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KEYWORDS: Mangosteen fruit rind, Antioxidant, Dietary supplement, DPPH radical scavenging assay

INTRODUCTION In the present, the market of dietary supplement products are increased rapidly. Antioxidant products were the most interesting. The extract of mangosteen *(Garcinia mangostana Linn.)* fruit rind is also one of attracted antioxidant [1)]. Werayut P found that the soxhlet extaction with 50% ethanol producing the mangosteen fruit rind extract with high yield [2)]. The antioxidant activity of mangosteen rind extract is examined by in vitro DPPH free radical scavenging assay which has been widely used [3)]. Tablet is the most popular dosage form because it is convenience for using and more stable than liquid dosage form. The present study was developed tablet formulation containing mangosteen rind extract in order to obtained a good appearance tablet with the accepted physical properties. In addition, this study also examined antioxidant activity of the tablet containing mangosteen rind extract.

MATERIALS AND METHODS

***Garcinia mangostana* L. or mangosteeen and preparation of mangosteen rind extract:**

Mangosteen were bought from Talad Thai, the market in Bangkok, Thailand during May and June, 2011 which are the peak of harvest. Mangosteen rind was washed, dried by hot air oven (Mammert Germany) at 50 °C and ground to coarse powder about 20 mesh sizes. The coarse powder of the fruit rind was extracted with 50% ethanol by soxhlet extraction. The extracts obtained were concentrated under vacuum at 60°C using a rotary evaporator to give the crude extracts which was lyophilized to dryness by freeze dryer. The percent yield of dry extract was recorded.

Quantitative determination of antioxidant activity: In vitro DPPH (2,2-Diphenyl-1-picrylhydrazyl) free radical scavenging assay:

1 ml of varying concentrations (2, 4, 8, 16, 32 and 64 ug/ml) of methanol (Merck KGaA, Germany) solution of mangosteen rind extract were mixed with 1 ml solution of 0.006 % DPPH (Sigma-ALDRICH, USA) in methanol. The mixture was allowed to react completely at room temperature in the dark for 30 minutes. Blank solutions were prepared with each test sample solution only when negative control was DPPH solution. L-ascorbic acid (Vitamin C, POCH, Poland) was the positive control and/or has been used as standard reference. The decrease in absorbance was measured at wavelength of 517 nm using UV-visible spectrophotometer (Evolution 600 UV-VIS, USA). Absorbance obtained was converted to the percentage inhibition of free radical DPPH or the DPPH free radical scavenging activity (%) according to the equation:

$$\% \text{ inhibition} = [(A_{blank} - A_{sample}) / A_{blank}] \times 100$$

The antioxidant activity is expressed as effective concentration (EC) values. The EC50 value, defined as the concentration of the sample leading to 50% reduction of the initial DPPH concentration, was calculated from the linear regression of plots of concentration of the test extracts (ug/ml) against the mean percentage of the percentage inhibition obtained from three replicate assays. Antioxidant activity was defined as the relative concentration of antioxidant required to lower the initial DPPH concentration by 50%. The lower the EC50 value, the more effective antioxidant activity is.

Tablet preparation containing mangosteen rind extract: The quantity of the extract in one tablet was calculated from EC50 equivalent to 50 mg of vitamin C. The tablet was prepared by direct compression method due to a good flow property of the mangosteen fruit rind extract. Avicel® PH102 (Novacel, Ireland) and spray dried lactose (MEGGLE, Germany) were used as diluents. Starch 1500® was used as both diluent and disintegrant. Sodium starch glycolate was used as super disintegrant with magnesium stearate and talcum as lubricant and glidant respectively. Four formulations were developed by the difference of quantities and compositions as shown in Table 1. Each formulation was then compressed on instrumented single punch press (Charatchai Machinery, Thailand). The obtained tablet is brown color with biconcave round shape, a diameter of 12 mm and 600 mg weight.

Table 1 Tablet formulas of mangosteen rind extract

Compositions	% w/w			
	Rx1	Rx2	Rx3	Rx4
Mangosteen rind extract	58	58	58	58
Avicel® PH102	33	25	25	-
Spray dried lactose	-	8	-	16.5
Starch 1500®	-	-	8	16.5
Sodium starch glycolate	6	6	6	6
Magnesium stearate	1	1	1	1
Talcum	2	2	2	2

Physical properties evaluation of mangosteen rind extract tablet: The physical properties of obtained tablet were examined such as weight variation followed USP [4] using analytical balance (Mettler Toledo, Switzerland), thickness measurment using micrometer caliper, hardness test using Monsanto hardness tester (K.S.L.Engineering, Thailand), friability test using Roche friabilator (Campbell Electronics, India), disintegration test using disintegration apparatus (Pharma-Test, Germany)

Antioxidant activity of mangosteen rind extract in tablet: Antioxidant activity was shown by dissolution profile of the extract dissolved from tablet. The dissolution apparatus (Erweka, Germany) was apparatus type II. The speed of the apparatus was 75 rpm and using two types of dissolution medium for each testing, 900 mL of distilled water and 1% SLS (sodium lauryl sulfate, S.TONG Chemical, Thailand) solution. Five milliliters of the medium solutions were collected at 0, 2, 5, 10, 20 and 30 minutes after the tablet were placed in the vessel of the apparatus. It was filtered and mixed with 0.006% DPPH solution in methanol in the ratio 1:1. The mixture was allowed to react completely at room temperature in the dark for 30 minutes. The sample was analyzed by using a spectrophotometer at the wavelength of 517 nm. The obtained absorbance was converted to the percentage inhibition of free radical DPPH by using the previous equation. The dissolution profiles were plot between the percentage inhibition and collected time for antioxidant activity of dissolved extract and the types of medium comparison.

RESULTS

Antioxidant activity of mangosteen rind extract: The yield of extract was 11.90% by weight of dried mangosteen rind. E50 of the extract and vitamin C was calculated from the linear regression of plots of concentration of the test sample (ug/ml) against the percentage inhibition as shown in Figure 2. It was found that E50 of mangosteen rind extract and vitamin C were 44.13 ug/ml and 6.60 ug/ml respectively. Antioxidant activity of 345 mg of the extract was equivalent to 50 mg of vitamin C.

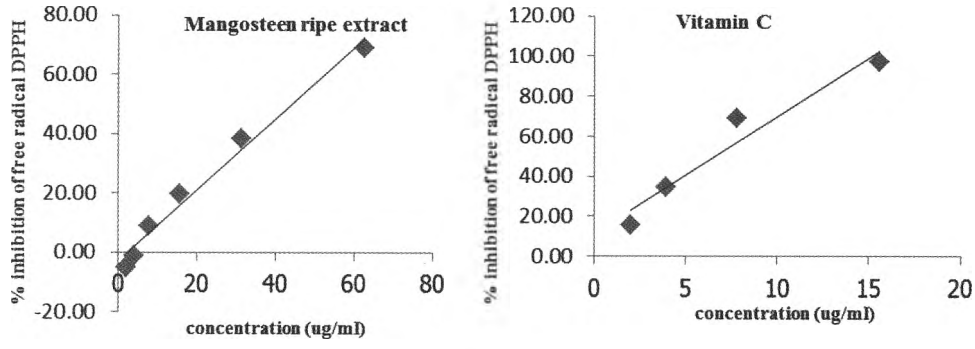

Figure 2 Linear regression of plot between % inhibition of free radical DPPH and concentration of mangosteen rind extract (left side) and vitamin C (right side)

Tablet preparation containing mangosteen rind extract: The formula Rx1, Rx 2 and Rx3 were chosen with good appearance.

Physical properties evaluation of mangosteen rind extract tablet: Weight variation, thickness, hardness, friabllity of three formulations of tablet containing mangosteen rind extract tablet were in the accepted range as shown in Table 2. The disintegration time of formula Rx 2 was not followed by USP requirement and Rx 1 was less than Rx 3.

Table 2 The physical properties of three formulations of mangosteen rind extract tablet

Items	Results		
	Rx 1	Rx 2	Rx 3
Weight variation	Pass	Pass	Pass
Thickness (mm)	5.40	4.79	4.82
Hardness (kg/in^2)	4.4	4.8	4.6
Friabllity (%)	0.32	0	0
Disintegration time (min)	3.56	>20	16.50

Antioxidant activity of mangosteen rind extract in tablet: The tablet of formula Rx 2 was only one formulation for testing because of least disintegration time. The extract was dissolved from tablet 80% expressed by % inhibition free radical DDPH within 10 and 30 minutes when the using medium was 1% sodium lauryl sulfate and distilled water respectively as shown in Figure 4.

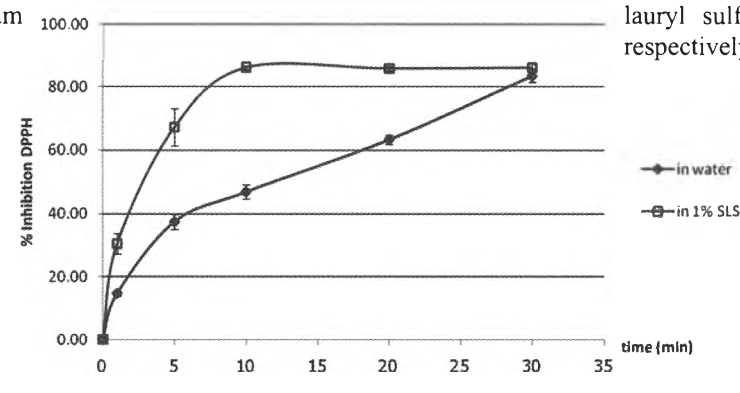

Fig. 4 Dissolution profiles of mangosteen rind extract tablet using distilled water and 1% sodium lauryl sulfate (SLS) solution as medium for dissolution study.

DICUSSION

Antioxidant activity of mangosteen rind extract: Soxhlet extraction with 50% ethanol was chosen for mangosteen rind extraction because this method promoted the maximum contents of crude extract (26.60 dry weight) and exhibited the most effective DPPH-scavenging activity [2]. This study obtained yield 11.9% dry weight which less than the previous study. It might be the difference time to get raw fruit. However 345 mg of the extract exhibited the antioxidant activity equivalent to 50 mg of vitamin C.

Tablet preparation containing mangosteen rind extract: Direct compression was using to prepare the tablet. It was not only due to good flow property but the extract was more stable than wet granulation method [6]. Avicel® PH 102 with low-moisture grades are used with moisture-sensitive materials (5) such as herb extract. Avicel® PH 102 was a good diluent when compared with spray dried lactose and Starch 1500®. The tablet with spray dried lactose and Starch 1500® as diluents took time to brake more than Avicel® PH 102 although using high quantity of super disintegrant such as sodium starch glycolate. It might be the binder property of both previous mentioned diluent. Therefore Rx 2 was a suitable formulation for a tablet containing mangosteen rind extract

Antioxidant activity of mangosteen rind extract in tablet: The result of antioxidant activity of the extract in tablet was evaluated by dissolution profile using DPPH free radical scavenging assay. It found that dissolution rate was increased when using 1% SLS solution as dissolution medium. Addition of surfactant such as SLS to the dissolution medium improves the dissolution of poorly water soluble drug by facilitating the drug release process at the solid/liquid interface and micelle solubilization in the bulk [7].

CONCLUSION

The antioxidant activity of mangosteen fruit rind extract could be examined that 345 mg of the extract was equivalent to 50 mg of vitamin c from calculated EC_{50}. The tablet could be prepared by direct compression method due to a good flow property of the mangosteen fruit rind extract. The compositions of the tablet were Avicel® PH 102 as a diluent, sodium starch glycolate as a disintegrant, magnesium stearate as lubricant, and talcum as a glidant. This optimum tablet formulation showed good physical properties confirmed to the requirements of USP30 (2007). The dissolution profiles showed that dissolved extract were 80% inhibited in 10 and 30 minutes using 1% sodium lauryl sulfate and distilled water as dissolution medium.

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