EXTRACTION AND STABILITY OF COSMETIC BIOACTIVE COMPOUNDS FROM DRAGON FRUIT PEEL

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Abstract

This study was purposed to extract and evaluate stability of cosmetic bioactive compounds from dragon fruit (*Hylocereus undatus*) peels. Five solvents including DI water, 50% ethanol, 95% ethanol, 50% propylene glycol (PG) and PG were compared in extraction efficacy. Microwave at 810 Watt was used to assist the extraction potential. Extractable phenolic content (EPC) assayed by Folin-Ciocalteu method and antioxidant capacity assayed by DPPH radical scavenging and ferric reducing antioxidant power (FRAP) assays were employed for comparative evaluation. The 50% PG extract showed the highest EPC and FRAP of 6.95 mg gallic acid equivalent per gram sample (GAE/g) and 363 mg trolox equivalent antioxidant capacity per gram sample (TEAC/g), respectively, whereas the 95% ethanolic extract provided the greatest DPPH scavenging capacity of 656.52 mg TEAC/g. Inclusion of 5% betel nut extract or 5% ginger extract did not affect color stability, while the latter increase the pH of the dragon fruit extract. Addition of betel nut and ginger extract to the dragon fruit extract were able to retain the EPC and antioxidant loss during storage. The former exhibited superior efficacy to the latter. Result of this study illustrated that the dragon fruit peel could be used as a source for cosmetic bioactive extraction due to it providing weather antioxidant and colorant capacity. Other plant source possessing high antioxidant activity was able to prolong the dragon fruit peel extract.

Keywords: antioxidant, cosmetic bioactive compound, dragon fruit, peel, stability

Introduction

Plant sources have been evaluated for developing natural antioxidants and melanogenesis inhibitors that are to be involved in anti-aging and skin whitening in cosmetic products (Lee et al., 2010). Interest in finding naturally occurring antioxidants in cosmetics, foods or medicines to replace synthetic antioxidants has increased considerably, given that synthetic antioxidants are being restricted due to their side effect. Moreover, natural antioxidants were considered with more safety, stability, and better antioxidant effects (Zheng et al., 2001).
Dragon fruit or pitaya is native in Latin America (Wanitchang et al., 2012) and has been grown in Vietnam for at least 100 years (Wichienchot et al., 2010). Dragon fruit exists in different variations of color known as white, magenta, and red and yellow (Juarez et al., 2010). In Thailand, the widely grown varieties and have been commercialized are *Hylocereus undatus* or red peel with white-flesh and *Hylocereus polyrhizus* (red peel with red-flesh). The red flesh variety is in particular richer in betalains which meet the increasing trade interest for antioxidant products and natural food colorants. Currently, there is much interest in

developing this crop for fresh fruit export beyond the local Asian markets of Singapore, Hong Kong, Taiwan, Philippines, Malaysia and Thailand (Hoa et al., 2006).
Due to the high consumption of their edible parts, their peels (as waste products) have been discharged, causing a severe problem in the community as they gradually ferment and release off odors. As part of ongoing research on antioxidants and other cosmetic bioactive compounds from natural resources, the peels of popular fruits become more interesting. There has been shown that extract of dragon fruit peel contained antioxidant activity and betalain. The various antioxidants that have good effect for reduce the free radicals (Wybraniec et al., 2007). Hence, dragon fruit peels might be attempted to use it as an alternative source for cosmetic bioactivity and color extraction.
Thereby, this research was aimed to study the extraction of cosmetic bioactive compound from the dragon fruit peels. Proper solvent for that extraction was also investigated. Folin-Ciocalteu method, DPPH and ferric reducing antioxidant power (FRAP) were used to assess the extractable phenolic content (EPC) and antioxidant capacities, respectively. For further utilization of the dragon fruit peel extract, its stability under various conditions was also determined.

Methodology

Sample preparation
Dragon fruit peel waste were obtained from Fah Thai market, Muang District, Chiang Rai. The peels were weighed and washed with tapping water and then air dried. The peels were then cut into 2 cm square and dried by a hot oven flow at 55°C. The sheet of peels were ground at twice then filter the powder to small with Hammer mill at 250 µm sieving. The peel powder was stored at -20 °C until used

Extraction of cosmetic bioactivity from dragon fruit peels
The cosmetic bioactive from dragon fruit peels was extracted by using 4 different solvent; DI water, 50% ethanol in water, 95% ethanol in water, 50% propylene glycol (PG) in water and100% PG. Ratio of ground sample to sample to solvent was 1:10 (w/v). The mixtures were subjected to microwave oven for assistance the extraction of cosmetic bioactive compounds. The microwave was carried out at 810 watt for 30 min. The extracts were obtained by filtration the mixture through a Whatman No.1 filter paper using aspirator pump.

Extraction of antioxidant from betel nut and ginger
Antioxidant from betel nut and ginger were extracted by using 95% ethanol. Ratio of ground sample and ethanol was 1:2 (w/v). The microwave was carried out at 810 watt for 30 min. The extracts were obtained by filtration the mixture through a Whatman No.1 filter paper using aspirator pump. The betel nut or ginger extract was used to include in dragon fruit peel extract for study of stability enhancement.

Absorption scanning of dragon fruit peel extract
The absorption spectra scanning between 400 – 700 nm of dragon fruit peel extract from various solvents were determined by using UV-Vis Spectrophotometer.

Determination of extractable phenolic content and antioxidant capacities
The extractable phenolic content was determined as described in Kumar et al. (2008) with some modifications. The result was expressed as gallic acid equivalent per gram extract (mg GAE/g). The antioxidant capacity was determined by DPPH radical scavenging assay

(Thaipong et al., 2006) and ferric reducing antioxidant power (Benzie and Strain, 1996) which was exhibited as mg trolox equivalent antioxidant capacity per gram extract (mg TEAC/g).

Determination of dragon fruit peel extract stability
Stability of dragon fruit peel extract (control) and the extract added with betel nut or ginger extract was performed by placing the 3 sample extracts under various conditions including 4°C dark, 4°C light, room temperature dark and room temperature light. All sample extracts were analyzed for their pH, color, EPC and antioxidant during 93 days storage. The pH and color was determined by pH meter and chromameter with CIE L*a*b* parameters system, respectively. The ΔE* values were calculated and expressed as color change result.

Results

Extraction of cosmetic bioactive compounds from dragon fruit peel.

The EPC and antioxidant capacity of dragon fruit peel extract shown in Table 1. The highest EPC of 6.95 mg GAE/g and the highest FRAP of 363 mg TEAC/g were found in 50% PG extraction, while the highest DPPH radical scavenging was observed that in 95% EtOH. Due to higher EPC and FRAP, the 50% PG was chosen for stability test.

Table 4.2 EPC and antioxidant capacities of dragon fruit peel extract

Solvent	**EPC** (mgGAE/g sample)	**Antioxidant capacity**(mgTEAC/g)	
		DPPH	**FRAP**
H_2O	0.29	79.92	23.74
50% Ethanol	0.39	118.83	137.19
95% Ethanol	1.28	656.52	30.82
50% Propylene glycol	6.95	367.82	363.01
Propylene glycol	2.96	391.78	276.62

Absorption spectra of dragon fruit peels extract.

Scanning absorbance of dragon fruit that various from solvents as distilled water, 50% EtOH, 95% EtOH, 50% PG and PG were measured by spectrophotometer in range 400-700 nm. The sample extracts absorped similar wavelength profiles. All extracts highly absorbed the 537, 475 and 450 nm as shown in Figure 1. These maximum absorption profiles has been reported to be characteristic of plant pigment called betalain (Woo et al., 2011; Harivaindaran et al., 2008; Herbach et al., 2006). This result indicated that the compound responsible for the reddish pink appearance of the dragon fruit peel possibly was betalain.

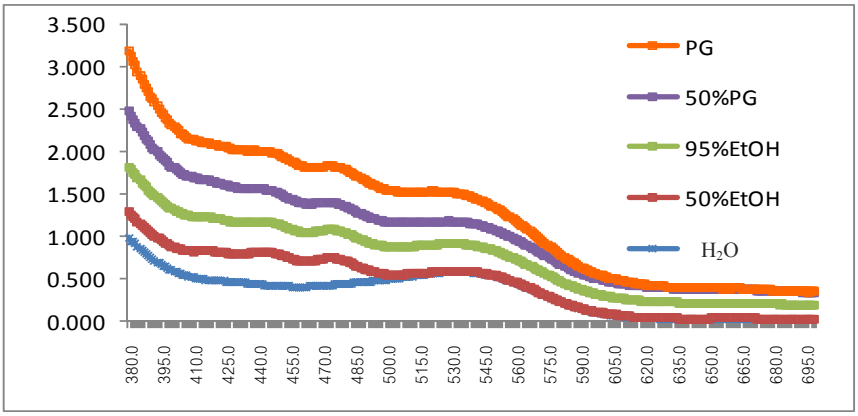

Figure 1 Absorption spectra of dragon fruit peels extract prepared by various solvent extraction

Color stability.

The 50% propylene glycol dragon fruit peel was used to study its stability at various condition including light 4°C, dark 4°C, light room temperature and dark room temperature. The dragon fruit peel extract alone was compared with the extract addition with betel nut or ginger extracts. Color change of the extract sample was evaluated by colorimeter and interpreted as total color difference (dE*). The dE* ($\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{½}$) is based on L*,a*,b* color differences (Esquivel et al., 2007). As can be seen in Figure 2, the dE* values of all extracts were not significantly change during storage in all samples.

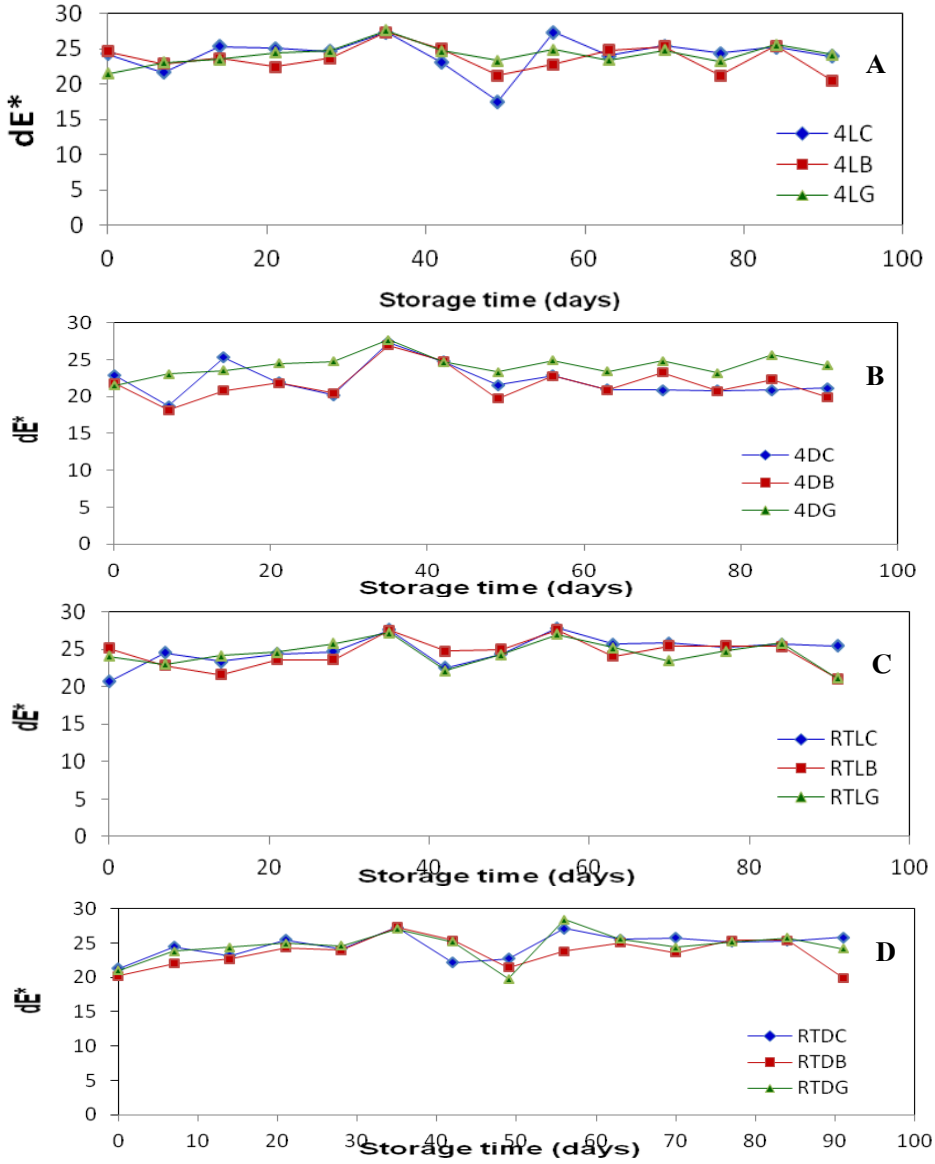

Figure 2 Color stability (dE change) at dark 4°C (A), light 4°C (B), dark room temperature (C) and light room termperature (D) of dragon fruit peel extract alone (DL and LC) when compared to that addition with betel nut (DB and LB) and ginger extracts (DG and LG)

pH stability.

The 50% propylene glycol dragon fruit peel extract was used to study its pH stability at various condition including light 4°C, dark 4°C, light room temperature and dark room temperature. The extract alone was compared with the betel nut added and ginger added extracts. The test was conducted at 0 to 93 days. The pH change of the extract sample was evaluated by pH meter. The pH of the dragon fruit peel extract (control), betel nut and ginger extracts were 5.01, 6.56 and 5.28, respectively.

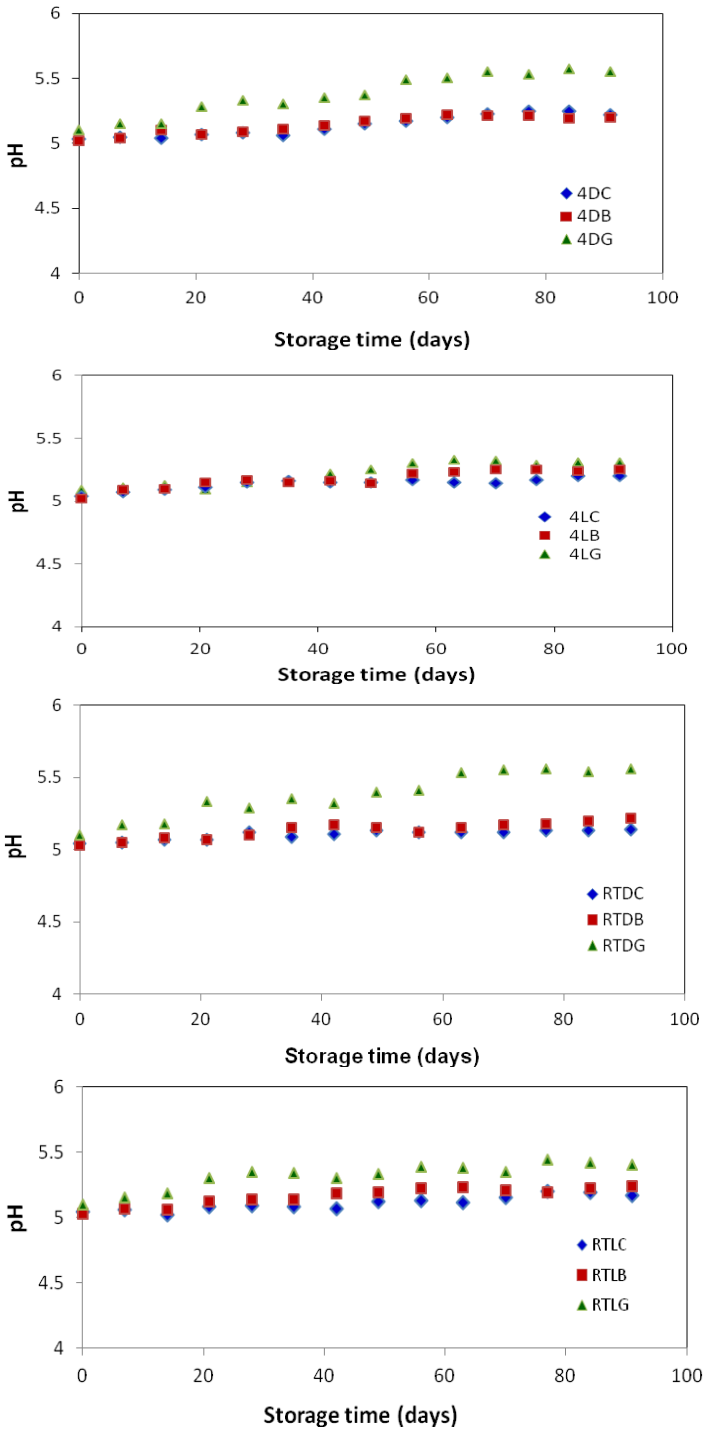

Figure 3 pH stability at dark 4°C (A), light 4°C (B), dark room temperature (C) and light room temperature (D) of dragon fruit peel extract alone (DL and LC) when compared to that addition with betel nut (DB and LB) and ginger extracts (DG and LG)
Stability of phenolic content (EPC).

The pH stability at dark room temperature condition of dragon fruit peel extract alone (RTDC) when compared to that addition with betel nut (RTDB) and ginger extracts(RTDG) is shown in Figure 3.The pH value of RTDC was 5.04 at the initial day and declined to 5.14 at the day 93, while those of RTDG atdark room temperature ginger was 5.10 at the first day and declined to 5.56. The pH value of RTDB was 5.03 at the initial day and declined to 5.22 at the final day.

Betet nut and ginger extracts were studied for their ability to enhance the EPC stability in the dragon fruit peel extract. The dragon fruit peel extract alone, the dragon fruit peel extract containing 5% betel nut, and the dragon fruit peel extract containing 5% ginger extract were designated as C, B and G, respectively. For example, the dragon fruit peel extract alone stored at 4°C was named 4LC and the dragon fruit peel extract containing betel nut stored at dark room temperature was designed as RTDB. Figure 4 shows stability of EPC in all extract when stored at various conditions. The EPC in dragon fruit peel extract (4LC) was gradually decreased during storage. The result illustrated that addition of betel nut extract to the dragon fruit peel extract can enhance the EPC stability. Dark condition greater stabilized the EPC in dragon fruit peel extract than the light condition.

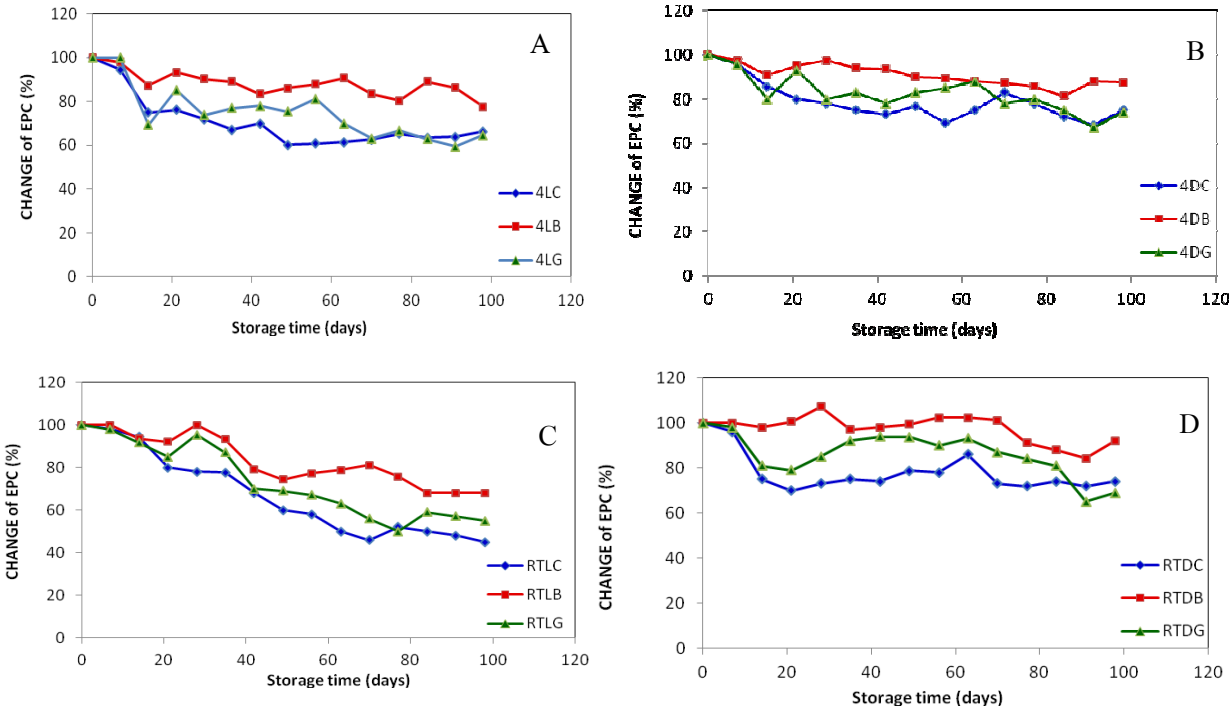

Figure 4 Phenolic content (EPC) at dark 4°C (A), light 4°C (B), dark room temperature (C) and light room temperature (D) of dragon fruit peel extract alone (DL and LC) when compared to that addition with betel nut (DB and LB) and ginger extracts (DG and LG)

Stability of antioxidant stability (DPPH radical scavenging activity).

It should be mentioned here again that the betel nut extract can enhance the stability of antioxidant constituent in the dragon fruit peel extract weather it was kept at 4°C or RT and dark or light condition (Figure 5).

Stability of reducing capacity (FRAP).

Antioxidant of the sample evaluated by FRAP method was also used in extract stability investigation. Figure 6 shows stability profile of the sample when stored at 4°C with light condition. The ginger extract inclusion (4LG) was not ability to maintain the reducing power. Its decrease during storage was comparable to the control (4LC). It is noticed that addition of betel nut extract (4LB) retain the reducing power of the dragon fruit peel extract of almost 100% during 93 days storage at dark 4°C.

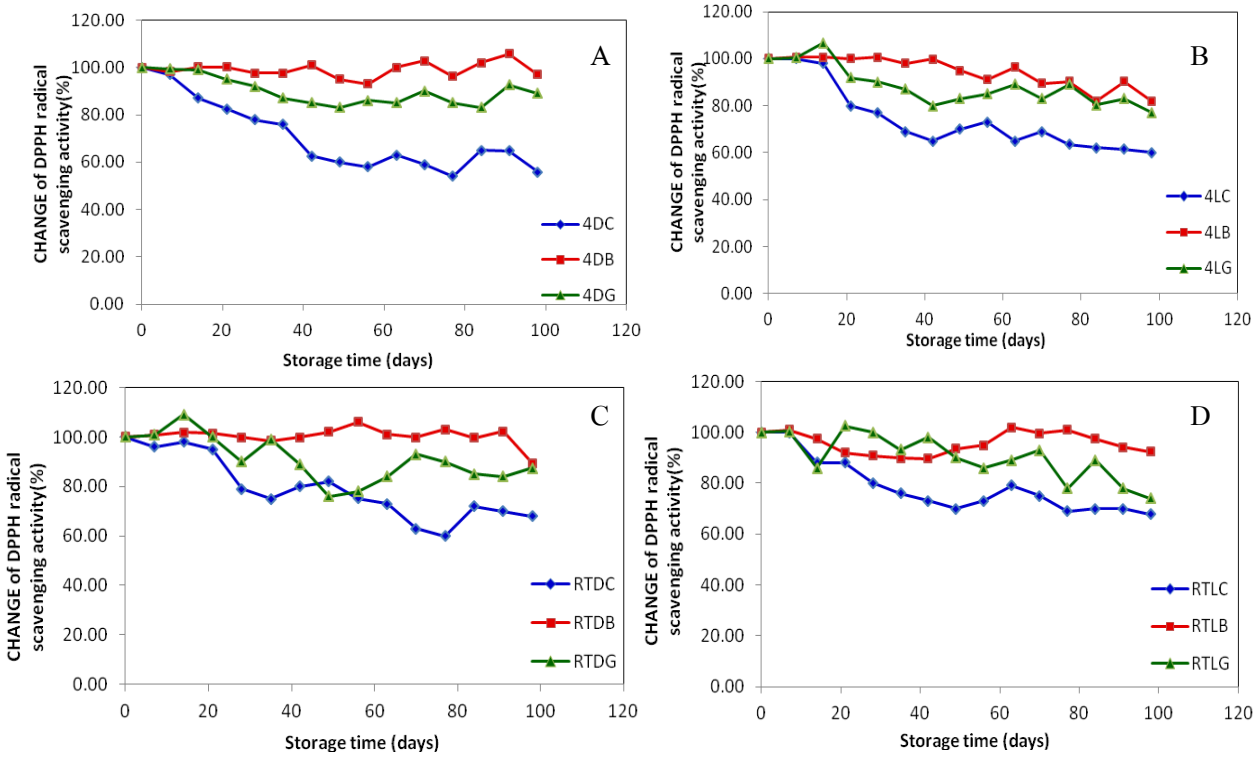

Figure 5 Change of DPPH radical scavenging capacity at dark 4°C (A), light 4°C (B), dark room temperature (C) and light room temperature (D) of dragon fruit peel extract alone (DL and LC) when compared to that addition with betel nut (DB and LB) and ginger extracts (DG and LG)

Discussion and Conclusion

Dragon fruit and its peel is one of the new focuses for the next source of red dye because it is rich in betalains, the nitrogen-containing pigment (Harivaindaran et al., 2008). The betalain made up of the red-violet betacyanins and yellow betaxanthins with maximum absorptivity at 535-537 and 475-480 nm, respectively (Harivaindaran et al., 2008; Herbach et al., 2006). The betalains have never been found occurring together with flavonoid anthocyanins Stintzing and Carle, 2004, though they exhibit the same color shade of red-violet (Rebecca et al., 2010). Quantification of betalain pigments was generally done by using spectrophotometric assay at 477 and 535 nm reading (Harivaindaran et al., 2008; Esquivel et al., 2007; Khan et al., 2012).

The betacyanin demonstrated the maximum peak at 537 nm due to both the optical active chiral carbons on the C-2 and C-15 position (Woo et al., 2011). On the other hand, absorbance peak between 470-480 nm, which is the characteristic peak for betaxanthin (Woo et al., 2011). The result in the research found the maximum absorption peak of the extract at 537,475 and 450 nm indicating betacyanin and betaxanthin of betalain composition in the dragon fruit peel sample.

Generally, betalain stability was influence greatly by light. lt has been reported that deterioration of betalain stability was observed when it was exposed to the light (Woo et al., 2011). The loss of red purple tone observed during storage explained that betacyanin in red dragon fruit is similar to betacyanin from other sources, which is sensitive towards light and storage temperature.

The degradation of betacyanin in red dragon fruit might follow the mechanism explained. According to their report, the primary steps of betalain degradation due to temperature are the nucleophilic attack by water at the C-11 position on betanin molecule (Woo et al., 2011). The effect of additive towards color degradation of natural fruit pigments has been reported.Supplement such as antioxidants or the commonly used ascorbic acid from the concentration of 0.1-1.0% showed some promising results in stabilizing red dragon fruit betacyanins (Woo et al., 2011; Herbach et al., 2006). There has been reported that 1% ascorbic acid managed to preserve the red hue of red beet pigment. Therefore, suggesting that colour degradation in the present study might be due to factor besides oxidation (Reynoso et al., 1997). Enhancement of betanin stability by employing isoascorbic acid which could be due to superior oxygen conversion and exhibit high redox potential has also been reported (Herbach et al., 2006).

Although betalains exhibit a broad pH stability ranging from pH 3 to 7 (Woo et al., 2011; Stintzing and Carle, 2004), pH conditions beyond this range readily induce betalain degradation. The pH optimum for betanin stability was reported to range between pH 4 and 6 (Woo et al., 2011).

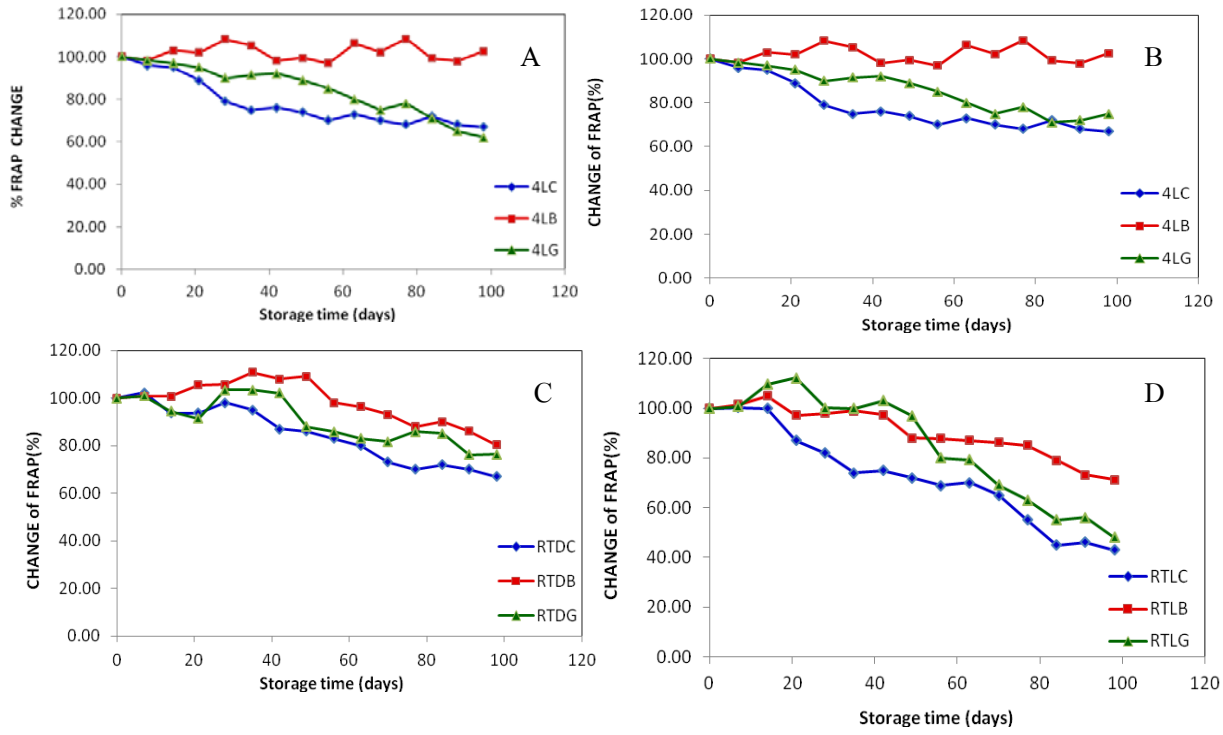

Figure 6 Change of reducing capacity at dark 4°C (A), light 4°C (B), dark room temperature (C) and light room temperature (D) of dragon fruit peel extract alone (DL and LC) when compared to that addition with betel nut (DB and LB) and ginger extracts (DG and LG)

When using 50% PG and PG as solvents for extraction of cosmetic bioactive compounds, the extracts appeared dark red and red, respectively. The ethanolic extraction provides yellow to brown color. Inclusion of betel nut extract or ginger extract in the sample extracts showed that the adjuvant did not affect to color and pH stability of the dragon fruit peel extract. The betel nuts extract improved stability of EPC and antioxidant capacity of the sample, whereas the ginger extract provided no effect. The result also showed that dark and cool temperature can enhance stability of dragon fruit peel extract during storage. The result from this study

provided well document for stabilization of bioactivity from natural color source for further application in cosmetics.

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