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Content of Beta-Carotene, Xanthophyll, Lutein and Zeaxanthin in Vegetables as Thai Side Dish

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Abstract. The beta-carotene, xanthophyll and zeaxanthin levels in 20 selected kinds of Thai side dish vegetables were determined by high performance liquid chromatography (HPLC). The result shown that there is beta-carotene in all selected kinds of vegetables. The highest of average beta-carotene (303.96±4.86 mg/100g edible portion) and xanthophyll contents (101.44±5.17 mg/100g edible portion) were found in Wild betal Leaf bush. The average zeaxanthin level (7.03±0.04 mg/100g edible portion) was the highest in Asiatic Pennywort, Indian Pennywort, or Tiger Herbal. Whereas lutein was detected only in Swamp Morning Glory or Water Morning Glory about 3.29±0.02mg/100g edible portion. This result revealed that the high potential vegetables include Wild betal Leaf bush, Asiatic Pennywort, Indian Pennywort, or Tiger Herbal were rich in beta-carotene, xanthophyll and zeaxanthin. It is useful for suggested that some kinds of side dish vegetables should be consumed as rich source of beta-carotene, xanthophyll and zeaxanthin for health benefits.

Keywords: Beta-carotene, Xanthophyll, Lutein, Zeaxanthin, Thai side dish, Vegetables.

1. Introduction

Nam phrik, a sauce of shrimp paste and chili, eaten with vegetables as side dish is one popular type of Thai food that most of Thai peoples usually have in their meal. There are varieties of Nam phrik. Because of their strong taste, spicy and sour, Nam phrik usually have been consumed with some kinds of vegetables as side dishes including winged bean, yard long bean, eggplant etc.[1],[2] Thai people favour to eat varieties of fresh vegetable in onetime for side dish.[1],[2] In recent days, most of people known that vegetable is high nutrition values due to fiber, vitamin and mineral contents.

However, fresh vegetables constitute important functional food component that less people have known. Therefore the study of such benefits of fresh vegetables is useful and importance. Landrum and Bone [3] reported that vegetables and fruits are a good source of minerals, vitamins and phytochemicals. The one of natural phytochemicals that have been very interested is vegetable pigment group such as beta-carotene, xanthophyll, lutein and zeaxanthin.[3,4] They are known as carotenoid that have important role not only the colouration in vegetables but also prevention of various diseases in human health. Literature survey on health benefits of photosynthetic pigment group are reported to be powerful antioxidants. In addition, epidemiological studies have demonstrated the inverse relationship between the consumption of pigment group rich vegetables and rick of incidence of cancer, cardiovascular disease, age related macular degeneration (ARMD) and cataract formation.[5] Moreover, Perry et. al. [16] have reviewed that xanthophylls, lutein, and zeaxanthin are thought to provide protection to the eye by the absorption of damaging near - to - UV blue light and/or as antioxidants. In facts, human body cannot create or synthesis these phytochemical by metabolism process. The good way to get value from pigment group is from diets in natural foods, such as fruits and vegetables. However, the high intake of pigment compounds is still not considered as an essential nutrient. Since some reports revealed that high consume pigment group as supplement risk of carotenoid toxicity like a carotenedermia.[5],[6] A tell-tale sign of excessive consumption of beta-carotene is a yellowish discoloration of the skin, most often occurring in the palms of the hands and

soles of the feet.[5] This indicated that many a significant sources of dietary xanthophyll, lutein and zeaxanthin come from vegetables and fruits.[3],[4] Consequently, the interest in pigment groups such as Beta-carotene, xanthophyll, lutein and zeaxanthin in edible plants is necessary because it may reveal rich source of Beta-carotene, xanthophyll, lutein and zeaxanthin.

Although Thailand possesses a great edible plant biodiversity, there are not however previous report on their caroteniod content. Hence reliable data on carotenoids and other micronutrients in vegetables provide not only information for good sources of beta-carotene, xanthophyll, lutein, and zeaxanthin but also assessing the dietary intake of these pigments and their relationship with ARMD. This research was carried out with an aim to evaluate the levels of beta-carotene, xanthophyll, lutein, and zeaxanthin in Thai side dish vegetables. Knowing their pigment contents can be used as fundamental data for nutritionists or public health workers to recommend consumers to select appropriate types of Thai side dishes vegetables in amount for their health needs.

2. Materials and Methods

2.1. Sample

Twenty types of popular Thai side dish vegetables were selected for HPLC analysis for beta-carotene, xanthophyll, lutein and zeaxanthin contents. Fresh vegetables used in this study were purchased from the local market at Mahasarakham province, Thailand. All of vegetables are cleaned and trimmed of only edible portion before they were used and analysed. The common name, scientific name of these vegetables and edible portion are given in Table 1.

2.2. Extraction and Determination of Xanthophyll Lutein and Zeaxanthin Content

Fresh vegetables as edible portion were crushed and then extracted in solvents (The method that used for extraction efficiency in this study is chloroform: methanol (2:1v/v)). Approximately 5 grams (dry weight) of well-ground samples was extracted with 50.0 ml of solvent and stored at room temperature and evaporated under reduced pressure at 25°C. The liquid phase was filtered and washed 3 times with a saturated sodium chloride solution. The organic layer was taken and dehydrated with anhydrous sodium sulphate and evaporated under reduced pressure at 25°C. The residue was dissolved in 10 ml solution of dichloromethane(DCM) and MeOH(6:4). The contents of beta-carotene, xanthophyll, lutein and zeaxanthin were quantified by high pressure liquid chromatography(HPLC) as recommended by Nhungetal.[7],[8] The RP-HPLC system (Shimadzu) consisted of an auto sampler and column oven equipped with Inertsil ODS(4.6mm×250mm,5lm) with mobile phase of DCM : acetonitrile (6:4,v/v, containing 0.05:BHA as antioxidant) (eluentA) and MeOH(eluentB). The following gradient was used: initial condition was 70%(A) and 30%(B) for 5 min, followed by 80%(A) and 20%(B) for 5 min. The flowing rate is 1.5 ml/min. Injection volume 20 μl and photodiode array detector at 472 nm for the analysis of lycopene and beta-carotene. Calibration curves were constructed with the external standards.

2.3. Statistical Analysis

This study used the means of triplicate determination on three batches of each vegetables with completely randomized design. Data analyses of xanthophyll, lutein and zeaxanthin content were performed by SPSS software version 13. A significant difference was considered values differing at the confidence level of $p<0.05$.

3. Result and Discussion

The quantity and variety of vegetables consumed is constantly increasing because of their nutritional benefits. There are varieties of fresh vegetables that play their role as side dishes in the market. Twenty fresh vegetables that grown in all of season in Thailand were selected in this research and determined pigment content. The common name, scientific name and edible portions are shown in Table 1.

Table 1 shown common name and scientific name of selected vegetables. In addition, the edible portion of vegetables that Thai people usually consume is also shown in Table 1. There are many edible portions of vegetables that people choose to eat with Nam phrik. Vegetables in dishes can support the taste of Nam

phrik to be less spicy. Furthermore, consumer interest in more kinds of vegetables like herbs but they taste bitter. In Thailand, varieties of vegetables have been eaten for centuries with traditional food such Nam phrik so consumers have useful on health benefits of vegetables.

Table 1 Common names, scientific name and edible portion of Thai side dish vegetables for analyze

Common name	Scientific name	Edible portion
Winged Bean	*Psophocarpus tetragonolobus* Linn.	fruit
Egg plant	*Solanum melongena L.*	fruit
Chinese Cabbage-PAI TSAI	*Brassica pekinensis*	leaf,flower
Swamp Morning Glory, Water Morning Glory	*Ipomcea aquatica Forsk.*	young stem
Chinese Cabbage	*Brassica pekinensis*	leaf
Chinese White Cabbage	*Brassica chinensis* (L.) Jusl.	leaf
Cabbage, Common Cabbage, White Cabbage, Red Cabbage	*Brassica oleracea* L. var. capitata L.	leaf
Devil's fig	*Solanum torvum Swartz*	fruit
Yellow berried nightshade	*Solanum xanthocarpum* Schrad. & Wendl.	fruit
Yard long bean, Asparagus bean.	*Vigna sesquipedalis Koern.*	fruit
Smooth Loofah	*Luffa cylindrica* (L.) M.Roem.	fruit
Asiatic Pennywort, Indian Pennywort, Tiger Herbal	*Centella asiatica* (L.) Urb.	leaf,stem
Wildbetal Leafbush	*Piper sarmentosum* Roxb.)	leaf
Ivy Gourd	*Coccinia grandis* (L.) Voigt	leaf,young stem
Balsam pear, Bitter cucumber	*Momordica charantin* Linn	fruit
Okra, Lady's Finger	*Abelmoschus esculentus* Linn.	fruit
Acacia pennata	*Acacia pennata* (L.) Willd.	leaf
Cowslip creeper	*Telosma minor* Craib	flower
Glalangal, Greater Galangal,Chinese Ginger	*Alpinia nigra (Gaertn.)*B.L.Burtt	shoot
Dill	*Anethum graveolens* Linn.	leaf,stem

Table 2: Amount of Xanthophyll, Lutein and Zeaxanthin in selected Thai fruits determine by HPLC)mg/100g)

Common name	Beta-carotene (mg/100g)	Xanthophyll)mg/100g)	Zeaxanthin)mg/100g)	Lutein)mg/100g)
Winged Bean	13.17±0.07	0.44±0.04	0.40±0.01	ND
Egg plant	3.05±0.08	0.29±0.01	ND	ND
Chinese Cabbage-PAI TSAI	57.19±1.23	17.60±0.94	2.036±0.07	ND
Swamp Morning Glory, Water Morning Glory	28.75±0.33	3.53±0.01	0.46±0.01	3.29±0.02
Chinese Cabbage	48.30±0.53	18.14±0.35	1.83±0.01	ND
Chinese White Cabbage	4.94±0.14	2.23±0.11	0.16±0.01	ND
Cabbage, Common Cabbage, White Cabbage, Red Cabbage	5.46±0.23	0.90±0.02	0.07±0.01	ND
Devil's fig	9.13±0.03	3.05±0.10	0.23±0.01	ND
Yellow berried nightshade	5.89±0.14	1.32±0.01	0.09±0.01	ND
Yard long bean, Asparagus bean.	12.79±0.31	3.22±0.07	0.36±0.01	ND
Smooth Loofah	9.90±0.02	3.84±0.10	0.28±0.01	ND
Asiatic Pennywort, Indian Pennywort, Tiger Herbal	248.60±0.62	92.76±1.08	7.03±0.04	ND
Wild betal Leaf bush	303.96±4.86	101.44±5.17	5.43±0.24	ND
Ivy Gourd	17.13±0.65	5.39±0.19	0.59±0.01	ND
Balsam pear, Bitter cucumber	169.70±3.05	47.88±096	5.36±0.20	ND
Okra, Lady's Finger	31.13±1.09	9.56±0.15	1.22±0.09	ND
Acacia pennata	18.20±1.32	3.50±0.25	0.41±0.02	ND
Cowslip creeper	22.10±0.55	2.77±0.12	0.30±0.01	ND
Glalangal, Greater Galangal,Chinese Ginger	143.86±0.63	34.33±1.66	3.56±0.12	ND
Dill	9.36±0.24	1.59±0.07	0.24±0.02	ND

ND = not Detect, Values are shown in mean ± SD of triplicate measurement.

The selected vegetables were evaluated for xanthophylls (lutein and zeaxanthin) and carotenoids (beta-carotene) levels by HPLC(Table 2). Table 2 illustrated the contents of beta-carotene, xanthophyll, lutein and zeaxanthin of vegetables. Interestingly, the beta-carotene content in the selected vegetables was higher than xanthophyll, lutein and zeaxanthin. The result shown that the beta-carotene has presented in all kinds of vegetables. The highest beta-carotene content was found in Wild betal Leaf bush (303.96±4.86 mg/100g edible portion). Further, the level of beta-carotene was high in Asiatic Pennywort, Indian Pennywort, Tiger Herbal (248.60±0.62 mg/100g edible portion). While the lowest beta-carotene content was measured in egg plant (3.05±0.08 mg/100g edible portion). The content of xanthophyll in vegetables analyzed in this study varied between 0.29±0.01 (egg plant) and 101.44±5.17 mg/100g edible portion (Wild betal Leaf bush). Asiatic Pennywort, Indian Pennywort and Tiger Herbal have represented the good sources of dietary xanthophyll (92.72±1.08 mg/100g edible portion). Moreover, the best sources of zeaxanthin among the vegetables analysed in this study were Asiatic Pennywort, Indian Pennywort and Tiger Herbal that their levels of zeaxanthin were 7.03±0.04 mg/100g edible portion, followed by Wild betal Leaf bush (5.43±0.24mg/100g edible portion). Whereas the selected vegetables represent a weak source of lutein due to the discovery that lutien was detected only in Swamp Morning Glory and Water Morning Glory (3.29±0.02mg/100g edible portion).

4. Conclusions

It is true that Landrum and Bone[3] reported fruits and vegetables are a good source of minerals, vitamins and phytochemicals. In conclusion, many kinds of the vegetables analyzed in this study were rich in carotenoids such as xanthophylls and beta-carotene. It clearly shown that people who consume vegetables as side dishes will get health benefits from beta-carotene, xanthophyll and zeaxanthin. In the other hands, lutein seem to be very low in vegetables. Among the selected vegetables, Wild betal Leaf bush, Asiatic Pennywort, Indian Pennywort and Tiger Herbal are found to be rich in beta-carotene, xanthophyll and zeaxanthin content. The obtained result generated important data that could be helpful in health promotion and make nutritionist confidence to recommend people to overcome health problems like prevention of disease. From recommended dietary intakes (RDI) reviewed that beta-carotene intake is 15 mg per day. It means that people can choose to consume Nam phrik with Wild betal Leaf bush only 10 g edible portion per day which is enough for regulation body function. Futhermore, a recent study shows that 10 mg per day of zeaxanthin is required to improve the vision in ARMD risk patients.[15] It conclude that people should consume Nam phrik with the amount of Asiatic Pennywort, Indian Pennywort or Tiger Herbal at 150 g. edible portion per day for providing their required.

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