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ScienceDirect
LWT - Food Science and Technology 41 (2008) 2118–2125
LWT
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Antioxidant properties of durian fruit as influenced by ripening

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Received 22 April 2007; received in revised form 29 July 2007; accepted 4 December 2007

Abstract

The antioxidant properties of durian (*Durio zibethinus* Murr., cv. Mon Thong) at different stages of ripening were investigated using fluorometry, UV spectroscopy, and HPLC/DAD analyses. Total polyphenols, flavonoids, anthocyanins and flavanols in ripe durian were significantly higher ($p < 0.05$) than in mature and overripe fruits. Free polyphenols and flavonoids were at lower levels than hydrolyzed ones. Caffeic acid and quercetin were the dominant antioxidant substances in ripe durian. In these fruits, methanol extracts contained a relatively high capacity of $74.9 \pm 7.1\%$ inhibition using β-carotene–linoleic acid assay. Ferric-reducing/antioxidant power (FRAP) and cupric-reducing antioxidant capacity (CUPRAC) assays supported this finding. The correlation coefficients between polyphenols and antioxidant capacities of durian samples with all applied assays were about 0.98. In conclusion, the bioactivity of ripe durian was high and the total polyphenols were the main contributors to the overall antioxidant capacity.

Keywords: Ripe, overripe and mature durian; Bioactive compounds; Antioxidant capacity

1. Introduction

The health protective effect of natural products such as fruits and vegetables is mostly related to their antioxidants, phenolic compounds, and to a lesser extent, dietary fiber (Chun et al., 2005; Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Erkkilae, Herrington, Mozaffarian, & Lichtenstein, 2005; Jung, Su, Keller, Mehta, & Kinghorn, 2006; Koebnick et al., 2005; Lairon et al., 2005; Mahattanatawee et al., 2006). Among these fruits is the lesser known durian [*D. zibethinus* Murr. cv. Mon Tong] (Ketsa & Daengkanit, 1998).

Ketsa and Daengkanit (1998) studied postharvest changes in ethylene production, respiration, solids, total sugars, starch, firmness, pectic substances and activities of polygalacturonase (PG), pectinesterase (PE) of durian, but did not evaluate antioxidant properties. Durian is consumed at different stages of ripening, and the differences in nutritional quality between ripening stages are practically unknown. Some authors have shown that there are significant differences in the content of bioactive compounds and in the antioxidant capacity of other tropical fruits at various stages of their ripening (Park et al., 2006; Zhang, Koo, & Eun, 2006). As far as we know, no

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0023-6438/$34.00
doi:10.1016/j.lwt.2007.12.001

studies of the antioxidant capacity of durian have been conducted, and there are no published articles describing these properties of durian at different stages of its ripening. Therefore, our objective was to study one of the most popular cultivar of durian Mon Thong *in vitro* at different stages of its ripening.

In order to receive a reliable picture of the differences between the mature, ripe and overripe samples of durian, the major antioxidant compounds (polyphenols, flavonoids, flavanols and anthocyanins) were determined (Cheng & Breen, 1991; Singleton, Orthofer, & Lamuela-Raventos, 1999; Vinson, Su, Zubic, & Bose, 2001). It was shown that the measures of the antioxidant capacity in natural products by only one assay are often not reliable (Ou, Huang, Hampsch-Woodill, Flanagan, & Deemer, 2002). Therefore, in this investigation we used three complementary assays.

1. Antioxidant test using β-carotene–linoleate model system [β-carotene] (Ferreira, Proenca, Serralheiro, & Araujo, 2006)
2. Ferric-reducing/antioxidant power [FRAP] (Szeto, Tomlinson, & Benzie, 2002)
3. Cupric-reducing antioxidant capacity [CUPRAC] (Apak, Guclu, Ozyurek, & Karademir, 2004)

2. Materials and methods

2.1. Samples

In this investigation, the Mon Thong cultivar at different stages of ripening was studied. Harvesting and determination of maturity was carried out by Thai skilled workers, combining the following techniques: day count, character of fruit spines, tapping the fruit, color and shape of fruit (Yaacob & Subhadrabandhu, 1995). The mature durian fruits were harvested carefully with peduncle intact. The samples were left for 1 day at room temperature and cut open to get mature durian flesh with firm texture and no smell. Some of the fruits were left for another 4 days at room temperature to ripen until their flesh became soft and they developed a typical durian aroma. Overripe samples having a strong smell were obtained when fruits were left for another 3 days.

The edible parts, botanically called aril, of the Mon Thong at different stages of ripening were prepared without using steel knives. The fruits were cleaned with tap water, dried, weighed, chopped and homogenized under liquid nitrogen in a high-speed blender (Hamilton Beach Silex professional model) for 1 min. A weighed portion (50–100 g) was lyophilized for 48 h (Virtis model 10-324), and the dry weight was determined. The samples were ground to pass through a 0.5-mm sieve and stored at −20 °C until analyzed.

2.2. Extract procedures

Durian lyophilized samples (0.2 g) were placed in a small vial and 3 ml of a binary mixture composed of ethanol and 0.2 M HCl (1:1, v/v) was added. The samples were kept in RK 255 H Sonorex Super sonication bath manufactured by the firm Bandelin (Berlin, Germany) for 40 min at 40 °C. The extracts were separated from the solid matter by filtration, condensed to 1 ml, and analyzed for the contents of flavonoids and polyphenols using high performance liquid chromatography (Heimler et al., 2006) with diode array detection (HPLC/DAD).

2.3. HPLC/DAD analysis of polyphenols and flavonoids

The HPLC/DAD was carried out with P580A LPG model liquid chromatograph, equipped with the Gina 50 model autosampler and the UVD340V DAD model diode array detector (Gynkotek/Dionex, Germering, Germany). The column (250 mm, 4.6 mm i.d.) was a Tosoh Biosep cartridge filled with TSK gel 5 μm; cat. # 08149, ODS-80 TM (Tosoh Corporation, Tokyo, Japan). The flow rate was 1 ml min^{-1} and injection was via autosamples. The chromatographic column was maintained at 40 °C. Sample volume for analysis was 50 μl. Each analysis lasted 50 min. Standards of polyphenols and flavonoids in ethanol solutions (0.1 mg/ml) were vanillic acid, caffeic acid, *p*-coumaric acid, cinnamic acid, morin, hesperidin, neohesperdigo, quercetin, myricitin, apigenin, and campherol. The linear calibration plots were obtained by changing the injection volume of the individual standard solutions from 5 to 30 μl. The analyses were carried out with a changing gradient of the mobile phase composition (Table 1).

2.4. Determination of total polyphenols

Lyophilized fruit samples were extracted from a 50-mg aliquot with 5 ml of 60% methanol/water with heating at 90 °C for 3 h for free polyphenols (FP) and under the same conditions with 5 ml of 1.2 M HCl in 60% methanol/water for total polyphenols (TP) with some modifications. The samples were cooled, diluted to 10 ml with methanol and centrifuged for 5 min at 4000×*g* to remove solids (Vinson et al., 2001). For total polyphenol determination, the Folin–Ciocalteu method was used, and the measurement was performed at 765 nm with gallic acid as the standard. The results were expressed as mg gallic acid equivalents (GAE)/100 g FW (Singleton et al., 1999; Heimler, Vignolini, Dini, Vincieri, & Romani, 2006; Park et al., 2006).

2.5. Determination of flavonoids

The absorbance of flavonoids (extracted with 5% $NaNO_2$, 10% $AlCl_3 \cdot 6H_2O$ and 1 M NaOH) was measured at 510 nm

Table 1
The applied composition gradient of the binary ACN + H_2O mobile phase

Time [min]	Program	ACN [%]	H_2O [%]
0–2	Constant composition	5	95
0–22	Composition change	Rise from 5 to 25	Drop 95 to 75
22–32	Composition change	Rise from 25 to 55	Drop from 75 to 45
32–50	Constant composition	55	45

with the standards prepared similarly with known (+)-catechin concentrations. The results were expressed as mg of catechin equivalents (CE)/100 g FW (Singleton et al., 1999).

2.6. Determination of total anthocyanins

The total anthocyanins were measured by a pH differential method. Absorbance was measured in a Beckman spectrophotometer at 510 nm and at 700 nm in buffers at pH 1.0 and 4.5, using $A = [(A_{510} - A_{700})_{\text{pH 1.0}} - (A_{510} - A_{700})_{\text{pH 4.5}}]$. Results were expressed as μg of cyanidin-3-glucoside equivalent (CGE)/100 g of FW (Cheng & Breen, 1991).

2.7. Determination of total flavanols

Total flavanols were estimated using the *p*-dimethylaminocinnamaldehyde (DMACA) method. Methanolic extracts from durian samples (0.2 ml), diluted 1:100 with MeOH, were introduced into a 1.5-ml Eppendorf tube, and 1 ml of DMACA solution (0.1% in 1 N HCl in MeOH) was added. The absorbance at 640 nm was then read against a blank. The concentration of total flavanols was estimated from the catechin calibration curve. Results were expressed as μg catechin equivalents (CE)/100 g FW (Arnous, Makris, & Kefalas, 2001).

2.8. UV–visible spectophotometric analysis and fluorometry of polyphenols

The spectra of methanol extracts in concentration of 0.02 mg/ml were measured on an Uvikon 930 (Bio-Teck-Kontron) and were recorded from 195 to 400 nm (Sarni-Manchado, Le Roux, Le Guerneve, Lozano, & Cheynier, 2000). Standards of caffeic acid and quercetin of 0.025 mM in methanol were used.

Fluorescence measurements were done using a model FP-6500, Jasco Spectrofluorometer, serial N261332, Japan. Fluorescence emission spectra measurements for all fruit samples at a concentration of 0.02 mg/ml were taken at excitation wavelengths (nm) of 270 and emission of 290 recorded over the frequency range from the excitation wavelength to a wavelength of 500 nm. Standards of caffeic acid and quercetin of 0.01 mM in methanol were used (Gorinstein et al., 2001).

2.9. Determination of antioxidant capacities

2.9.1. β-Carotene–linoleic acid assay

The procedure was done according to Ferreira et al. (2006). A stock solution of β-carotene and linoleic acid was prepared by dissolving 0.5 mg of β-carotene in 1 ml of chloroform and adding 25 μl of linoleic acid with 200 mg of Tween 40. The chloroform was removed at 40 °C under vacuum (evaporated), using a rotary evaporator (Rotavapor R-3000, Switzerland). Aerated water (100 ml) was added to the residue. To 2.5 ml of this mixture, 300 μl of durian acidic and non acidic methanol extracts were added. The samples were incubated in boiling water for 120 min together with two blanks, one containing

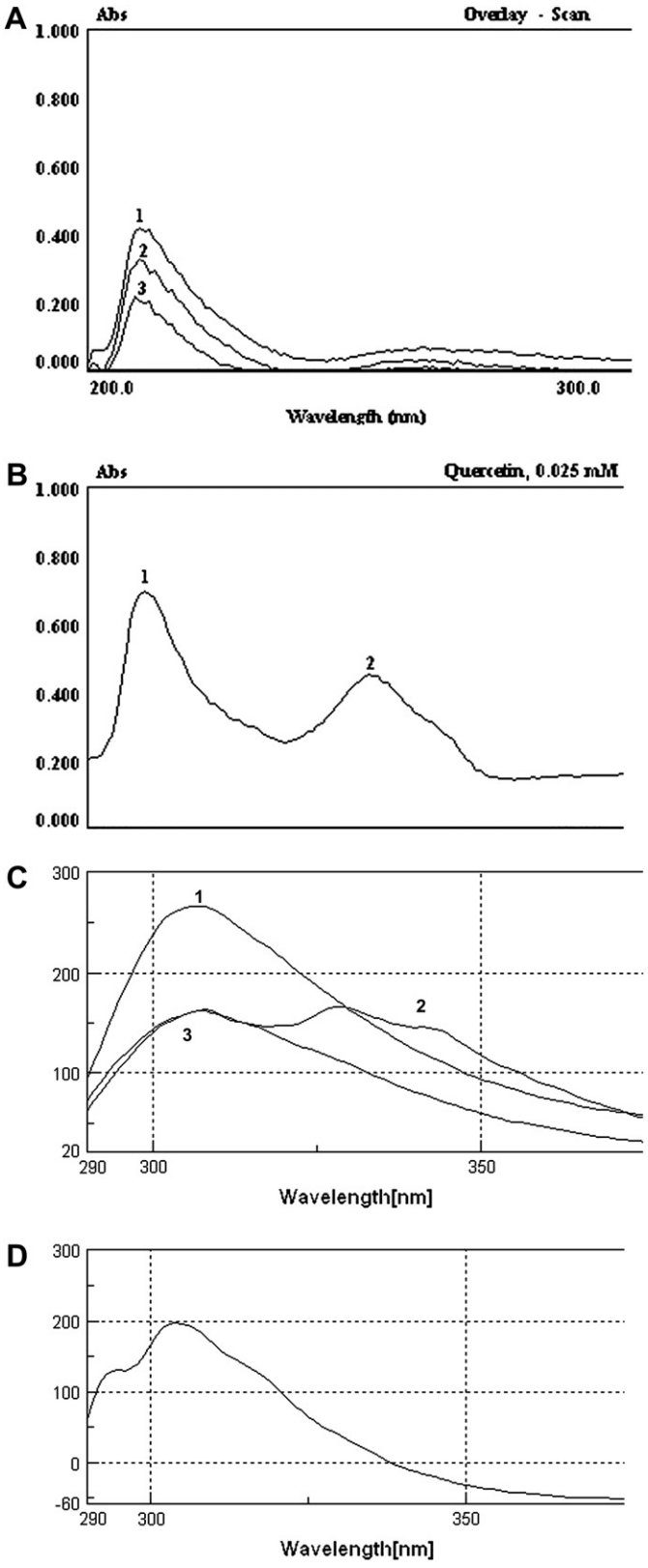

Fig. 1. UV absorption spectra of methanol extracts recorded from 195 to 400 nm. A, free polyphenols (0.02 mg/ml) of ripe (1), overripe (2) and mature (3) durian fruit. B, quercetin (0.025 mM). Fluorimetric spectra of methanol extracts taken at excitation wavelengths (nm) of 270 and emission of 290 recorded over the frequency range from the excitation wavelength to a wavelength of 500 nm. C, free polyphenols (0.02 mg/ml) of ripe (1), overripe (2) and mature (3) durian fruit. D, quercetin (0.01 mM).

the antioxidant BHT and the other one without antioxidant. The absorbance was measured at 470 nm.

2.9.2. Ferric-reducing/antioxidant power (FRAP)

The procedure was according to Szeto, Tomlinson, and Benzie (2002). FRAP reagent (2.5 ml of a 10 mM ferric-tripiridyltriazine solution in 40 mM HCl plus 2.5 ml of 20 mM $FeCl_3 \cdot H_2O$ and 25 ml of 0.3 M acetate buffer, pH 3.6) of 900 μl was mixed with 90 μl of distilled water and 30 μl of durian samples or methanol as the appropriate reagent blank. The absorbance was measured at 595 nm.

2.9.3. Cupric-reducing antioxidant capacity (CUPRAC)

The procedure was according to Apak et al. (2004). To the mixture of 1 ml of copper (II)-neocuproine and NH_4Ac buffer solution, acidified and non acidified methanol extracts (or standard) solution (x, in ml) and H_2O [$(1.1 - x)$ ml] were added to make the final volume of 4.1 ml. The absorbance at 450 nm was recorded against a reagent blank.

2.10. Chemicals

Trolox (6-hydroxy-2,5,7,8,-tetramethyl-chroman-2-carboxylic acid); BHA (butylated hydroxyanisole); β-carotene, $FeCl_3 \cdot 6H_2O$; $CuCl_2 \cdot 2H_2O$ and neocuproine (2,9-dimethyl-1,10-phenanthroline) were obtained from Sigma Chemical Co., St. Louis, MO, USA. 2,4,6-tripyridyl-*s*-triazine (TPTZ) was purchased from Fluka Chemie, Buchs, Switzerland. All reagents were of analytical grade. Deionized and distilled water were used throughout.

2.11. Statistical analyses

The results of this investigation *in vitro* are means ± SD of three measurements. Differences between groups were tested by two-way ANOVA. In the assessment of the antioxidant potential, the Spearman correlation coefficient (R) was used. Linear regressions were also calculated. The p values of <0.05 were considered significant.

3. Results

3.1. UV and fluorimetric spectra, total polyphenols, flavonoids, anthocyanins and flavanols

Polyphenols in the acidified and non acidified methanol extracts had absorption maxima in a range between 206 and 220 nm. The spectra were compared with the standards of caffeic acid and quercetin with the maximum between 206 and 215 nm, which indicated that flavonoids were the predominant phenolic compounds (Ferreira da Silva, Lima, Quina, & Macüanita, 2004; Sarni-Manchado, Le Roux, Le Guerneve, Lozano, & Cheynier, 2000). The absorption UV maxima of acidified ripe durian were similar to caffeic acid (not shown). Non acidified samples (Fig. 1A) showed the following maxima (nm) and absorption units (AU): ripe with 209.1 and 0.812; overripe −213.2 and 0.678; mature −220.2 and 0.606, respectively, and were similar to quercetin with 206.7(Fig. 1B).

The fluorimetric data supported the UV results, where various contents of phenolic compounds were detected in the extracts, depending on the extraction solvent: acidified and non acidified and the stage of ripening. The following data of fluorimetric measurements were obtained: for non acidified (free) polyphenols extracts: ripe durian with a peak of 306 nm and the absorption of 266.96 AU; mature −307 nm and 162.48 AU and the overripe −308 nm with the absorption of 163.28 AU (Fig. 1C). Quercetin, as well as caffeic acid showed the maximum of the peak at 304 nm (Fig. 1D).

Total polyphenols (mg (GAE)/100 g) and flavonoids (mg CE/100 g) in ripe durian (374.4 ± 32.4 and 97.9 ± 9.3) were significantly higher ($p < 0.05$) than in mature (231.4 ± 22.1 and 57.3 ± 6.1) and overripe (298.5 ± 24.4 and 76.5 ± 6.9, Table 2). The free polyphenols and flavonoids were present at lower concentration than the hydrolyzed ones. Anthocyanins (μg of cyanidin-3-glucoside equivalent (CGE)/100 g FW) and flavanols (μg of catechin equivalent (CE)/100 g FW) were significantly higher in ripe durian (442.7 ± 33.3 and 177.1 ± 16.3) than in mature (388.5 ± 41.1 and 155.4 ± 15.7) and overripe (393.1 ± 23.8 and 163.8 ± 17.1), respectively.

Identification of the compounds in the durian extracts was carried out through a comparison of their respective retention times (t_R) with those of the applied standards (Table 3, Fig. 2), and their respective UV spectra with those of the standards. Quantification was calculated from the linear calibration plots. These were the absolute data detected by HPLC analysis on

Table 2
Bioactive compounds (100 g FW) in different durian samples

Durian samples	Total polyphenols (mg GAE)	Free polyphenols (mg GAE)	Total flavonoids (mg CE)	Free flavonoids (mg CE)	Anthocyanins (μg CGE)	Flavanols (μg CE)
Ripe	374.4 ± 32.4[a]	45.4 ± 4.6[a]	97.9 ± 9.3[a]	23.9 ± 2.4[a]	442.7 ± 33.3[a]	177.1 ± 16.3[a]
Overripe	298.5 ± 24.4[b]	35.1 ± 3.4[b]	76.5 ± 6.9[b]	19.3 ± 1.9[b]	393.1 ± 23.8[b]	163.8 ± 17.1[b]
Mature	231.4 ± 22.1[c]	27.3 ± 2.9[c]	57.3 ± 6.1[c]	14.7 ± 1.5[c]	388.5 ± 41.1[b]	155.4 ± 15.7[c]

Values are means ± SD of three measurements.
Means in columns without superscript letters in common differ significantly ($P < 0.05$).
Abbreviations: FW, fresh weight; GAE, gallic acid equivalent; CE, catechin equivalent; CGE, cyanidin-3-glucoside equivalent.

Table 3
Compounds identified by HPLC/DAD in the durian extracts, their respective retention times, t_R [min], and concentrations calculated in μg mg^{-1} of the lyophilized dry matter

Compounds	Overripe		Ripe		Mature	
	t_R	C	t_R	C	t_R	C
Vanillic acid	2.80	0.032	2.80	0.011	2.80	0.016
Caffeic acid	3.51	0.012	3.50	0.017	–	–
p-Coumaric acid	–	–	6.58	0.023	6.70	0.032
Cinnamic acid	9.37	0.038	9.43	0.029	9.47	0.032
Morin	23.18	0.062	23.13	0.024	24.01	0.006
Hesperidin	–	–	–	–	28.12	0.011
Neohesperdigo	28.59	0.029	–	–	–	–
Quercetin	–	–	31.65	0.053	–	–
Myricitin	32.04	0.016	32.04	0.014	32.05	0.057
Apigenin	33.92	0.138	33.92	0.027	–	–
Campherol	34.27	0.282	34.26	0.095	34.26	0.059

Values are means of three measurements.

the weight of lyophilized sample (Table 3). Caffeic acid (μg/100 g) was significantly higher in ripe 490 vs. 360 than in overripe durian and was not detected in mature fruit. Quercetin of 1200 μg/100 g was estimated only in ripe durian sample (Table 4).

3.2. Antioxidant capacity

The ripe durian had the highest amounts of antioxidant capacity and bioactive compounds (Table 5). FRAP absorption measurements (Fig. 3 A and B) showed that durian at the ripe stage had higher antioxidant activity than the other two samples.

A very good correlation was observed between the antioxidant capacities determined by FRAP and CUPRAC (Fig. 4, A and B) and the total polyphenols (R^2 is 0.972 and 0.891, respectively). The correlation coefficients between the antioxidant capacity determined by FRAP and CUPRAC and for flavonoids (Fig. 4 A and B) were lower than for total polyphenols (R^2 is 0.865 and 0.711, respectively).

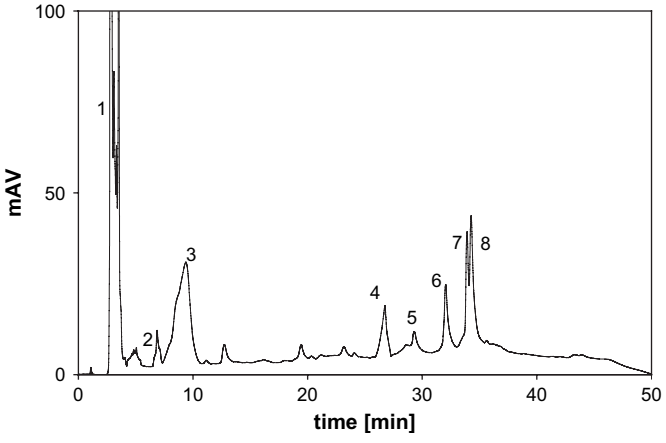

Fig. 2. The chromatogram obtained from the Durian overripe extract. The identified compounds: (1) vanillic acid; (2) caffeic acid; (3) cinnamic acid; (4) morin; (5) neohesperdigo; (6) myricetin; (7) apigenin; and (8) campherol.

4. Discussion

Fruits have long been regarded as having considerable health benefits, due to their main antioxidant compounds, of which phenolics are the most abundant (Gorinstein et al., 2006; Park et al., 2006; Sarni-Manchado, Le Roux, Le Guerneve, Lozano, & Cheynier, 2000). A large screening study of the antioxidant capacity of methanol extracts of fruits reported that these fruits contain different quantities of antioxidant compounds and have different levels of antioxidant capacity (Halvorsen et al., 2002). Durian fruit was not studied yet in such a way. Therefore, this fruit at different stages of its ripening was investigated in this study as a fruit diet and as an additive to functional foods for prevention of cardiovascular and other diseases as traditional fruits (Miller, Liebowitz, & Newby, 2004). Free radicals require the ability to measure them and the oxidative damage that they cause (Halliwell & Whiteman, 2004); therefore, in this study the radical scavenging assays were carried out to show the ability of the durian extracts to scavenge free radicals *in vitro* (expressed as TEAC value) by CUPRAC and FRAP.

The antioxidant capacity is mainly derived from the alcohol soluble antioxidants and has a high correlation coefficient with polyphenols (0.97), which corresponds with others (Caballero-

Table 4
Compounds identified by HPLC/DAD in durian extracts and concentrations calculated in μg/100 g FW

Compound	Overripe	Ripe	Mature
Vanillic acid	970	250	300
Caffeic acid	360	490	–
p-Coumaric acid	–	530	600
Cinnamic acid	720	660	600
Morin	1900	550	110
Hesperidin	–	–	200
Neohesperdigo	880	–	–
Quercetin	–	1200	–
Myricitin	480	320	1060
Apigenin	4200	620	–
Campherol	8500	2200	1100

Values are means of three measurements.

Table 5
Antioxidant activity in different durian samples (in 100 g FW)

Durian samples	FRAP, reducing/ antioxidant power (μMTE)	CUPRAC, cupric-reducing antioxidant capacity (μMTE)	β-Carotene, % inhibition
Ripe	270.4 ± 27.2^{a}	1112.7 ± 83.4^{a}	76.8 ± 6.8^{a}
Overripe	257.5 ± 24.8^{a}	1091.2 ± 72.5^{a}	70.6 ± 6.3^{b}
Mature	217.4 ± 20.9^{b}	1019.8 ± 68.5^{a}	64.3 ± 5.3^{c}

Values are means ± SD of 3 measurements.
Means in columns without superscript letters in common differ significantly ($P < 0.05$).
Abbreviations: FW, fresh weight; TE, trolox equivalent.

George et al., 2002). The UV and fluorimetric spectra of acidified and non acidified extracts were close to each other and showed higher intensity of ripe durian in comparison with two other samples. Such interpretation of our results

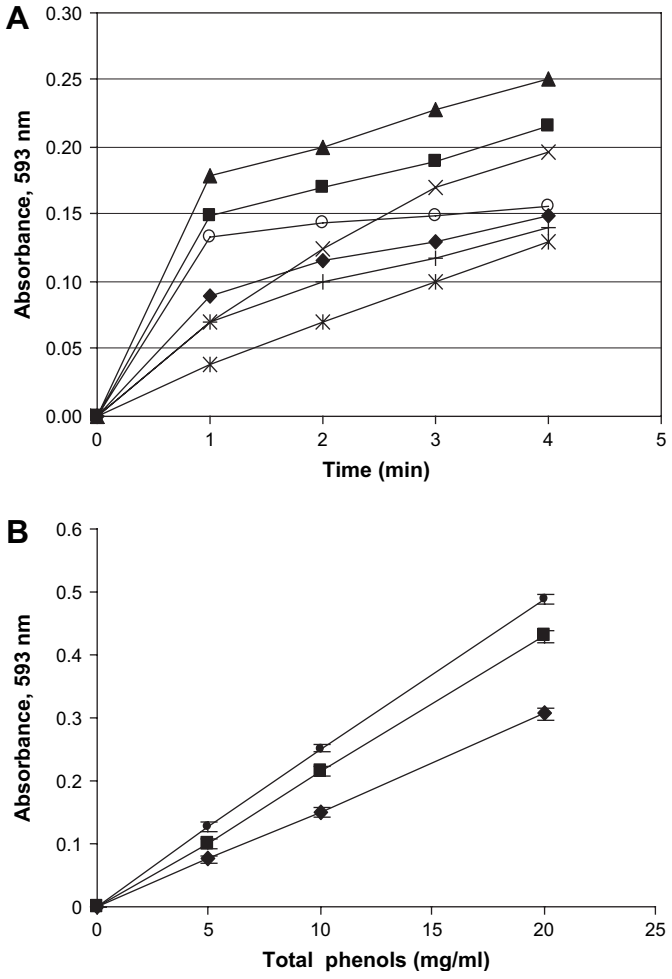

Fig. 3. FRAP (Ferric-reducing/antioxidant power) measurements of durian extracts with two variables (different concentrations and different periods of time): A, total polyphenol extracts of durian cultivar Mon Thong at different stages of ripening: (◆) M, mature; (■) O, overripe; (▲) R, ripe at constant concentration (10 mg/ml) and with the change of time (1, 2, 3, and 4 min). Standards (30 μg/ml), (×) NAR, (*) FIC, (+) QUER, naringin, ficitin and quercetin, respectively; (○) GA, gallic acid, 10 μg/ml; B, total polyphenol extracts from durian cultivar Mon Thong at different stages of ripening: (◆) C, mature; (■) D, overripe; (●) G, ripe at constant time (4 min) with the change of extracts concentration (5, 10, 15 and 20 mg/ml).

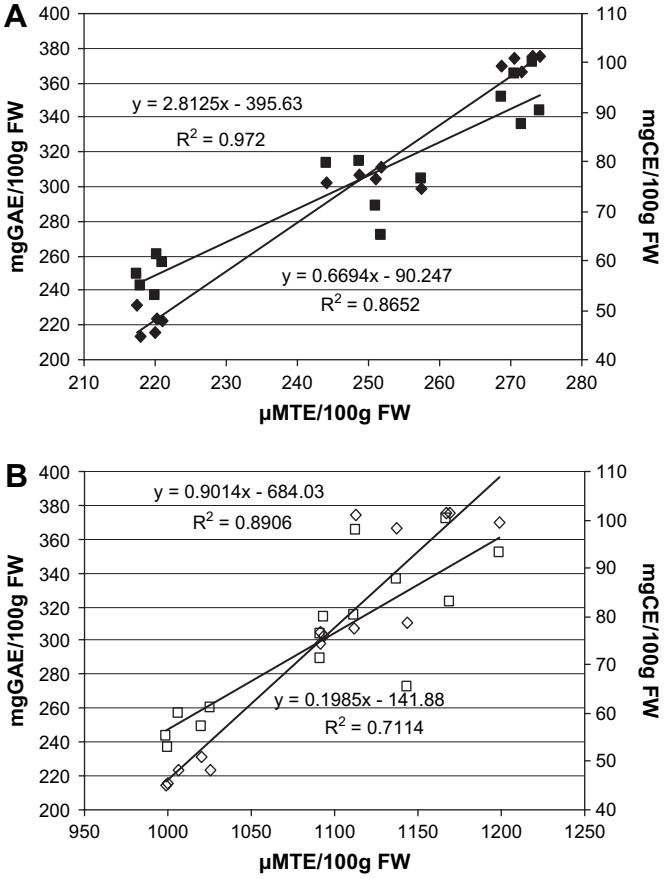

Fig. 4. Correlation between measures of antioxidant capacities (AC) and total phenolics (TPOL). A, (◆) ACFRAP (μMTE/100 g FW, X) and TPOL (mg GAE/100 g, Y_1), (■) ACFRAP (μMTE/100 g, X) and TFLAV (mg CE/100 g FW, Y_2). B, (◇) ACCUPRAC (μMTE/100 g, X) and TPOL (mg GAE/100 g, Y_1), (□) ACCUPRAC (μMTE/100 g, X) and TFLAV (mg CE/100 g, Y_2). *Abbreviations:* FRAP, Ferric-reducing/antioxidant power; CUPRAC, Cupric-reducing antioxidant capacity; TPOL, Total polyphenols; TFLAV, Total flavonoids.

corresponds with Ferreira da Silva et al. (2004). Another possibility for explanation of the high antioxidant capacity can be the total activity of all phenolic acids (Nilsson et al., 2005).

Our results were similar to those reported for strawberry and banana (Mahattanatawee et al., 2006). It was interesting to compare between different stages of ripening; mostly our data correspond with guava and mango. Ripe and green mangos and papayas slightly differ in the total polyphenols from our results (Mahattanatawee et al., 2006).

The phenolic content and the % of inhibition by β-carotene of the investigated fruits corresponded with wild mulberry and commercial frozen pulp of mulberry as shown by Hassimotto, Genovase, and Lajolo (2005).

The numbers of total polyphenols in durian corresponded with the data of Wu et al. (2005) for plums and bananas.

Our results of Mon Thong ripe durian polyphenol content are similar to plums and mature fruits correspond with strawberries (Chun et al., 2005). The amount of flavonoids and the antioxidant activity for Mon Thong cultivar in ripe stage was lower than in plums and mature fruit was equal with strawberries.

The comparison of the cited and the present data was done using different solvents for the extraction of bioactive compounds: methanolic extracts of durian samples (0.2 mg/ml) and the decoction extracts (0.1 mg/ml). Our results of inhibition by β-carotene assay for ripe, overripe and mature durians correspond with *Melissa officinalis* and *Lavandula pedunculata* (Ferreira et al., 2006). The present results can be compared as well with Hassimotto et al. (2005), where the samples investigated by β-carotene bleaching system gave inhibition values >70%.

BHT (78.1 ± 1.6), quercetin (48.8 ± 4.7) and rutin (13.6 ± 1.4) were measured in the present report and compared with the corresponding data of 77.6 ± 0.4, 49.2 ± 3.4 and 12.7 ± 2.3 obtained by Hassimotto et al. (2005). The durian ripe sample can be compared with the data of BHT (50 μM). The antioxidant capacity of mature durian was between BHT and quercetin.

The DPPH (1,1-diphenyl-2-picrylhydrazyl, radical scavenging activity) antioxidant activity and ORAC (oxygen radical absorbance capacity) determined in different stages of maturity showed that the ripe papaya showed 2.19 and 2.04 times higher values than the green ones (29.7; 2.6) (Mahattanatawee et al., 2006). In this experiment, the antioxidant activity determined by FRAP, CUPRAC and β-carotene showed slightly lower relations between the ripe and mature samples such as 1.24; 1.09 and 1.19, respectively. The FRAP values of the durian samples corresponded with apple and banana, according to Halvorsen et al. (2002), and were lower than banana and similar to mango, according to Nilsson et al. (2005).

In conclusion, (1) it is preferable to consume ripe Mon Thong durian, which has higher content of bioactive compounds and possesses higher antioxidant capacity than the mature and overripe samples and (2) according to the results of the present and our previous investigations, the antioxidant capacity of tested tropical fruits was in decreasing order: ripe Mon Thong durian > snake fruit > mangosteen > lichi > guava > mango.

Acknowledgements

The authors are thankful to Dr. Elena Katrich (Hebrew University of Jerusalem, School of Pharmacy, Israel) for her technical assistance in determination of antioxidant activity, Dr. Ratiporn Haruenkit and Dr. Sumitra Poovarodom (King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand) for supplying the durian samples.

This work was partly supported by the Food Industrial Technology Innovation Center at Mokpo National University.

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