Antioxidant activity and phenolic profiles of traditional Thai rice varieties

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Abstract: The aims of this work were to study antioxidant activities and total phenolic compounds and their antioxidant properties of six traditional Thai rices namely Mali normal rice, Brown rice, Mali-insee brown rice, Hommali Dang-insee brown rice, Homnin brown rice and Homnin germinated brown rice. These six types traditional Thai rice were extracted by methanol. The antioxidant activity using DPPH was studied. In addition, total phenolic compounds of crude extract was determined by Folin-Ciocalteu method. The results showed that the obtained methanol crude extract of Homnin germinated brown rice showed the highest antioxidant activity obtained from DPPH assay with 70.27±7.34%. Since Homnin germinated brown rice is black rice with germination process, it exhibited the highest antioxidant activity. For Folin-Ciocalteu method, the methanol crude extract of Homnin brown rice showed the highest total phenolic compound with 172.4±34 mg TAE/g dry weight tannic acid. Based on the obtained results, traditional Thai rice varieties are excellent sources for health-promoting nutrient.

1. Introduction

Rice (Oryza sativa) is a good choice for consumers who care about their own. It is a main food for more than half of the world's population, particularly those living in southern and eastern Asia. White rice is the most commonly consumed type, but brown rice is becoming increasingly popular in some Western and Asia countries due to its health benefits. Various products are made from rice. These include rice flour, rice syrup, rice bran oil, and rice milk. It is usually white in color, but brown rice can come in a variety of shades: brown, reddish, purplish, or black1.

Brown rice, unmilled or partly milled, contains more nutritional components than ordinary white rice. The germination of brown rice can be used to improve its taste and further enhance its nutritional value and health functions. Moreover, germinated brown rice has been reported to exhibit many physiological effects, including antihyperlipidemia, antihypertension and the reduction in the risk of some chronic diseases, such as cancer, diabetes, cardiovascular disease and Alzheimer's disease. Therefore, it is likely that germinated brown rice will become a popular health food2.

The phytochemical profiles and antioxidant activity of free, soluble-conjugated and bound fractions of brown rice and its processed products (textured rice, cooked rice and rice noodle) were studied. It is necessary to consider the effects of processing on phytochemical profiles and antioxidant activity of whole grains for whole foods designed for reducing chronic disease risk3.
Eight varieties of pigmented rice grown in southern Thailand, as a dehusked grain, were studied for their chemical compositions, antioxidant properties and color parameters. The results showed that dark purple grain has higher iron content, polyphenol content and antioxidant capacities than red brown grain. This study can guide in the selection and production of rice varieties with enhanced nutritional qualities, suggesting the use of color parameters as a practical indicator of some key nutritional characteristics.

In this research, six types of traditional Thai rice including Mali normal rice, Brown rice, Mali-insee brown rice, HommaliDang-insee brown rice, Homnin brown rice and Homnin germinated brown rice were selected to study for their antioxidant activity using 2-diphenyl-2-picrylhydrazyl (DPPH) assay. Moreover, Folin-Ciocalteu method was applied to investigate the total phenolic compounds of traditional Thai rice.

2. Materials and Methods
2.1 Chemicals
Sodium carbonate was purchased from Riedel-dehaen. 2,2-Diphenyl-1-picrylhydrazyl radical (DPPH), 6-Hydroxy-2,5,7,8-tetramethyloxylchroman-2-carboxylic acid (Trolox®), Folin-Ciocalteu’s reagent and Tannic acid, A.C.S. reagent were purchased from Sigma Aldrich Chemical Co. Ltd.

2.2 Sample preparation
Six types of traditional Thai rice grown in Northeastern region of Thailand were selected in this study. The selected Thai rice were extracted by reflux in a bottle containing methanol (Commercial grade) at 120°C for 3 hrs. Each crude extract were dried under reduced pressure. The concentrated extracts were kept in refrigerator (4-5 °C) for antioxidant activity assays and methanol crude extract was used. The antioxidant activities of rice were tested by DPPH radical scavenging. Moreover total phenolic compounds (TPC) were evaluated. Rice extraction process for this study is summarized in Figure 1.

2.3 2-diphenyl-2-picrylhydrazyl (DPPH) assay
DPPH method is used in measuring the ability of antioxidants by DPPH method. The assay is based on electron-transfer that produces a purple solution and can absorb light at 517 nm wavelength. The test of antioxidant was performed by addition of 100 mL of the extract solution (5 mg/mL in methanol (MeOH, AR grade)) and was transferred into a test tube and then mixed with 2.9 mL DPPH solution and incubated in the dark at room temperature for 1 h. The absorbance of the mixture was then measured at 517 nm.

2.4 Total phenolic compounds (TPC)
TPC assay was tested by using Folin-Ciocalteu method by reacting phenolic compounds with phosphotungstic and phosphomolybdic acid. Briefly, 200 μL of crude extract (5 mg/mL methanol (MeOH, AR grade)) were adjusted the volume up to 2.5 mL with distilled water, mixed thoroughly with 0.5 mL of 50% Folin-
Ciocalteu reagent for 3 min, followed by the addition of 0.8 mL of 7%(w/v) sodium carbonate. The mixture was allowed to stand for 40 min in dark, and absorbance was measured at 765 nm. Tannic acid was used as the standard. Because tannic acid is a substance that has a lot of hydroxyl group (-OH), which is a group of aromatic rings of phenolic compounds that can prevent oxidation causing new free radicals to stabilize. Then the amount of total phenol was calculated in milligrams of tannic acid equivalent (TAE) to the extract rice samples of 1 gram.

3. Results and Discussion
3.1 2-diphenyl-2-picrylhydrazyl (DPPH) assay
The antioxidant percentages of methanol crude extract obtained from DPPH assay are shown in Table 1. The scavenging percentage of methanol crude extract ranged from 21.75±2.48 to 70.27±7.34%. The result indicated that Hommali germinated brown rice showed highest antioxidant activity of the crude extract with 70.27±7.34%.

Table 1. DPPH radical scavenging activity of the crude extract. (% scavenging effect)

<table>
<thead>
<tr>
<th>Rice Variety</th>
<th>Processing</th>
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<tbody>
<tr>
<td>Mali normal</td>
<td>21.75±2.48</td>
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<tr>
<td>Brown</td>
<td>28.77±0.66</td>
</tr>
<tr>
<td>Mali-insee brown</td>
<td>31.16±1.99</td>
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<tr>
<td>Hommali Dang-insee brown</td>
<td>40.47±1.49</td>
</tr>
<tr>
<td>Homnin brown</td>
<td>55.41±4.15</td>
</tr>
<tr>
<td>Homnin germinated brown</td>
<td>70.27±7.34</td>
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</tbody>
</table>

Values are of three experiments ± SD

3.2 Total phenolic compounds (TPC)
Table 2 shows the total content of phenolic compounds of the methanol crude extract. The total content of phenolic compounds ranged from 47.62±12 to 172.4±34 mg TAE/g dry weight tannic acid. The highest total phenolic content of methanol crude extract was Hommali-insee brown rice and Hommali germinated brown rice with 172.4±34 and 156.1±39 mg TAE/g dry weight tannic acid, respectively.

Table 2. Total phenolic contents of the crude extract. (mg TAE/g dry weight tannic acid)

<table>
<thead>
<tr>
<th>Rice Variety</th>
<th>Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mali normal</td>
<td>47.62±12</td>
</tr>
<tr>
<td>Brown</td>
<td>66.47±5.1</td>
</tr>
<tr>
<td>Mali-insee brown</td>
<td>83.81±8.8</td>
</tr>
<tr>
<td>Hommali Dang-insee brown</td>
<td>105.8±15</td>
</tr>
<tr>
<td>Homnin brown</td>
<td>172.4±34</td>
</tr>
<tr>
<td>Homnin germinated brown</td>
<td>156.1±39</td>
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</tbody>
</table>

Values are of three experiments ± SD

4. Conclusion
The antioxidant activities of six types of rice were evaluated by using DPPH method and Folin-Ciocalteu method. The selected rice were extracted by methanol. The antioxidant activities of traditional Thai rice obtained from DPPH method indicated that Hommali germinated brown rice showed the highest antioxidant activity of the crude extract with 70.27±7.34%. Since Homnin germinated brown rice is black rice with germination process, resulting in the highest antioxidant activity. For Folin-Ciocalteu method, Hommali-insee brown rice showed highest total phenolic compound with were 172.4±34 mg TAE/g dry weight tannic acid. The determination of antioxidants using DPPH method and Folin-Ciocalteu method can conclude that germinated brown rice showed better antioxidant activity and total phenolic compound than the less color rice or normal rice. Therefore, colored rice should be chosen to consume. Therefore, Thai rice varieties with color are excellent sources for health-promoting nutrient.

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References