Determination of Natural Colour from 10 Edible Plants in Kamphaeng Phet Province,Thailand

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Abstract. Natural colour from 10 edible plants were extracted using water. *Clitoria ternatea* Linn. extract showed greater Anthocyanin (blue colour), *Tiliacora triandra* Diels extract showed greater Beta-carotene (orange colour) and *Colubrina asiatica* L. ex Brongn extract showed greater both of Chlorophyll (a and b) than others edible plants. The results demonstrated that the colour parameter obtained from all edible plants were difference in darkness. *Amaranthus lividus* L. were difference in redder and *Clitoria ternatea* Linn. were difference in bluer. However, when the colour stability was considered, the results revealed that *Clitoria ternatea* Linn. extract showed greater colour stability for blue colour, *Basella alba* Linn. extract showed greater colour stability for orange colour and *Amaranthus lividus* L. extract showed greater colour stability for green colour.

1. Introduction

Colour is a measured of quality and nutrient contenting foods [1] and often overlooked sensory character that certainly influences flavor perception to customer [2]. There is an increasing demand for scientific interest in new natural colourants and the application of these natural colour as environmental awareness public concern about pollution increase and public health [3,4]. Natural colours were obtained from plants, insects/animals and minerals but only a few have ever been used on a commercial scale. There are renewable and sustainable bio-resource products with minimum environmental impact and known since antiquity for their use, not only in colouration of textiles but also as food that have been used for colour food. Some of the most common ones are Anthocyanin, Beta-carotene and Chlorophyll. Anthocyanin is the best natural source for deep purple and blue colours and it is soluble in water, so they can be used to colour water-based products. Moreover, its associated flavonoids that have demonstrated ability to protect against a myriad of human diseases, yet they have been notoriously difficult to study with regard to human health [5]. Beta-carotene have a deep red, yellow or orange colour beta-carotene is soluble in fat, it is a great choice for colouring dairy products, which typically have a high fat content. Therefore, it is would be protect humans against cancer or cardiovascular diseases, showed decreased cardiovascular death rate in groups supplemented with carotenoid and has a variety of functions [6]. Chlorophyll main natural pigment, was found in all green plants [7] that has ability to prevent cancer and being used in cancer therapy because of their have more therapeutic properties [8]. Many literatures in Thailand related white natural colour from Thai plants such as *Terminalia chebula* Retz., *Clitoria ternatea* Linn., *Curcuma longa* L., *Kaempferia parviflora* Wall. ex Baker, *Maclura cochinchinensi* Corner., *Pterocarpus macrocarpus* Kurz, *Oryza sativa* L., *Carthamus tinctorius* L., *Diospyros mollis* Griff., *Tagetes erecta* L., *Caesalpinia sappan* L., *Terminalia Belerica* Roxb., *Hibiscus sabdariffa* L., *Tiliacora triandra* Diels, *Hylocereus undatus* L., *Indigofera tinctoria* Linn. and *Baphicacanthus cusia* Brem. [9-11]. Thailand is a country that presents great agro-ecological diversity and a large variety of vegetables. However, many colour plants in Kamphaeng Phet Province, In addition, traditional Thai foods are

interested to health-conscious consumers but literature did not coverage investigation. The aims of research were to measure colour, colour stability from 10 edible plants in Kamphaeng Phet province, Thailand finding potential source of natural colorant to produce the healthy food.

2. Material and Methods

2.1 Plant materials

The 10 edible plants were *Sauropus androgynous* (L.) Merr., *Tiliacora triandra* (Colebr.) Diels, *Amaranthus lividus* L., *Cratoxylum formosum* (Jack) Dyer, *Momordica charantia* Linn., *Passiflora foetida* Linn., *Glinus oppositifolius* A. DC., *Basella alba* Linn., *Colubrina asiatica* L. ex Brongn., and *Clitoria ternatea* Linn. were collected from local market and natural plants in Nakorn Chum sub-district, Kamphaeng Phet Province, Thailand as in Fig. 1.

Fig. 1. Varieties of edible plants from Kamphaeng Phet Province, Thailand

2.2 Preparation of plants extract

2.2.1 A direction of pigment extraction were follow:

- Cleaned or soak the fresh edible part of plants for example leaves or flowers and chop its into small pieces and crushing using mortar into a small size.
- Drop the edible part of plants into fast boiling water and boil for 2 to 3 minutes. And remove its and cool the liquid as quickly as possible. Blanched samples were used to homogenized accepted *Tiliacora triandra* Diels and *Clitoria ternatea* Linn. [12].
- Homogenized 100 grams of fresh edible part of plants leaves with 0.5 L of water in blender and filtrated by using filter paper extraction.

- The edible plants extract were boiled at 40° Celsius for 60 minute and kept its in refrigerator after packed in brown bottle at 20° Celsius for colour measuring in L*a*b units and colour stability.

2.2.2 Spectrophometric measurements were carried out at wavelengths of 535 nm for Anthocyanin, 436 nm for Beta-carotene and 645, 663 nm for Chlorophyll a and b, respectively.

3. Results and discussion

3.1 The extract yield from 10 edible plants extract

The pigments from 10 edible plants were extracted with water. Edible plants pigments of Anthocyanin, Beta-carotene and Chlorophyll a and b were determined using spectrophotometry. The resulted found that high amount the blue colour (Anthocyanin) obtained from *Clitoria ternatea* Linn., *Passiflora foetida Linn*, and *Colubrina asiatica* L. ex Brongn extract were 11.784, 11.523 and 8.572 mg/100 g fresh weight, respectively. The studied according to Kungsuwan, K. et al. [13] that *Clitoria ternatea* Linn. is a source of natural coloring that used for food and cosmetics in Thailand. Its colour pigments are mostly comprised of Antocyanin which show high antioxidant activity and ability to change colour according to pH. Therefore, it has been used as food colorants as well as components of pharmaceutical preparations and functional foods [14].

The greater amount of orange colour (Beta-carotene) obtained from *Tiliacora triandra* Diels., *Basella rubra* Linn, and *Glinus oppositifolius A. DC.* extract were 9.720, 6.125 and 5.972 mg/100 g fresh weight, respectively. These resulted according to Kaewpiboon, C. et al. [15] revealed that *Tiliacora triandra* is an angiospermic plant that is native to mainland Southeast Asia, is naturally abundant in Thailand. In addition, *T. triandra* leaves have been shown to be a natural source of antioxidants, containing high levels of beta-carotene, condensed tannins, triterpenes, flavonoids and saponins, as well as minerals, such as calcium and iron.

Furthermore, the high amount of green colour a (Chlorophyll a) obtained from *Colubrina asiatica* L. ex Brongn., *Tiliacora triandra* Diels. and *Amaranthus lividus* L. extract were 0.182, 0.079 and 0.061 mg/100 g fresh weight, respectively. Moreover, the highest amount of green colour b (Chlorophyll b) from *Colubrina asiatica* Brongn., *Tiliacora triandra* Diels., and *Amaranthus lividus* L. extract were 0.085, 0.058 and 0.045 mg/100 g fresh weight, respectively (table 1.)

Table 1. The extract yield from 10 edible plants extract (mg/ 100 g fresh weight)

Edible plants	**Anthocyanin (Blue Colour)**	**Beta-carotene (Orange colour)**	**Chlorophyll a (Green Colour a)**	**Chlorophyll b (Green Colour b)**
Sauropus androgynus Merr	5.140	3.035	0.031	0.021
Tiliacora triandra Diels	6.405	9.720[1]	0.079[2]	0.058[2]
Amaranthus lividus	4.567	2.235	0.061[3]	0.045[3]
Cratoxylum formosum (Jack) Dyer	3.471	1.640	0.012	0.009
Momordica charantia Linn	8.151	3.300	0.025	0.014
Passiflora foetida Linn	11.523[2]	3.175	0.029	0.014
Glinus oppositifolius A. DC.	4.782	5.970[3]	0.052	0.036
Basella alba Linn	7.527	6.125[2]	0.053	0.036
Colubrina asiatica L. ex Brongn	8.572[3]	1.780	0.182[1]	0.085[1]
Clitoria ternatea Linn.	11.748[1]	3.240	0.024	0.016

* Number 1,2,3 Means the ranking of extract yield from 10 edible plants extract

3.2 Colour measuring in L*a*b units

The colour variation in the aqueous solutions of crude extracts were studied. The results demonstrated that all edible plants were difference in darkness. Mostly of edible plants were difference in greener accepted *Amaranthus lividus* L. (a^* = 3.32). Furthermore, mostly of edible plants were difference in yellower accepted *Clitoria ternatea* Linn. (b^* = -1.33) more details have shown in table 2.

Table 2. The colour measuring in L*a*b units of pigment from 10 edible extracted

Edible plants	Colour units		
	L^*	a^*	b^*
Sauropus androgynus Merr	13.47	-1.21	8.12
Tiliacora triandra Diels	11.61	-4.61	6.32
Amaranthus lividus L.	12.24	3.32	1.78
Cratoxylum formosum (Jack) Dyer	11.35	-2.15	6.10
Momordica charantia Linn.	13.50	-0.75	5.93
Passiflora foetida Linn.	8.37	-0.85	0.33
Glinus oppositifolius A. DC.	11.38	-2.28	7.14
Basella alba Linn.	11.97	-2.12	2.52
Colubrina asiatica L. ex Brongn	11.33	-0.66	6.44
Clitoria ternatea Linn.	3.38	-0.33	-1.33

L^* Means a difference in lightness and darkness (+ = lighter, - = darker),
a^* Means a difference in red and green (+ = redder, - = greener) and b^* Means a difference in yellow and blue (+ = yellower, - = bluer)

3.3 Colour stability

The colour stability of from *Clitoria ternatea* Linn., *Passiflora foetida* Linn., *Colubrina asiatica* L. ex Brong extract (blue colour) at 5 hr. were 11.748, 11.523 and 8.572 mg/100 g, respectively. The result after stored at 20°C and randomly analysis at 1 week to 5 week were 11.253, 8.654 and 8.042 mg/100 g, respectively. The results found that colour stability of all extract were decreased. The highest colour stability in 5 week was obtained from *Clitoria ternatea* Linn. extract.

The colour stability from *Tiliacora triandra* Diels, *Basella alba* Linn., *Glinus oppositifolius* A. DC. extract (orange colour) at 5 hr. were 9.720, 6.125 and 5.970 mg/100 g, respectively. The results after stored at 20°C and randomly analysis at 1 week to 5 week were 9.689, 6.102 and 5.892 mg/100 g, respectively. The results found that colour stability of all extract were decreased. The highest colour stability in 5 week was obtained from *Basella alba* Linn. extract. Some of research found that *Basella alba* Linn. has been used for many of its useful product from ancient times. Nowadays its properties have been utilized for the extraction of some useful material [16].

In additional, the colour stability from from *Colubrina asiatica* L. ex Brongn, *Tiliacora triandra* Diels, *Amaranthus lividus* L. extract (green colour, a) at 5 hr. were 0.182, 0.079 and 0.061 mg/100 g, respectively. The result after stored at 20°C and randomly analysis at 1 week to 5 week were 0.115, 0.037 and 0.032 mg/100 g, respectively. The results found that colour stability of all extract were decreased. The highest colour stability in 5 week was obtained from *Amaranthus lividus* L. extract. Moreover, colour stability from the same edible plants extract (green colour, b) and randomly analysis at 5 hr. were 0.085, 0.058 and 0.045 mg/100 g and after 5 week were 0.060, 0.038 and 0.027 mg/100 g, respectively. The results found that colour stability of all extract were decreased. The highest colour stability in 5 week was obtained from *Amaranthus lividus* L. extract.

4. Conclusion

Natural colour are containing of several pigments. The extract could be developed to prepare the ready-to-use natural blue colour from *Clitoria ternatea* Linn., orange colour from *Basella alba* Linn. and green colour from *Amaranthus lividus* L. by using water extraction. Finally, this method provides a rapid, low cost and harmless. This result suggested that some edible plant may be a potential source of natural colorant.

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