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Evaluation of Antioxidant Activities of Cabbage (*Brassica oleracea* L. var. *capitata* L.)

Rutanachai Thaipratum

***Abstract*—**At present, it is widely-known that free radicals are the causes of illness such as cancers, coronary heart disease, Alzheimer's disease and aging. One method of protection from free radical is the consumption of antioxidant-containing foods or herbs. Several analytical methods have been used for qualitative and quantitative determination of antioxidants. This project aimed to evaluate antioxidant activity of ethanolic and aqueous extracts from cabbage (*Brassicca oleracea* L. var. *capitata* L.) measured by DPPH and Hydroxyl radical scavenging method. The results show that averaged antioxidant activity measured in ethanolic extract (μmol Ascorbic acid equivalent/g fresh mass) were 7.316 ± 0.715 and 4.66 ± 1.029 as determined by DPPH and Hydroxyl radical scavenging activity assays respectively. Averaged antioxidant activity measured in aqueous extract (μmol Ascorbic acid equivalent/g fresh mass) were 15.141 ± 2.092 and 4.955 ± 1.975 as determined by DPPH and Hydroxyl radical scavenging activity assays respectively.

***Keywords*—**Free radical, antioxidant, cabbage, *Brassicca oleracea* L. var. *capitata* L.

I. Introduction

PEOPLE pay more attention on health and beauty as can be seen for the number of researches on beneficial substances and toxic substances especially on the research of free radicals and antioxidants. Free radicals are very unstable and react quickly with other compounds, trying to capture the needed electron to gain stability. Generally, free radicals attack the nearest stable molecule, "stealing" its electron. When the "attacked" molecule loses its electron, it becomes a free radical itself, beginning a chain reaction. Once the process is started, it can cascade, finally resulting in the disruption of a living cell. Some free radicals arise normally during metabolism. Sometimes the body's immune system's cells purposefully create them to neutralize viruses and bacteria. However, environmental factors such as pollution, radiation, cigarette smoke and herbicides can also spawn free radicals. Theses free radicals can be get rid or reduced their toxin by antioxidants. Antioxidants neutralize free radicals by donating one of their own electrons, ending the electron-"stealing" reaction. The antioxidant nutrients themselves do not become free radicals by donating an electron because they are stable in either form they act as scavengers, helping to prevent cell and tissue damage that could lead to cellular damage and disease. There are 2 types of antioxidants; the synthetic and the natural one. The natural antioxidants are believed as safer than the synthetic. They can be found in Vitamin C, E, and Beta-carotene which can be found in microbes, animals, and plants. Antioxidants do not give any nutritional value due to its composition structure of phenolic compounds such as xanthone and flavonoid. Because plants are the main source of antioxidants, this research investigates the potential of cabbage which is popularly consumed vegetable. Cabbage contains high amount of antioxidants which play an important role in getting rid of hydroxyl radicals considered to be the free radicals causing several serious diseases such as cancer, heart disease, diabetes, etc [1]. This project aimed to evaluate antioxidant activity of ethanolic and aqueous extracts from cabbage measured by DPPH and Hydroxyl radical scavenging method.

Rutanachai Thaipratum is with the Department of Science, Faculty of Science and Technology, Suan Sunandha Rajabhat University, Thailand (e-mail: Rutanachai.th@ssru.ac.th, Sindnas@hotmail.com).

II. Materials and Method

A. Plant Material

Brassicca oleracea L. var. *capitata* L. was purchased from the Nonthaburi province of Thailand.

B. Chemicals and Reagents

DPPH (α, α-Diphenyl-β-picrylhydrazyl), $FeSO_4.7H_2O$, 1, 10-phenanthroline and L-ascorbic acid were purchased from Sigma Aldrich Co., Ltd. Ethanol was purchased from Merck Co., Ltd. All other solvents and chemicals were of analytical grade.

C. Preparation of Plant Extracts

The plant samples were ground in a mortar. Slurries were then extracted with distilled water or ethanol then were centrifuged at 13,000 g for 10 min and the supernatants were collected.

D. Antioxidant Activities

The DPPH radical-scavenging activity of samples was monitored according to the method of Luo *et al* [2]. Briefly, a 2.0 ml aliquot of test sample (0.4, 0.8, 1.2, 1.6 and 2 g/ml) was added 2.0 ml of 0.16×10^{-3} mol/l DPPH ethanolic solution. The mixture was vortexed for 1 min and then left to stand at room temperature for 30 min in the dark, and its absorbance was measured at 517 nm. The ability to scavenge DPPH radical was calculated using the following equation:

$$\text{DPPH radical scavenging activity (\%)} = [1 - (\text{A sample} - \text{A sample blank})/\text{A control}] \times 100$$

where the A control is the absorbance of the control (DPPH solution without sample), the A sample is the absorbance of

the test sample (DPPH solution plus test sample), and the A sample blank is the absorbance of the sample only (sample without DPPH solution). L-ascorbic acid was used as positive controls.

The hydroxyl radical-scavenging activity of samples was measured according to the method of previous report [3]-[5] with some modifications. In this system, hydroxyl radicals were generated by the Fenton reaction. Hydroxyl radicals could oxidize Fe^{2+} into Fe^{3+}, and only Fe^{2+} could be combined with 1, 10-phenanthroline to form a red compound (1,10-phenanthroline-Fe2+) with the maximum absorbance at 536 nm. The concentration of hydroxyl radical was reflected by the degree of decolourization of the reaction solution. Briefly, 1, 10-phenanthroline solution (1.0 ml, 1.865×10^{-3} mol/l), phosphate buffer saline (2.0 ml, 0.2 mol/l, pH 7.40), and samples (1.0 ml, 0.125, 0.25, 0.5, 1 and 2 g/ml) were added into a screw-capped tube orderly and mixed homogeneously. The $FeSO_4.7H_2O$ solution (1.0 ml, 1.865×10^{-3} mol/l) was then pipetted into the mixture. The reaction was initiated by adding 1.0 ml H_2O_2 (0.03% v/v). After incubation at 37°C for 60 min in a water bath, the absorbance of reaction mixture was measured at 536 nm against reagent blank. The reaction mixture without any antioxidant was used as the negative control, and without H_2O_2 was used as the blank. The hydroxyl radical scavenging activity was calculated by the following formula:

$$\text{Hydroxyl radical scavenging activity (\%)} = [(As\text{-}An)/(Ab\text{-}An)] \times 100$$

where As, An, and Ab were the absorbance values determined at 536 nm of the sample, the negative control, and the blank after reaction, respectively. L-ascorbic acid was used as positive controls.

III. Results and Discussion

The antioxidant activities of extracts from cabbage on DPPH and hydroxyl radicals, expressed as DPPH radical scavenging activity (%) and hydroxyl radical scavenging activity (%), were showed in Figs. 1-4. The antioxidant activities were found to be dose-dependent.

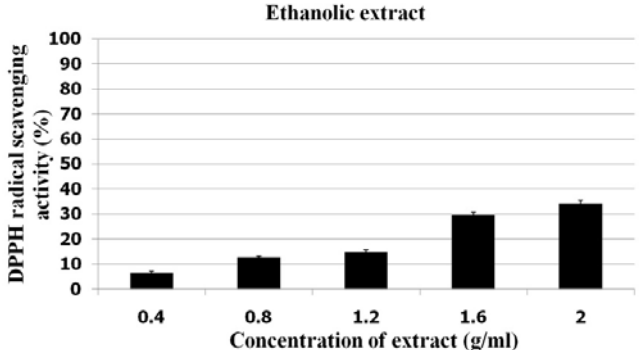

Fig. 1 DPPH radical scavenging activity (%) of ethanolic extracts from cabbage. Data points shown are averages of three measurement ± SE

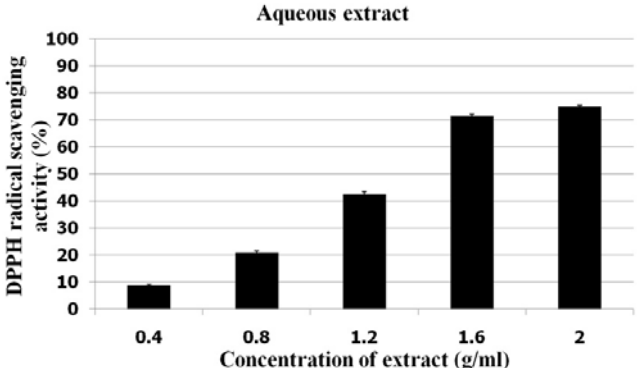

Fig. 2 DPPH radical scavenging activity (%) of aqueous extracts from cabbage. Data points shown are averages of three measurement ± SE

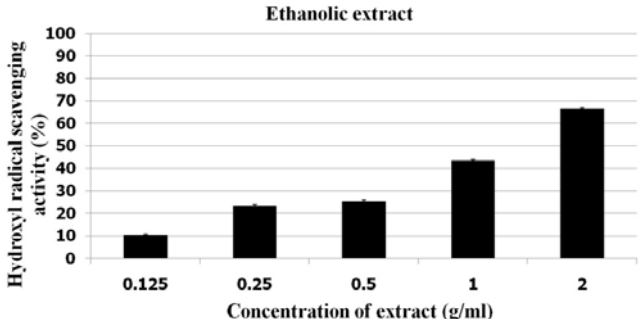

Fig. 3 Hydroxyl radical scavenging activity (%) of ethanolic extracts from cabbage. Data points shown are averages of three measurement ± SE

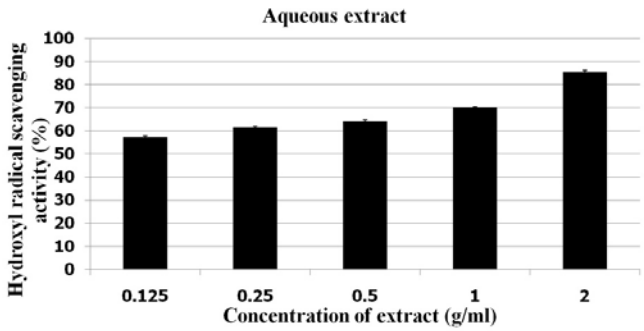

Fig. 4 Hydroxyl radical scavenging activity (%) of aqueous extracts from cabbage. Data points shown are averages of three measurement ± SE

IV. Conclusion

To evaluate antioxidant activity of ethanolic and aqueous extracts from cabbage measured by DPPH and Hydroxyl radical scavenging method, the results show that the averaged antioxidant activity measured in ethanolic extract (μmol Ascorbic acid equivalent/g fresh mass) were 7.316 ± 0.715 and 4.66 ± 1.029 as determined by DPPH and Hydroxyl radical scavenging activity assays respectively. Averaged antioxidant activity measured in aqueous extract (μmol Ascorbic acid equivalent/g fresh mass) were 15.141 ± 2.092

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Rutanachai Thaipratum was born in Nakhon Ratchasima City (a city in the northeast of Thailand) on March 20, 1982. He received his B.Sc. degree in Biochemistry from Khon Kaen University (KKU), Khon Kaen, Thailand in 2002 and Ph.D. degree in Biochemistry from Mahidol University (MU), Bangkok, Thailand in 2009. Since June 2010, he has been a lecturer of the Department of Science at Suan Sunandha Rajabhat University (SSRU), in Bangkok. His main research interests include plant biochemistry and physiology.