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Research Article

Crystal guava (*Psidium guajava* L. "Crystal") treated with gibberelic acid (GA_3) : Evaluation of in vitro antioxidant capacities

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Keywords

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Abstract

Free radicals can cause many diseases, such as cancer. Antioxidant is a compound that could scavenge free radicals. One of the natural source antioxidants is guava. The application of gibberellic acid (GA_3) is known to affect the physicochemical properties and antioxidant content of the fruit. The goals of this research were to investigate the antioxidant activity of skin, flesh and fruit of crystal guava were given additional GA3 treatment with concentration 0; 60; 120; 180; 240; and 300 ppm by determining the value of the Antioxidant Activity Index (AAI) using DPPH; evaluate the total phenolic content (TPC), ferric reducing antioxidant power (FRAP) and physicochemical properties; analyse the correlation between the TPC with AAI DPPH by Pearson's method. Extraction was performed by the maceration method using acetone 50% mixed with a magnetic stirrer for 1 h. Determination of AAI DPPH, FRAP and the TPC was performed by UV-Visible spectrophotometry. TPC in the flesh and fruit fractions tended to increase and FRAP values in all fractions decreased with GA_3 application. The highest TPC and FRAP was given by the G3 treatment on the skin fraction and G0 treatment on the skin fraction. The highest AAI in all fractions was given by the G3 treatment. The TPC was significantly positively correlated with the AAI DPPH of the flesh and fruit fraction extracts ($0.250 \leq r \leq 0.880$), and the skin fraction extracts showed a strong negative correlation between TPC and AAI DPPH ($-0.813 < r < -0.973$).

Introduction

Free radical is a small molecule that is very reactive because of its unpaired electron. Antioxidant is a compound that could scavenge a free radical. Consumption of an antioxidant can prevent the effect from a free radical. One of the natural antioxidants is guava. Guava (Psidium guajava) is one of the most important commercial fruit crop in tropical and subtropical countries and claims superiority over different fruits by virtue of its commercial and nutritional values (Musa et al. 2010). Crystal guava is the one of the most favourite guava in Indonesia, like many other fruits and vegetables, is rich antioxidant compounds such as polyphenols, ascorbic acid and carotenoids (Musa et al. 2010).

The application of gibberellic acid (GA_3) is known to affect the physicochemical properties and antioxidant content of the fruit. GA_3 are natural growth hormones that play a major role in triggering the auxin reaction which helps in controlling growth and has a direct effect on internode elongation, flowering, fruiting, quality, and yield (Tian et al. 2017). GA_3 (50, 75, and 100 ppm) has been reported to increase the sweetness of strawberries (Jamal-Uddin et al. 2012), while an increase in vitamin C and acidity in strawberry due to the application of GA_3 as much as 80 ppm has been reported by Kumar et al (2012). Spraying GA_3 30 ppm three times increased the total soluble solid but it declined fruit size and hardness (Adnyesuari et al. 2015). The application of GA_3 has been shown to improve fruit quality in peach (Dagar et al. 2012), strawberry (Kumra et al. 2018), and dates (Awad and Al-Qurashi, 2012), but it has not been found in crystal guava.

In this research, extraction of crystal guava was performed by maceration method using acetone 50% mixed with magnetic stirrer for 1 h (Musa et al. 2010). The purposes of this research were to investigate the antioxidant profile of skin, flesh and fruit of crystal guava (*Psidium guajava* L. "Crystal") treated with GA_3 by determining the Antioxidant Activity Index (AAI) using DPPH; determining the total phenolic content (TPC), ferric reducing antioxidant power (FRAP) and physicochemical properties; analyse the correlation between the TPC with AAI DPPH.

Method

Crystal guava fruit was obtained from Nusa Bangsa University experimental garden at the Kemang, Bogor Regency, West Java-Indonesia. The application of GA_3 by spraying on crystal guava plants using a hand sprayer and carried out in the afternoon between 15.00-16.00 WIB. The concentration of GA_3 applied includes 6 levels, G0= 0 ppm; G1= 60 ppm; G2 = 120 ppm; G3 = 180 ppm; G4 = 240 ppm; and G5 = 300 ppm. Plants were sprayed three times with an interval of 14 days, after which the crystal guava fruit was harvested and transferred in ice on the same date to the analysis laboratory, Limnology-BRIN.

Materials

Commercial GA_3 from marketplace; DPPH (2,2-diphenyl-1-picrylhydrazyl), 2,4,6,-tri(2-pyridyl)-s-triazine (TPTZ), obtained from Sigma-Aldrich; sodium hydroxide, ascorbic acid, Folin-Ciocalteu, metaphosphoric acid, acetone, sodium acetate trihydrate, glacial acetic acid, hydrochloric acid, methanol, gallic acid, ferric chloride, and cupric chloride, obtained from Merck.

Physicochemical Properties

Fruit weight and seed weight were measured using analytical balance (CAS MWP-300H). The flesh weight was computed by subtracting seed weight from fruit weight. The fruit volume was determined by water displacement (mL) and specific gravity was calculated by dividing the weight of the fruit by the volume of the fruit. To determine the titratable acidity (TTA), samples were crushed and blended in a blender. Ten mL of blended samples were diluted with 50 mL water before titrated with 0.1 N NaOH and calculated as percent citric acid. The pH was determined using a pH meter Lutron PH-208 from the undiluted samples. For L-ascorbic acid determination, 1 g was extracted with 25 mL 1% cold metaphosphoric acid and determining using spectrophotometer UV Visible Shimadzu UV-1800 (Chang et al. 2006).

Extraction of Antioxidants

Fruit was deseeded and the skins were removed using fruit peeler to get skin and flesh fraction as well as whole fruit. Samples were extracted with 50% aqueous acetone (Musa et al. 2010).

Total Phenolic Contents (TPC)

A 100 µL aliquot of fivefold diluted pink guava extract was oxidized with diluted Folin-Ciocalteu reagent (500 µL). after 5 min, the mixture was neutralized with 1 mL Na_2CO_3 (8% w/v), and incubated for 120 min before reading absorbance at 765 nm (Musa et al. 2010).

Ferric Reducing Antioxidant Power (FRAP)

The FRAP assay method of Benzie and Strain was modified to determine antioxidant activity using ascorbic acid as standard. The FRAP reagent was prepared using 300 mM acetate buffer, pH 3.6 (3.1 g sodium acetate trihydrate, plus 16 mL glacial acetic acid made up to 1 L with distilled water). The acetate buffer was mixed with 10 mM TPTZ (2,4,6,-tri(2-pyridyl)-s-triazine) in 40 mM HCl and 20 mM $FeCl_3.6H_2O$ at the ratio of 10:1:1 to produce the working reagent. For assays, 3950 µL of freshly prepared FRAP reagent was mixed with 50 µL sample, standard, or blank and incubated for 30 min before reading absorbance at 595 nm (Musa et al. 2010).

Antioxidant Activity Index (AAI) of DPPH

Blois's method with some modification was applied in the determination of the antioxidant activity by DPPH (Hartati et al. 2020). Two mL of sample extract solution with a concentration of 3 mg/mL was added with 2 mL of 40 mg/L DPPH solution. DPPH solution was prepared in methanol and ascorbic acid as standard. The absorbance was evaluated at 515 nm by UV-Vis spectrophotometer, after 30 min of incubation. The experiment

was performed using different sample concentration (0.5-5 mg fresh sample / mL extraction solvent), to determine the IC_{50} (inhibitory concentration 50%) of the G0 sample and the sample with the highest antioxidant activity among G1-G5. A calibration curve was plotted between % of DPH scavenging activity versus concentration, to obtain IC_{50}. Thereafter, the AAI of extract was determined by dividing the final concentration of DPPH with IC_{50} at each extract.

Calculation of the Antioxidant Activity Index (AAI)

The DPPH scavenging activity of crystal guava extracts were denoted as the AAI. The estimation of the AAI was performed with the following equation:

$$\text{AAI} = \frac{\text{final concentration of radical solutions } (\mu g/mL)}{\text{IC50 or EC50 } (\mu g/mL)}$$

Statistical Analysis

Statistical analysis was carried out by SPSS 26 for Windows. Analysis of each sample was in triplication. All of the expressed results were means ± standard deviation. The statistical significance was observed using the one-way ANOVA method ($p < 0.05$). Pearson's correlation method was applied to analyse the correlation of the TPC between antioxidant activity of DPPH.

Results and Discussion

***Physicochemical Properties of Crystal Guava (Psidium guajava* L. "Crystal")**

Table 1 shows the physicochemical characteristics of crystal guava fruit (*Psidium guajava* L. "Crystal") treated with Gibberelic acids (GA_3). In general, fruit, flesh, seed weight, and vitamin C in the skin fraction increased with GA_3 application compared to control (G0), but acidity and vitamin C in the flesh and fruit fractions decreased. The highest fruit weight was obtained from application of GA_3 240 ppm (G4). The improvement in weight and size of guava fruits due to application of various concentration of GA_3 might be result of enhanced internal physiology during fruit development which induced efficient utilization of resources like water, nutrients, and other vital compounds (Singh et al. 2017).

Table 1. Physicochemical Properties of Crystal Guava (*Psidium guajava* L. "Crystal") with GA_3 Treatment

Characteristics	G0 (0 ppm)	G1 (60 ppm)	G2 (120 ppm)	G3 (180 ppm)	G4 (240 ppm)	G5 (300 ppm)
Fruit weight (g)	215 ± 39^{a}	215 ± 14^{a}	322 ± 85^{b}	300 ± 32^{a,b}	334 ± 49^{b}	242 ± 57^{a,b}
Flesh weight (g)	213 ± 38^{a}	212 ± 15^{a}	320 ± 86^{b}	297 ± 31^{a,b}	331 ± 49^{b}	239 ± 59^{a,b}
Seed weight (g)	2.0 ± 0.7^{a}	2.3 ± 1.3^{a}	1.9 ± 0.4^{a}	2.7 ± 0.7^{a}	3.1 ± 0.7^{a}	3.2 ± 2.6^{a}
Number of seeds	43 ± 10^{a}	51 ± 19a	41 ± 13^{a}	50 ± 5^{a}	50 ± 8^{a}	57 ± 28^{a}
Fruit volume (mL)	217 ± 41^{a}	237 ± 17^{a,b}	311 ± 85^{b,c}	318 ± 37^{c}	365 ± 63^{d}	236 ± 39^{b,c}
pH	4.88 ± 0.03^{a}	5.08 ± 0.02^{c}	5.05 ± 0.03^{c}	4.94 ± 0.01^{b}	5.45 ± 0.01^{d}	5.84 ± 0.01^{e}
Specific gravity	1.03 ± 0.31^{a}	0.91 ± 0.10^{a}	1.12 ± 0.50^{a}	0.95 ± 0.17^{a}	0.94 ± 0.25^{a}	0.95 ± 0.19^{a}
Acidity	0.82 ± 0.00^{e}	0.56 ± 0.00^{c}	0.75 ± 0.00^{d}	0.74 ± 0.00^{d}	0.12 ± 0.00^{a}	0.38 ± 0.00^{b}
Vitamin C (mg/g fresh weight)						
- skin	44.16 ± 2.12^{b}	36.91 ± 2.11^{a}	44.77 ± 2.39^{b}	52.74 ± 2.16^{d}	49.90 ± 1.77^{c,d}	47.41 ± 2.82^{b,c}
- flesh	79.03 ± 0.37^{d}	63.07 ± 0.20^{c}	44.45 ± 2.13^{a}	47.64 ± 1.22^{b}	50.48 ± 2.40^{b}	49.19 ± 1.47^{b}
- fruit	87.16 ± 0.00^{d}	68.48 ± 0.41^{c}	47.17 ± 2.01^{a}	53.94 ± 1.04^{b}	51.74 ± 2.97^{b}	51.90 ± 0.20^{b}

Values are means of triplicate samples ± SD. Different letters in the same row indicate significant differences ($p < 0.05$).

The acidity was significantly decreased with application of GA_3. It is clear from data that maximum acidity was observed with control (G0) whereas the minimum acidity was recorded with GA_3 240 ppm (G4). Thus, with increase in GA_3 concentration the titratable acidity was decreased which may be due to early ripening of fruits caused by treatment, where acid might have been used during respiration or rapidly converted into sugars. Similarly, Lal and Das (Lal and Das, 2017) had recorded minimum acidity (0.16%) in guava under application of 50 ppm GA_3.

The vitamin C in the skin fraction increased with GA_3 application compared to control (G0), but in the flesh and fruit fractions decreased. The highest ascorbic acid in the skin fraction was given by the G3 treatment. The possible reason for increase in ascorbic acid in the skin fraction by GA_3 treatment might be due to perpetual synthesis of glucose-6-phosphate throughout the growth and development of fruit which is thought to be the precursor of vitamin C as reported by Singh et al (2017) on guava skin. Ascorbic acid is a water-soluble antioxidant and the most bioactive form of vitamin C which is a strong antioxidant, reacting with singlet oxygen and other free radicals to relieve oxidative stress, thereby imparting health benefits on humans (Kumar et al. 2013). Ascorbic acid content of fruits dependent highly on the varieties and the cultivation conditions. Distinct varieties of the same fruit type showed significantly different concentrations (Musa et al. 2010).

Total Phenolic Contents (TPC) and Ferric Reducing Antioxidant Power (FRAP)

Individual fruit fractions showed a wide variation of their total phenolic contents (TPC) and FRAP values in various GA_3 treatments (Table 2). In general, TPC in the skin fraction decreased with GA_3 application compared to control (G0), but there was an exception in the G3 treatment where the TPC increased. Different from the skin fraction, in general the TPC in the flesh and fruit fractions tended to increase with GA_3 application compared to control (G0). Maximum TPC values were obtained for crystal guava fruit variety fractions with G3 treatment (180 ppm) when compared to all fractions of various treatments (Fig.-1a).

Table 2. Folin-Ciocalteu Index and Ferric Reducing Antioxidant Power (FRAP) Values for Different Crystal Guava (*Psidium guajava* L. "Crystal") Fruit Fractions with GA_3 Treatment.

Treatment	Fruit Fraction	Total Phenolic Content (TPC)*	FRAP**
G0	Skin	43.01 ± 3.09^{k}	363.92 ± 33.58^{e}
	Flesh	10.29 ± 0.69^{a}	$76.24 \pm 7.77^{a,b,c}$
	Fruit	$16.36 \pm 0.73^{c,d}$	130.25 ± 9.93^{c}
G1	Skin	36.11 ± 0.48^{i}	239.13 ± 30.25^{d}
	Flesh	11.80 ± 0.87^{a}	$66.71 \pm 4.94^{a,b,c}$
	Fruit	$14.78 \pm 0.20^{b,c}$	$69.47 \pm 17.15^{a,b,c}$
G2	Skin	32.16 ± 0.44^{h}	224.43 ± 6.95^{d}
	Flesh	14.35 ± 0.43^{b}	$73.58 \pm 3.69^{a,b,c}$
	Fruit	$18.27 \pm 0.38^{e,f}$	$123.50 \pm 14.48^{b,c}$
G3	Skin	55.44 ± 1.73^{l}	326.99 ± 128.31^{e}
	Flesh	14.24 ± 0.28^{b}	55.04 ± 11.50^{a}
	Fruit	19.06 ± 0.13^{f}	$98.88 \pm 14.52^{a,b,c}$
G4	Skin	38.05 ± 0.60^{j}	229.24 ± 10.69^{d}
	Flesh	$15.00 \pm 0.27^{b,c}$	56.78 ± 8.13^{a}
	Fruit	$15.12 \pm 0.21^{b,c}$	$59.95 \pm 0.79^{a,b}$
G5	Skin	20.85 ± 0.43^{g}	$93.37 \pm 8.60^{a,b,c}$
	Flesh	13.59 ± 0.49^{b}	55.35 ± 1.63^{a}
	Fruit	$17.32 \pm 0.78^{d,e}$	$80.65 \pm 6.65^{a,b,c}$

Values are mean±SD. Different letters in the same column indicate significant differences ($p < 0.05$).
* mg gallic acid equivalent/g fresh weight (mg GAE/g FW).
** mg ascorbic acid equivalent/g fresh weight (mg AAE/g FW).

In general, FRAP values in all fractions decreased with GA_3 application compared to control (G0). Maximum FRAP values were obtained for crystal guava fruit variety fractions with G0 treatment (0 ppm) when compared to all fractions of various treatments (Fig.-1b). FRAP is a method to screen the ability of cells and plant tissue to be able for maintaining the redox status. It cannot act by hydrogen atom transfer for quenching radical particularly protein. Adjusting to pH 3.6 which is in acidic medium, it is able to maintain the solubility of the iron in the solution. Due to this medium, it drives the electron transfer and increases the redox potential (Maisarah et al. 2013). From this study, it can be seen that the high FRAP value may not be contributed by the phenolic compounds present in the sample. Antioxidant activities may be evaluated with different antioxidant

assays due to the fact that different antioxidant activities may show different mechanism and act in various ways such as lipid peroxidation decomposition, radical scavenging abilities and metal ions chelation (Maisarah et al. 2013). Different types of fruit and plant varieties can also show different results on TPC and its antioxidant activity.

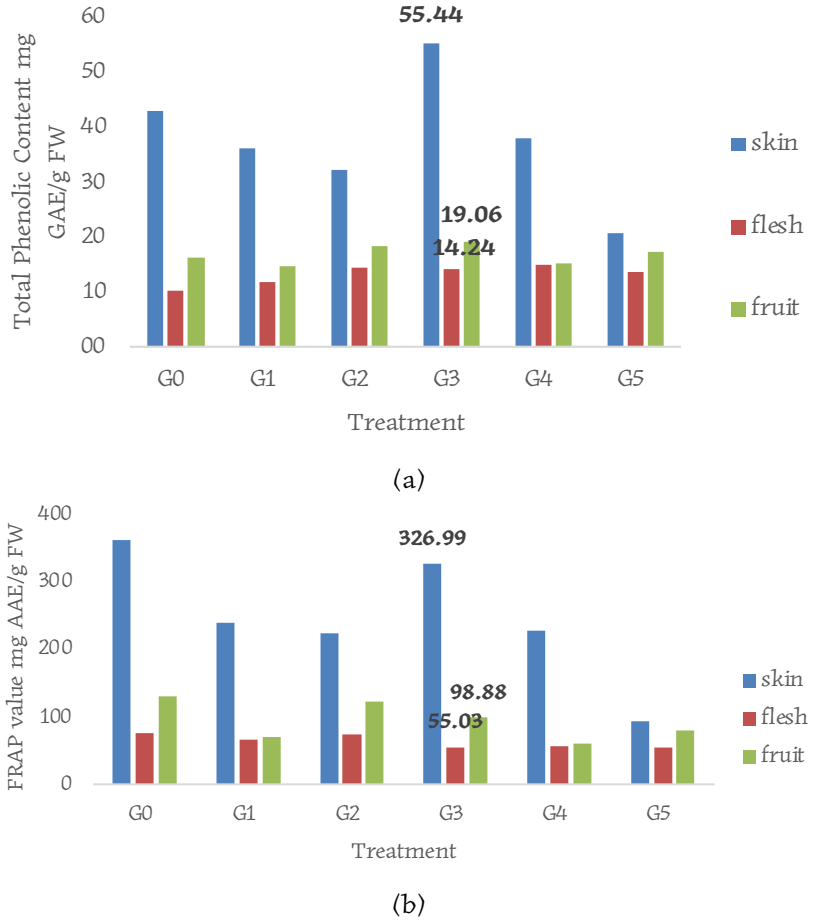

Fig.-1. Total Phenolic Content (a) and FRAP Value (b) of Crystal Guava Extracts (*Psidium guajava* L. "Crystal") from Skin, Flesh and Fruit, Treated with GA_3.

Among each variety fractions, skins showed the highest TPC and FRAP values, followed by the fruit and flesh, respectively. According to Liu et al (2018) guava skin contains high bioactive compounds with content values exceeding three times that of other parts, which indicates an excellent source for processing by-products. Several similar results were described by Irawan et al (2017) on the fruit of Pometia pinnata which showed higher levels of phenolic compounds in the skin than flesh or fruit of the hexane and acetylacetate extracts. Another study on Feijoa fruit cultivars also reported that the peel extract showed higher TPC and antioxidant activity than fruit and flesh extract (Peng et al. 2019).

***DPPH Radical Scavenging Activity of Crystal Guava (Psidium guajava* L. "Crystal")**

The radical scavenging activity values in Fig.-2 indicate a different activity of each crystal guava fruit samples with GA_3 treatment. The DPPH assay measures the ability of the fruit extract to donate hydrogen to the DPPH radical resulting in bleaching of the DPPH solution. The greater the bleaching action, the higher the antioxidant activity (AEAC/AAI value), and this is reflected in a lower IC_{50} value (Yan et al. 2006). Sample extracts were measured after being incubated for 30 min, which is the optimal time condition for the DPPH assay (Fadda et al. 2014). In general, the radical scavenging activity in all fractions decreased with the application of GA_3 compared to the control (G0), but there was an exception in the G3 treatment where the radical scavenging activity increased. Skin fraction extract of all treatment gave the highest yield compared to the fruit and flesh fraction. Results from single concentration may not be directly used in comparing between radical scavenging activities of different samples. The use of different sample concentrations may result in more information

about antioxidant extracts. The radical scavenging activity was reported as percentage as inhibitory concentration (IC_{50}) and compared to RSA. RSA could be used for screening purposes while IC_{50} could be used for sample classification and details. G0 and G3 treatments gave the highest radical scavenging activity values compared to other treatments, so further testing was carried out to obtain the IC_{50} value.

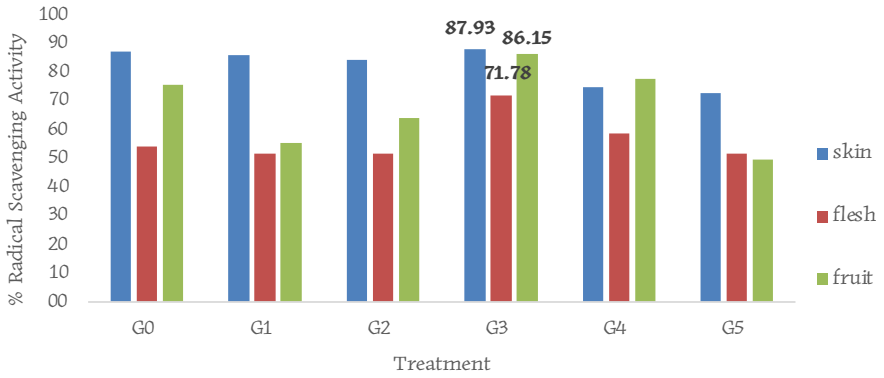

Fig.-2. DPPH Radical Scavenging Activity of Crystal Guava (Psidium guajava L. "Crystal") with GA3 Treatment, for 3 mg/mL Solutions of Sample.

The RSA for crystal guava extract at different concentration shown in Table 3. As anticipated, the higher concentration of sample, the higher the scavenging activity. Antioxidant activity is reported as IC_{50} value which indicates the concentration of the sample of crystal guava fruit that can reduce 50% absorbance of DPPH. The highest antioxidant capacity means had the lowest IC_{50}. The highest IC_{50} in all fractions was given by the G3 treatment, compared to the control (G0). The rank of the antioxidant activity values in crystal guava fruits was: G3 fruit > G3 flesh > G0 fruit > G0 flesh > G3 skin > G0 skin.

Table 3. Radical Scavenging Activity as a Function of Sample Concentration for Crystal Guava Fruit (*Psidium guajava* L. "Crystal").

Fruit Sample	Radical Scavenging Activity (RSA) (%)					IC_{50}	AAI DPPH
	0,5	1	2	3	4		
G0 skin	59.12^{b}	77.25^{c}	83.75^{d}	83.49^{c}	83.44^{b,c}	2.72	0.01
G0 flesh	14.15^{a}	26.10^{a}	46.54^{a}	51.57^{a}	70.60^{a}	2.64	0.01
G0 fruit	12.29^{a}	21.42^{a}	46.06^{a}	71.58^{b}	83.93^{b}	2.24	0.02
G3 skin	56.63^{b}	81.59^{c}	86.19^{d}	85.65^{c}	85.10^{c}	2.68	0.01
G3 flesh	22.07^{a}	36.66^{b}	63.18^{b}	80.42^{c}	85.10^{c}	1.70	0.02
G3 fruit	20.59^{a}	40.95^{b}	70.36^{c}	82.29^{c}	85.10^{c}	1.56	0.03

Different letters in the same column indicate significant differences ($p < 0.05$)
- Sample concentration (mg fresh sample / mL solvent).
- IC_{50} expressed in mg weight / mL extracting solvent.

When the concentration of radical solution was different, the result of IC_{50} could be different too, while the Antioxidant Activity Index (AAI) would be similar. According to the AAI, the antioxidant activity could be classified into four groups, poor (AAI < 0.5), moderate (0.5 ≤ AAI < 1), strong (1 ≤ AAI ≤ 2), and very strong (AAI > 2) (Hartati et al. 2020). The highest AAI in all fractions was given by the G3 treatment, compared to the control (G0). Dewage et al (2022) reported that the methanol extract of Psidium guajava fruit in India gave the highest antioxidant activity results compared to other plants with an IC_{50} value of 1.33 mg/mL. Antioxidant activity of crystal guava with G0 and G3 treatments was higher than that of tomatoes from Toraja (Mu'nisa, 2012). Antioxidant capacity might be linked with total phenolic content. According to Bouchoukh et al. (2019) extracts with high phenolic content showed the best antioxidant capacity.

The highest AAI from DPPH method gave the highest antioxidant capacity. Therefore, the TPC contributed to the antioxidant capacity when the correlation was significant and positive (Table 4). The TPC was significantly positively correlated with the AAI DPPH of the flesh and fruit fraction extracts (0.250 ≤ r ≤ 0.880),

where an increase in the TPC in fruit of crystal guava would increase the antioxidant activity by DPPH. High positive correlation between TPC and antioxidant activity of DPPH was also reported by Wern et al. (2016) in fruit juices. The similar relationship between TPC and AAI DPPH also confirmed in the previous studies (Wang et al. 2019; Praptiwi et al. 2021; de Souza Silva et al. 2022). In contrast, skin fraction extracts showed a strong negative correlation between TPC and AAI DPPH (-0.813 < r < -0.973). DPPH radical quenching activity is indicated by negative corelation since the radical content decreases as activity increases. Therefore, TPC in skin fraction extracts may play a major role in increase in DPPH radical scavenging activity. Similar results were observed by Skenderidis et al (2020) who reported that Pomegranate peel had a significantly negative correlation between TPC and antioxidant activity of DPPH. Kim and Lee (2020) also reported that Umbelliferae salad plants had negative correlation between TPC and DPPH radical scavenging activity. The difference between the result of TPC and AAI DPPH has also been found in previous study (Fidrianny et al. 2017; Fidrianny et al. 2018; Hong et al. 2021).

Table 4. Correlation of the Total Phenolic Content (TPC) of crystal guava fruit (*Psidium guajava* L. "Crystal") with AAI DPPH.

AAI DPPH	Pearson's correlation coefficient (*r*) TPC
G0 skin	-0.813*
G0 flesh	0.783*
G0 fruit	0.250*
G3 skin	-0.973*
G3 flesh	0.880*
G3 fruit	0.872*

*Significant at $p < 0.01$

Total phenolic compounds are not the only bioactive compounds in fruits which contribute to antioxidant activity. The samples with low phenolic content might show high antioxidant activity because other methanol-soluble compounds such as methylxanthine or certain pigment from fruits can also react with DPPH radicals (Wern et al. 2016). The different types of polyphenols present in fruit and plant extracts exert several antioxidant effects and properties through numerous mechanisms, including free radical scavenging and transition metal chelation and singlet oxygen quenching (Kim and Lee, 2020). Using one type of detection method provides only limited information about the antioxidant activity of fruits and plants. Therefore, it is more appropriate to carry out analyses of the antioxidant activity of fruit and plant extracts using a variety of methods. Using multiple analytical methods is a more comprehensive approach to determine the antioxidant activity of fruit and plant extracts (Kim and Lee, 2020).

Conclusion

In general, fruit, flesh, seed weight, and vitamin C in the skin fraction increased with GA_3 application compared to control (G0), but acidity and vitamin C in the flesh and fruit fractions decreased. The highest fruit weight, highest ascorbic acid in the skin fraction and minimum acidity was obtained from application of GA_3 240 ppm (G4). TPC in the flesh and fruit fractions tended to increase and FRAP values in all fractions decreased with GA_3 application compared to control (G0). Maximum TPC values were obtained for crystal guava fruit variety fractions with G3 treatment (180 ppm) and maximum FRAP values were obtained for crystal guava fruit variety fractions with G0 treatment (0 ppm). The highest AAI in all fractions was given by the G3 treatment, compared to the control (G0). The TPC was significantly positively correlated with the AAI DPPH of the flesh and fruit fraction extracts ($0.250 \leq r \leq 0.880$), and the skin fraction extracts showed a strong negative correlation between TPC and AAI DPPH ($-0.813 < r < -0.973$).

Conflict of Interests

The author (s) declares that there is no conflict of interest in this research and manuscript.

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