EXTRACTION AND DEVELOPMENT OF RED DRAGON FRUIT (*HYLOCEREUS POLYRHIZUS*) FOR COSMETIC APPLICATION

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Abstract.

This study aims to evaluate the natural pigment extract from red dragon fruit for application in cosmetics. Aqueous extraction from both pulp and peel of red dragon fruit wereperformed by varying extraction temperature. The color pigment content was determined based on the absorbance using Ultraviolet-visible (UV-Vis) at 535 nm. The result shows that the color intensity decreased with increasing temperature. In addition, the extract showsdecreased in total betacyanin content over time as it exposed to light. The extracts were powdered with corn starch and white clay and the stability of obtained color powder was studied. In conclusion, the natural pigment extracted from red dragon fruit using water as a solvent has a high potential to be used as a natural colorant.

Keywords: dragon fruit, natural pigment, pigment extraction, cosmetic

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Introduction

Dyes derived from the natural sources without chemical synthetic processing are known as natural dyes. Natural dyes obtained from different plants, animal and minerals resources. Natural colorant is an important group of non-wood forest products which find use in industries producing food products, textiles, cosmetics, medicines, paint, ink, etc. Consideringthe risks to the environment, human health and sustainability issues relating to the synthetic dyes, there has been a reignited global interest in natural dyes, which are eco-friendly and non-toxic (Ahlström, 2005).

Production cost of natural dyes from direct harvesting are high as compared to production costs from waste and byproducts. Therefore, the by-products from the agricultural food value chain could be the ideal source for extracting natural dyes (Ohama, 2014). In addition to reducing production costs, it also contributes to sustainability.

Red Dragon Fruit (*Hylocereus Polyrhizus*) is native to Mexico but is now cultivated worldwide, including in Vietnam, Taiwan, Southern China, Israel, and more recently inThailand. Consumption of dragon fruit in large levels will produce peel waste that is rarely used. However, it was reported that dragon fruit peel also has antioxidant capacity, antiproliferative effect (Madane *et al*., 2020).

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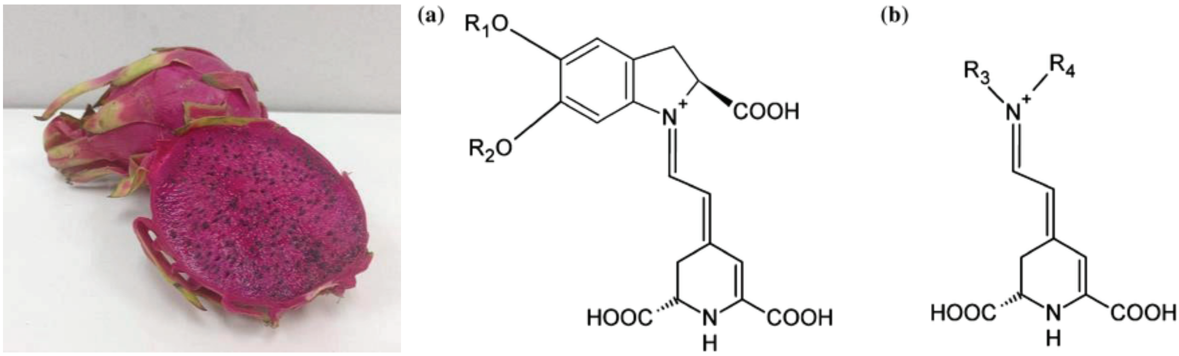
Figure 1: (left) Red Dragon Fruit and (right) Structures of betacyanins (a) and betaxanthins (b). R1 and R2:hydrogen, acyl or sugar moieties; R3: amine or amino acid group; R4: usually hydrogen



Source: Mohammad et al., 2019

Betalain pigments are responsible for imparting yellow, orange, red and purple color to flowers, grains, vegetables and fruits of a comparatively limited number of species all belonging to the suborder Chenopodiniae within the Caryophyllales (Stinzing *et al*., 2004). Betalain, which is having potential to be used as a natural colorant substitute for carotenoid, iscomposed of two major structural groups: (i) the red to red-violet betacyanins with an absorption maximum at 535-538 nm and (ii) the yellow-orange betaxanthins absorbing at 480 nm (Stintzing *et al*., 2002). Contrary to anthocyanins, betalains are more stable to pH and temperature (Ravichandran *et al*., 2013). However, they are unstable, especially in aqueous or moisture environment or when exposed to heat and/or light (Solymosi *et al*., 2015).

It was known worldwide that food loss and waste cause a huge value in economic losses. Therefore, there are efforts to reduce food waste to achieve the sustainable management and efficient use of natural resources, which is one of the Sustainable Development Goals (SDGs).The main objective of the present study was to investigate the extraction of natural pigment from waste red dragon fruit for application in cosmetics to promote efficient use of natural resources.

Experimental Methods

Extraction of Pigment from Red Dragon Fruit

Red dragon fruits were obtained from a local market in Bangkok, Thailand and were cleaned and peeled. Then fruit pulp and peel were cut into small pieces. Each 100 g of red dragon fruit peel and pulp were soaked into 400 ml of distilled water and boiled for 1 hrs. Thetemperature was varied from 30 – 100˚C. The optical density was determined with the help of UV-VIS spectrophotometer. Finally, the extract was tripple filtered by muslin, then pH of the extract was measured and the extract was stored in 4˚C for futur use.

In order to observe the storage stability, the extracts were stored in dark and clear vials fora week. The pH and UV-VIS absorbance were investigated everyday.

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Determination of natural pigment content

The natural betacyanin concentration was determined using Beer's Lambert law formula (Sambasevam *et al.*, 2020).

$$Betacyanin\ content\ (mg/L) = \frac{A \times MW}{\varepsilon \times b} \times DF \times 1000$$

Where:

A = absorbance (λ max)

MW = molecular weight of betacyanin, 550 g mol^{-1}DF = dilution factor

ε = molar extinction coefficients, 60,000 L mol^{-1} cm^{-1} in waterb= path length of cuvette, 1 cm

Synthesis of color powder from Red dragon fruit

A known amount of the white clay and corn starch was added to red dragon fruit extract ina 1:1 ratio and left for stirring. After 3 hr. of stirring, the solution was left to settle down. The mixture was dried in hot air oven at 60˚C for 3 hrs. and was crush using a pestle and mortar toobtain color powder.

The color of powder samples were determined by light reflectance technique using a Hunter Lab spectrophotometer Color Quest XE. The results are given in CIELab coordinates (L*, a*, b*): L* corresponding to the brightness (100 = white, 0 = black), a* to the red – green coordinate (+ve = red, -ve = green) and b* to the yellow – blue coordinate (+ve = yellow, -ve = green).

Results and Discussion

Extraction of Red dragon fruits

The color of the red dragon fruit extracts is indicated in Figure 2 and UV-VIS spectrum ofextract was shown in Figure 3.

Figure 2: Red Dragon Fruit extract, (a) peel extract (100°C), (b) peel extract (50°C), (c) pulp extract (100°C), (d) pulp extract (50°C), (e) pulp extract (30°C), (f) pulp extract (50°C), (g) pulp extract (80°C), (f) pulp extract (100°C). Extraction time was 30 minutes for sample (a)-(d) and 120 minutes for sample (e)-(h)

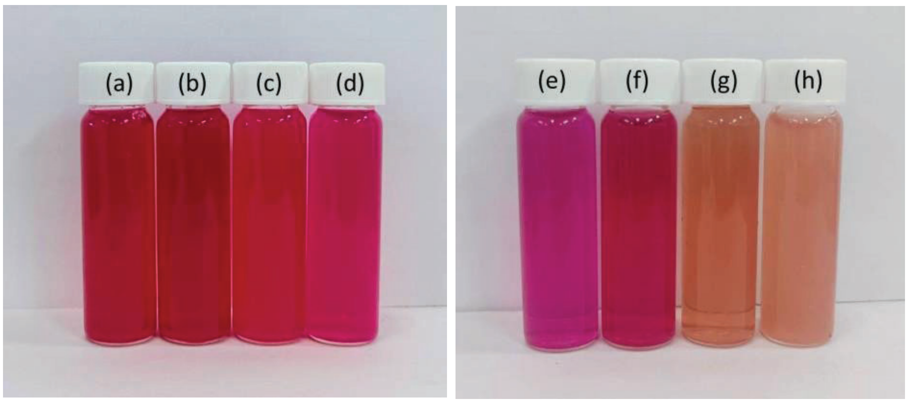

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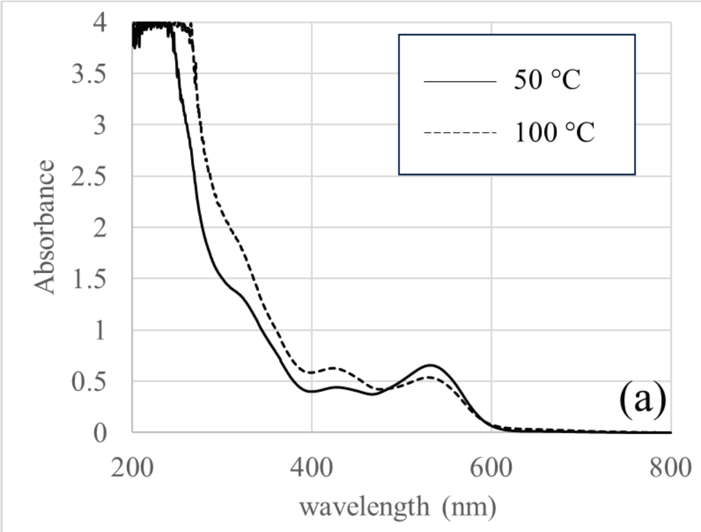
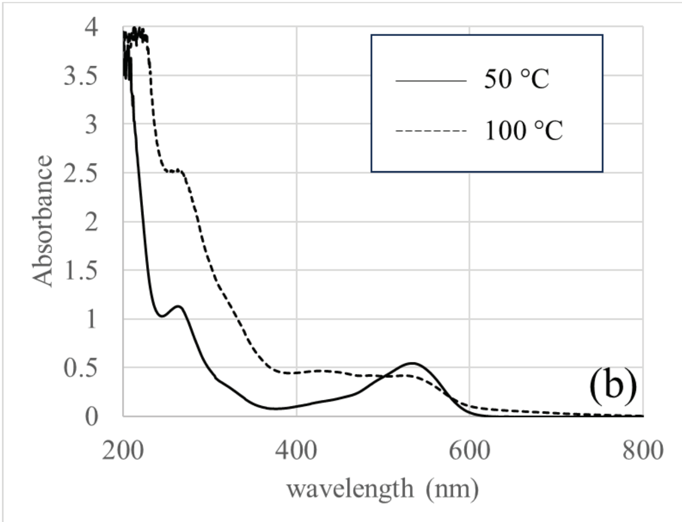
Figure 3: UV-VIS spectrum for red dragon fruit (a) peel and (b) pulp aqueous extract with extractiontemperature at 50°C and 100°C





The UV-visible absorption spectrum from the obtained extractions shows major maximum absorption at 270 nm in UV range and 536 nm in visible green range. These absorption peaks are characteristic absorption for the red-violet betalain group known as betacyanin (Sanchez, 2006; Sadowska-Bartosz and Bartosz, 2021). According to higher absorbance, extraction of red dragon fruit peel gives slightly higher betacyanin content compared to pulp. In addition, the dragon fruit peel extract shows maximum absorption at 430 nm, which is the range of yellow.

Figure 3 also shows the effect of temperature in the extraction of betacyanin from red dragon fruit. The decrease in the height of the absorption peak at 536 nm indicate that the total betacyanin content decreased as well as the color change of the extracts. On the other hand, the absorption of yellow pigment increased with increasing temperature. In this study, itwas observed that the red-violet color of betacyanin changed to light brown at 80 - 100 °C of extraction time. This is due to the increase in the betacyanin degradation rates as the temperature of extraction increased (Azeredo, 2009)

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The study of storage stability of extracts

The extracts were stored in dark and clear vials. The samples were collected daily for 7 days in order to observe the storage stability. The result was shown in Table 1. Consideringthe decrease in pH and total betacyanin content, it was found that the red dragon fruit peel extract was more stable than the pulp extract. Because the presence of light will affect the electron of double bonds in betacyanin molecules to be in the excited stage and cause the higher degradation of betacyanin (Kunnika and Pranee, 2011), the expose to light during storage significantly resulted in decrease in both pH and total betacyanin content.

Table 1: The storage stability of Red Dragon Fruit extract

Day	*H. Polyrhizus* Peel				*H. Polyrhizus* Pulp			
	pH		Total Betacyanin content (mg/L)		pH		Total Betacyanin content (mg/L)	
	Light	Dark	Light	Dark	Light	Dark	Light	Dark
0	5.36	5.36	17.88	17.88	4.92	4.92	17.88	17.88
1	5.11	4.62	18.70	18.70	5.01	4.93	18.15	17.88
2	5.32	4.37	13.75	17.60	4.62	4.35	12.38	13.75
3	5.29	4.43	17.33	17.88	4.81	4.86	11.83	12.65
4	5.30	4.36	15.95	17.33	4.14	4.25	11.55	11.55
5	5.32	4.40	16.23	16.50	3.75	4.23	9.900	10.45
6	5.58	4.31	15.95	16.23	3.09	3.47	8.800	9.635
7	5.86	4.35	14.58	15.13	3.05	3.10	8.250	8.800

Synthesis of color powder from Red dragon fruit

White clay and corn starch was added to red dragon fruit extract to obtain color powder. The color powder was stored for 2 weeks. The color of the samples was measured weekly andthe color coordinates, CIELab values are shown in Table 2.

Table 2: Absorption (%) K/S values and L, a*, b* values for Red Dragon Fruit color powder (CL000: clay powder, CL001: clay+pulp extract, CL002: clay+peel extract, PT000: corn starch, PT001; corn starch+ pulp extract and PT002: corn starch+ peel extract)*

Sample	Color coordinates						Appearance
	1st week			2nd week			
	L*	a*	b*	L*	a*	b*	
CL000	87.57	1.00	7.31	86.53	1.25	7.60	
CL001	80.20	8.52	6.03	80.29	7.19	7.49	
CL002	86.54	1.52	7.91	87.52	1.03	6.98	
PT000	95.75	0.08	3.51	95.6	0.13	3.24	
PT001	80.13	17.97	-6.77	80.35	17.69	-6.88	
PT002	83.81	12.21	-0.92	84.33	10.90	-0.14	

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Figure 3: Red Dragon Fruit color powder using (left) white clay powder and (right) corn starch as a colorabsorbent in a various ratio of color extract.

From the experimental results, it was found that powder obtained from clay showed the reddish-brown color while the powder from corn starch gave a pink color. Since the substances used as color absorbent had different whiteness, representing different L* values, the obtained color powder therefore showed different colors.

The powder made from pulp and peel extract of red dragon fruit also showed different color. The powder from pulp extract resulted in higher a*, which correlates with red color.

Conclusions

This work contributes to the increasing knowledge about the effect of heat on the extraction of betacyanins from red dragon fruits. As a result, it is evident that higher temperatures (>50 °C) lead to a greater pigment degradation. As commonly true for natural pigments, betacyanins are afflicted with inferior stability compared to synthetic dyes. In particular, temperature, oxygen and light are known to affect the stability of betacyanin.

The extract of super red dragon fruit can be used as colorant in color powder with storage period for 2 weeks at room temperature. In summary, the results show that the red dragon fruit could be a useful betacyanin source as a natural colorant to the food and cosmetic industry.

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