samples

Twenty kilograms of colored rice cv. black glutinous paddy rice, non-colored paddy rices, cv. Chai Nat 1 and cv. Supan 1, were provided by the Rice Research Center, Phathumthani province, Thailand. They were dehusked on a Satake Rice Machine (Satake Co., Japan), rice bran was obtained by polishing using a Grainman polisher model 60-115-60-2AT (Douglas International Corp, Coral Gables, FL) for 90% milling and the rice brans were ground to pass through a 100-mesh sieve on a Ultracentrifilgal Mill (UDY Corporation, Fort Collins, Colorado, USA).

Extraction of rice bran samples

Five grams of each of the rice bran samples were extracted with 75 mL of methanol at room temperature for 12 h (repeated three times) and then was filtered through Whatman No. 1 filter paper (Whatman Internation Ltd., Maidstone, England). The residue was evaporated at 50ºC under reduced pressure.

Total phenolic content (TPC)

The TPC was determined using a modified Folin–Ciocalteu method.[8] Each test sample (250 μL) was added to a test tube that contained 6.0 mL of distilled water. After vortexing the tubes, 500 μL of Folin–Ciocalteu's phenol reagent was added to each tube. The tubes were vortexed and 2 min later, 2.0 mL of 15% Na_2CO_3 was added to each tube. 1.25 mL of distilled water was added to each tube. The tubes were vortexed again and then allowed to stand for 2 h at room temperature. Thereafter, the absorbance of each sample was measured against a blank at 750 nm.

Total flavonoid content

The total flavonoid content was determined using a modified version of the method described by Zhishen *et al*.[9] Each test sample (250 μL) and 1.25 mL of distilled water were added then 75 μL of 5% $NaNO_2$, 150 μL of 10% $AlCl_3$ was added. After 6 min, 0.5 mL of 1 M NaOH was added. The absorbance of the solution was measured against a blank at 510 nm using a spectrophotometer.

DPPH assay

The free radical scavenging activity of different fractions was measured by the DPPH (1-1 Diphenyl-2-picryl hydrazyl) scavenging method proposed by Shimada *et al.*[10] DPPH (2.5 x 10^{-4} M) in methanol was prepared and 2.0 mL of this solution was added to 2.0 mL of different black rice extracts obtained in different storage conditions. The mixture was shaken vigorously and left to stand for 30 min in the dark, and the absorbance was then measured at 517 nm against a blank. The DPPH radical-scavenging activity was calculated according to the following: % of DPPH scavenging activity = {1- (AbS/AbC)} x 100, where AbC was the absorbance of the control and AbS was the absorbance in the presence of the test compound. EC_{50} is the effective concentration in mg extract/mL which inhibits the DPPH activity by 50%.

Radical cation ABTS•+ scavenging activity

Radical cation scavenging capacity of bran extract was examined against ABTS•+ generated by the chemical method.[11] The absorbance of the reaction mixture was measured at 734 nm and the BHT equivalent was calculated using a standard curve prepared with BHT. Triplicate determination was performed.

α-Amylase inhibitory assay

This assay was carried out using a modified procedure of McCue and Shetty.[12] A total of 250 μL of extract (1.25–10 mg/mL) was placed in a tube and 250 μL of 0.02 M sodium phosphate buffer (pH 6.9) containing α-amylase solution (0.5 mg/mL) was added. This solution was preincubated at 25ºC for 10 min, after which 250 μL of 1% starch solution in 0.02 M sodium phosphate buffer (pH 6.9) was added at timed intervals and then further incubated at 25ºC for 10 min. The reaction was terminated by adding 500 μL of dinitrosalicylic acid (DNS) reagent. The reaction mixture was diluted with 5 mL distilled water and the absorbance was measured at 540 nm using spectrophotometer. The α-amylase inhibitory activity was calculated as percentage inhibition:

$$\% \text{ Inhibition} = [(Abs_{control}-Abs_{extract})/ Abs_{contro}] \times 100$$

Concentrations of extracts resulting in 50% inhibition of enzyme activity (IC_{50}) were determined graphically. Acarbose was used for comparison.

α-Glucosidase inhibitory assay

The effect of the plant extracts on α-glucosidase activity was determined according to the method described by Kim *et al.*[13] using α-glucosidase. The substrate solution p-nitrophenyl glucopyranoside (pNPG) was prepared in 20 mM phosphate buffer, and pH 6.9. 100 μL of α-glucosidase (1.0 U/mL) was preincubated with 50 μL of the extracts for 10 min. Then 50 μL of 3.0 mM (pNPG) as a substrate dissolved in 20 mM phosphate buffer (pH 6.9) was then added to start the reaction. The reaction mixture was incubated at 37ºC for 20 min and stopped by adding 2 mL of 0.1 M Na_2CO_3. The α-glucosidase activity was determined by measuring the yellow-colored paranitrophenol released from pNPG at 405 nm. The results were expressed as percentage of the blank control. Percentage inhibition is calculated as

$$\% \text{ Inhibition} = [(Abs_{control}-Abs_{extract})/ Abs_{contro}] \times 100$$

Concentrations of extracts resulting in 50% inhibition of enzyme activity (IC_{50}) were determined graphically. Acarbose was used for comparison.

Experimental design

All experimental parameter measurements were done in duplicate. The experiment was used to generate the experimental model for a factorial design.

Statistical analysis

All analyses were carried out in triplicate and the means with standard deviation were reported. Data collected were subjected to analysis of variance (ANOVA), and Fisher's least significant difference test was used to determine if the means were significantly different ($p < 0.05$) by using SPSS™ statistical software version 17.

Results and Discussions

Total phenolic content of rice bran ranged from 23.23 ± 1.79 to 63.89 ± 2.62 mg/g, with the lower values coming from the Supan 1 rice bran, while the highest value was from black glutinous rice bran (Table 1). The results showed that pigmented rice bran had higher total phenolic contents than white rice bran. Flavonoid contents in rice brans ranged from 10.37 ± 0.62 to 27.14 ± 0.37 mg/g while the highest value was from black glutinous (Table 1). The antioxidant capacity was measured using the DPPH assay and converted to EC_{50}. Black glutinous rice bran extract had EC_{50} value of 336.24, around 5.22 times and 18.42 times less than of that Chai Nat 1 and Supan 1, respectively (Table 2). The antioxidant capacity was measured using the ABTS assay and converted to EC_{50}.

Black glutinous rice bran extract had EC_{50} value of 25.71, around 6.09 times and 13.23 times less than of that of Chai Nat 1 and Supan 1, respectively (Table 2). From the results, lower EC_{50}, higher antioxidant capacity, so, black glutinous rice bran had antioxidant capacity higher than that of Chai Nat 1 and Supan 1. Higher antioxidant capacity might be due to anthocyanin of black glutinous rice bran (Table 2).

The methanolic extracts of rice brans cv. black glutinous, Chai Nat 1 and Supan 1 were obtained and used for phytochemicals analysis, antioxidant property and the inhibition studies. α-amylase inhibition by methanol extracts of rice brans showed a dose dependent increase inhibition of the enzyme activity.

Black glutinous rice brans extract showed the highest inhibition of 77.43 ± 0.16 % at a concentration of 1,500 mg/L (IC_{50} value 122.07 ± 4.51 mg/L (Table 3 and Table 8) while the Chai Nat 1 and Supan 1 rice bran extracts showed an inhibition of 62.55 ± 2.74% and 60.74 ± 1.89% at the concentration of 2,000 mg/L with IC_{50} value of 989.84 ± 43.37 mg/L and 1,124.51 ± 143.16 mg/L, respectively (Table 4 and Table 8).

α-glucosidase inhibition by black glutinous rice bran extract showed maximum inhibition of 84.22 ± 3.23% at 1,500 mg/L (Table 5) with IC_{50} value of 97.43 ± 5.62 mg/L (Table 8).

The extracts of Chai Nat 1 and Supan 1 rice brans showed α-glucosidase inhibition of 80.57±2.17% with the concentration of 2,500 mg/L (Table 6) and 68.30±1.75% with the concentration of 5,000 mg/L (Table 7). IC_{50} values of the enzyme of Chai Nat 1 and Supan 1 rice bran extracts were 619.65 ± 21.46 mg/L and 2,522.49 ± 126.24 mg/L, respectively (Table 8). From the results, the rice brans showed a dose dependent increase in its inhibition.

Table 1 Phenolic, flavonoid and anthocyanin contents of different rice bran cultivars.

Rice bran	Phenolic (mg/g)	Flavonoid (mg/g)	Anthocyanin (mg/g)
Black glutinous	63.89± 2.62a	27.14 ± 0.37a	11.04± 0.26a
Chai Nat 1	32.84± 2.43b	12.92 ± 0.71b	0b
Supan 1	23.23± 1.79c	10.37 ±0.62c	0b

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran cultivar.

Table 2 Antioxidant capacity of different rice bran cultivars.

Rice bran cultivar	Antioxidant capacity (mg/L)[a]	
	DPPH	ABTS
Black glutinous	336.24±16.52a	25.71±3.26a
Chai Nat 1	1,756.33± 67.23b	156.49±7.46b
Supan 1	6,193.75± 72.95c	340.26± 14.27c

[a]EC_{50} value, the effective concentration at which the antioxidant activity was 50%; DPPH radicals or ABTS radicals were scavenged by 50%. EC_{50} value was obtained by interpolation from line a regression analysis.

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran cultivar.

α-amylase and α-glucosidase are involved in a number of important biological processes, such as digestion of starch into glucose or processing of the oligosaccharide moieties of glycoprotein. There is now a great deal of interest in α-amylase and α-glucosidase inhibitors.[14]

Inhibition of α-amylase and α-glucosidase could result in starch digestion and glucose absorption with reduction of post prandial hyperglycemic excursions. It was found that inhibitors generally do not alter the total amount of starch absorbed so there is no effect on the net nutritional caloric loss although they slow down starch digestion.

Table 3 The percentage of inhibitory activity (% inhibition) of α-amylase with black glutinous rice bran extract.

Concentration (mg/L)	% Inhibition of amylase activity
50	27.63 ± 3.28a
100	43.33 ± 2.41b
500	65.22 ± 4.67c
1,000	70.72 ± 6.35cd
1,500	77.43 ± 4.16d

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Table 4 The percentage of inhibitory activity (% inhibition) of α-amylase with non-colored rice brans extract.

Concentration (mg/L)	% Inhibition of amylase activity	
	Chai Nat 1	Supan 1
200	35.07±1.77a	33.26±2.29a
500	42.39±1.92b	40.58±2.58b
1,000	49.51±2.06c	47.70±1.42c
1,500	56.23±2.60d	54.42±2.24d
2,000	62.55±2.74e	60.74±1.89e

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Table 5 The percentage of inhibitory activity (% inhibition) of α-glucosidase with black glutinous rice bran extract.

Concentration (mg/L)	% Inhibition
10	30.37±1.26a
50	45.84±1.37b
500	67.65±2.32c
1,000	76.02±4.45d
1,500	84.22±3.23e

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Table 6 The percentage of inhibitory activity (% inhibition) of α-glucosidase with Chai Nat 1 rice bran extract.

Concentration (mg/L)	% Inhibition
100	8.27±0.63a
250	15.59±2.18b
500	42.91±1.12c
1,000	64.23±2.53d
2,500	80.57±2.17e

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Table 7 The percentage of inhibitory activity (% inhibition) of α-glucosidase with Supan 1 rice bran extract.

Concentration (mg/L)	% Inhibition
250	6.34±0.52a
500	11.56±2.74b
1,000	25.78±2.11c
2,500	47.04±2.44d
5,000	68.30±1.75e

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Table 8 The 50% inhibitory concentration (IC_{50}) of α-amylase and α-glucosidase with different rice bran extract.

Rice cultivar	IC_{50} (mg/L)[a]	
	α -amylase	α -glucosidase
Black glutinous	122.07±4.51a	97.43±5.62a
Chai Nat 1	989.84 ± 43.37b	619.65 ±21.46b
Supan 1	1,124.51±143.16c	2,522.49 ±126.24c

[a]IC_{50} value, the effective concentration at which the enzyme activity was 50%; α-amylase or α-glucosidase were inhibited by 50%. IC_{50} value was obtained by interpolation from linear regression analysis.

Data are presented as mean ± SE. Mean values and standard deviations with different letters (a, b, c, ...) in the same column indicate significant differences (*P<0.05*) among different rice bran extract concentration.

Starches are source of calories, so, before being absorbed, they have to be digested into monosaccharides. The digestion occurs due to α-amylase and α-glucosidase.[15] Investigations have shown that the use of medical plants by diabetic patients is a ordinary practice and many medical plants extracts have been reported for their anti-diabetic activities.[16] Total antioxidant activity of black glutinous rice bran extract was higher than that of Chai Nat 1 and Supan 1 rice bran and a significant different was determined (Table 1). However, the antioxidant activities for DPPH and ABTS of black glutinous rice bran extract were lower than that of the positive control (Butylated Hydroxyl Toluene, BHT) (EC_{50} of 17.19 mg/L and 1.41 mg/L for DPPH and ABTS, respectively). The aflavins and catechins present in green and black teas have been reported to inhibit α-amylase and α-glucosidase activity as well as retard starch digestion in an *in vitro* model. α-amylase inhibitors are also present in grains, including wheat and rice.[17]

The present study was carried out with a view to exploring some traditional food plants, commonly used in daily life, for their α-amylase and α-glucosidase inhibitory potential *in vitro*. Brown rices are used locally as food plants and also are known for possessing many functional foods. Brown rices extracts were screened for anti-diabetic activity via inhibition of α-amylase. They showed a dose dependent inhibition with methanol extract. Black glutinous rice bran extract was found highest inhibition with 77.43 ± 4.16 % inhibition at concentration of 1,500 mg/L (IC_{50} value 122.07± 4.51 mg/L). For α -glucosidase, black glutinous rice bran extract also exhibited a dose dependent inhibition with the highest inhibition of 84.22± 3.27 % at concentration of 1,500 mg/L (IC_{50} value 97.43 ± 3.62 mg/L). IC_{50} values for α-amylase and α-glucosidase of black glutinous rice bran extract were lower than that of Chai Nat 1 and Supan 1 rice bran and a significant different was determined (Table 7). However, the IC_{50} for α-amylase of black glutinous rice bran extract was higher than that of the positive control (agarbose) (IC_{50} of 9.28 mg/mL) but lower IC_{50} for α-glucosidase than that of the positive control (IC_{50} of 146.34 mg/ml mg/L).

The literature on phytochemical analysis of rice brans indicate that they have a large number of phytochemicals that might form a part of functional food and the rich fiber content of the rice bran suggests that it could retard the starch ingestion and decrease the occurrence of metabolic disorders like diabetes. The anti α-amylase activity of rice bran may be due to the presence of phenolic compounds which have been shown to interact with and inhibit enzyme. The mechanism reaction involved in the inhibition of α-amylase and α-glucosidase might be because of the flavonoids in the bran.[14]

The experimental evidence representing anthocyanin benefits for diabetic disorder has been reported in recent years, and the efficiency is attributed in prevention of free radicals and lipid peroxidation effects including reduced pancreatic swelling, and reduced sugar in blood stream and urine.[18] The extraction of anthocyanin showed significant α-amylase inhibition activity. The extracts of the bioactive compounds from rice bran anthocyanins might be involved in the findings of new compounds in the prevention and treatment of diabetic disorders.

Colored rice is a pigmented variety of rice that which is planted widely in Asia, including Thailand. It has anthocyanins which is used food colorant. Rice anthocyanins consist of cyanidin 3-O-glucoside, peonidin 3-O-glucoside and cyanidin 3-O-gentiobioside.[19] These constituents can prevented eye diseases in mice and bacteria.[20] This inhibition was dependent on the antioxidant capacity of the anthocyanins. In addition, anthocyanins suppressed angiogenesis leading to diabetic retinopathy and the proliferation, migration and tube formation of human retinal microvascular endothelial cells induced by vascular endothelial growth factor.[21,22] So, anthocyanins have been represented to prevent the eyes from diseases. Diabetes mellitus involves chronic hyperglycemia due to insulin inefficiency. It is considered to be caused by the combination of some genetic defects and too much carbohydrate consumption. Thus, diabetes has emerged as a serious disease. Specifically, the number of patients with diabetes has been increasing in Asia countries including Thailand.[23-25] In the previous study, anthocyanin was reported to suppress retinopathy caused by diabetes animals.[21] However, the studies of efficiencies of Thai colored and non-colored rice bran cultivars against diabetics is limited. Comparison of colored and non-colored rice bran extracts reveal efficiency in the suppresses carbohydrate absorption, this could facilitate the control of blood sugar levels through daily lifestyle choices. Therefore, this study is conducted basic studies of Thai colored and non-colored rice bran extracts to investigate theirs efficacy for preventing diabetes. From this study, it was found that non-colored rice brans, cv. Chainat1 and cv. Supan1, could suppresses carbohydrate degradation for preventing diabetes while anthocyanins in colored rice bran cv. black glutinous has higher efficiency on inhibition of carbohydrate degradation than that of the non-colored rice brans. Therefore, this finding that rice bran cv. black glutinous highly inhibition of α-amylase and α-glucoamylase activities to suppress postprandial glucose is the first report of its kind.

Conclusions

This study was revealed that the rice bran bioactive components that had high antioxidative properties and inhibit α-amylase and α-glucosidase activities. Among the compounds we investigated, total phenolic, flavonoid and anthocyanin concentrations were most strongly correlated with antioxidant capacity and α-amylase and α-glucosidase inhibitory activity. This study was carried out not only to validate the traditional uses of rice brans in diabetes but also to initiate search for different pharmacophores with specificity towards α-amylase and α-glucosidase. The α-glucosidase inhibitory activities of black glutinous rice bran, was comparable in level to the anti-diabetic drug acarbose, and had the potential to be improved into a dietary or nutraceutical supplement for the managing of diabetes.

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