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In Vitro Study of Antioxidant and Antimicrobial Activities of *Garcinia mangostana* L. Peel Extract

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ABSTRACT
Plant extract are natural additives that are in great demand. Many biological capabilities of plant extracts in the fields of health and medicine, make research on plant extract quite rapid. Mangosteen (*Garcinia mangostana* L.) is one of the most famous fruits in Indonesia. In this paper, the antimicrobial and antioxidant activities of mangosteen peel were studied. The mangosteen peel extract were prepared by maceration method using ethanol for 48 hours. After the evaporation, the crude extracts were tested using DPPH assay for antioxidant activity and antibacterial activity was performed using dilution method. The scavenging activity of mangosteen peel extracts values in the range of 73.57 – 79.14% with extract concentration of 100 ppm to 800 ppm, respectively. The antibacterial activity of mangosteen peel extract were conducted against Gram-positive bacteria (*S. aureus*) and Gram-negative bacteria (*E. coli*). The inhibition zone of mangosteen peel extract was 6.95 mm against *S. aureus* and 5.33 ppm against *E. coli* at extract concentration of 10000 ppm. The results obtained indicate that mangosteen peel extract is potentially applied in the fields of medicine and health.
Keywords: *mangosteen, antioxidant, antibacterial, DPPH assay*

I. INTRODUCTION

Plants extracs including herbs and spices have consisted of natural compounds, that usually used in food ingredients. Besides to improve the taste and flavor of food, it also possessed natural antioxidant and antimicrobial properties. Recently, the antioxidant and antimicrobial from plants is preferred compared to synthetic antioxidant, since there are several of negative effect of synthetic antioxidant. According to consumers, more fresh and natural foods with fewer synthetic additive are important [1]. Because of this, the plants have a tendency of replacing synthetic antioxidants and antimicrobial agents [2]. The utilization of plants extracts as antioxidant and antimicrobial agents are urgently needed to reduce the health hazard and to prolong the shelflife of food.

Mangosteen (*Garcinia mangostana* L.) is one of the famous fruits in Indonesia. Some studies have shown that the extracts from mangosteen parts (barks, leaves, peel) contain bioactive compounds such as xanthones [3]. Xanthones from G. mangostana possess several activity such as antifungal, antibacterial, antiviral, anti-inflammatory dan antiallergy [4,5]. The aim of this present study is to evaluate the antioxidant and antibacterial activity of *G. mangostana* peel extract from Sleman district, Yogyakarta Province, Indonesia.

II. METHODS

A. Preparation of G. mangostana extract

The mangosteen peel (*G. mangostana*) was collected from Sleman, Yogyakarta, Indonesia on January 2019. The *G. mangostana* peels were first cleaned and washed thoroughly to remove any impurities. After washing, the peel was chopped into small pieces. The samples were dried using usual drying under sunlight (without direct exposure) for 3 days. The dried samples were ground to be powder and macerated in ethanol 95% (1:6 w/v) for 2 days at room temperature. After filtration and evaporation of the filtrate, the ethanolic extract of *G. mangostana* was obtained.

B. FTIR spectroscopy characterization

The FTIR characterization of *G. mangostana* peel was performed using FTIR spectrometer Shimadzu 8201 PC (Japan). The samples were mixed with KBr and the FTIR spectra were evaluated in the range of 4000 to 500 cm^{-1}.

C. DPPH scavenging activity assay

The antioxidant activity of *G. mangostana* peel extract was performed by DPPH method according to Darsih *et al.* (2019) with light modification [6]. Several concentrations of *G. mangostana* ethanolic extracts were dissolved in methanol, and then reacted with DPPH 1.01 mM at dark room temperature for 30 minutes. The absorbance was recorded using Elisa Reader at 517 nm. The scavenging activity was calculated by the equation as follows:

DPPH radical scavenging activity (%) = $\left(\frac{A_o - A_1}{A_o} x\ 100\right)$ (1)

where A_o is absorbance of the control and A_1 is absorbance of the sample. The assays were carried out in triplicates. Ascorbic acid was used as positive control.

D. Antibacterial activity assay

The antibacterial activity of the *G. mangostana* peel extract was evaluated against *E. coli* and *S. aureus* using agar well diffusion method [7]. The *G. mangostana* peel extract was dissolved in DMSO. Approximately 100 µL of bacteria suspension were inoculated in nutrient agar plates. The wells were punched in the solid media. Several concentrations of the *G. mangostana* ethanolic extracts were added to wells, and then incubated at 37 °C for 24 hours. Ampicillin was used as a positive control, while DMSO was used as a negative control. The antibacterial activity was evaluated by measuring the inhibition zone diameter after incubation.

III. RESULTS AND DISCUSSION

In this study, *G. mangostana* peel extract was obtained by maceration process using ethanol. Ussually, extraction of *G. mangostana* with ethanol resulting in several active compound such xanthone and other phenolic compounds [8,9]. The result of *G. mangostana* peel extraction showed that the yield of as of 9.75% (w/w).

The antioxidant activity of *G. mangostana* peel extract was evaluated using DPPH radical scavenging assay. This method is the most extensively used to perform the radical scavenging activity of plant extracts. The antioxidant of *G. mangostana* peel extract can be seen in Figure 1.

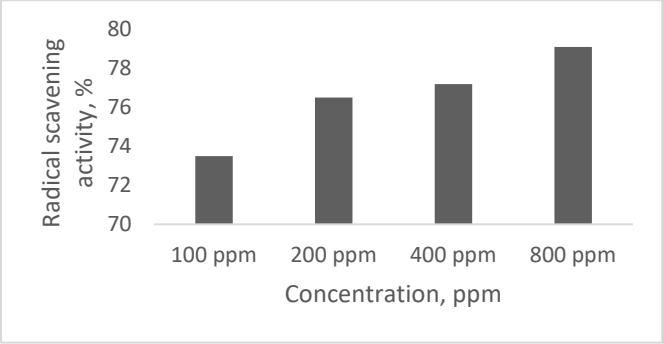

Figure 1. Radical scavenging activity of *G. mangostana* peel extract.

Based on the DPPH assay, the higher the concentration of *G. mangostana* peel extract, the higher the radical scavenging activity. The *G. mangostana* peel extract has high activity as of 73.6% at 100 ppm, 76.5 % at 200 ppm, 77.2% at 400 ppm and 79.1 % at 800 ppm. The IC 50 of *G. mangostana* peel extract is below 50 ppm, meanwhile ascorbic acid as a positive control has a radical scavenging activity as of 76.7 at 25 ppm.

Several studies had evaluated the potential of antioxidant activity of *G. mangostana*. Research by Palakawong *et al*., 2010 showed that extract of G. mangostana peel using ethanol 50% had the highest radical scavenging activity (IC50 = 5.94 µg/ml) compared to bark and leaves (IC50 = 6.46 and 9.44 µg/ml, respectively). A study by Zadernowski et al. (2009) [10] reported that peel of mangosteen (inner peel and outer peel) rich of phenolic contents. Moreover, some research showed that antioxidant activity was in correlation with its phenolic content [11,12]. The different extraction method of *G. mangostana* and the maturity level of *G. mangostana* also can result in different results of its antioxidant activity [12,13,14].

In this study, agar well diffusion method is used to evaluate the antibacterial activity of G. mangostana peel extract. The inhibition zone area is the parameter of the antibacterial activity. G mangostana peel extract was assessed for the antibacterial activity against *E. Coli* as a gram-negative bacteria and *S. aureus* as a gram-positive bacteria. The positive control was using ampicilin, while the negative control was using DMSO. The results are presented in Table 1.

Table 1. Antibacterial activity of *G. mangostana* peel extract against *E. coli* and *S. aureus*

Bacteria	Concentration of *G. mangostana* extract (ppm)	Inhibition zone diameter (mm)		
		well 1	well 2	Mean
E. coli	500	2.95	2.65	2.80
	1000	5.75	5.66	5.70
	10000	4.32	4.84	4.58
S. aureus	500	-	-	-
	1000	-	-	-
	10000	7.27	6.58	6.92
Ampicillin	500	32.95	22.65	27.8
DMSO		-	-	-

At the concentration of 500 ppm, *G. mangostana* peel extract showed inhibition activity of bacterial growth as of 2.80 mm against *E. coli* but no inhibition against *S. aureus*. At concentration 1000 ppm, *G. mangostana* peel extract inhibited *E. coli* growth with inhibition zone diameter as of 5.70 mm, while it was no inhibition against S. aureus. However, *G. mangostana* peel extract showed good inhibition against *S. aureus* at 10000 ppm as of 6.92 mm, while against *E. coli* as of 4.58 mm. DMSO that used as solvent showed no inhibition against the bacteria, while ampicillin as positive control showed inhibition as of 27.8 mm.

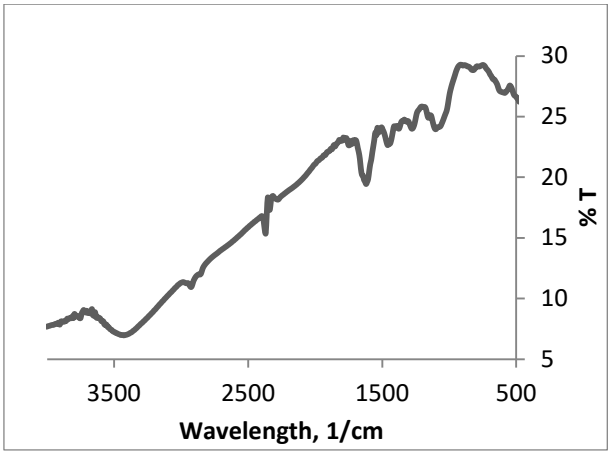

Figure 2. FTIR spectra of *G. mangostana* peel

The study by Palakawong et al., 2010 [15] also showed that the extract of *G. mangostana* extracts (peel, barks and leaves) had a strong antibacterial activity against gram-positive bacteria. Several studies found that in the mangosteen, especially the peel part, there were xanthone, an active compound that can inhibit microorganism. Bioactive compounds of α- and β-mangostin were found in mangosteen [8,9]. Study by Sakagami et al (2005) [16] and Iinuma et al (1996) [17] also reported that α- and β-mangosteen had antibacterial activity against *S. aureus*. According to this study and literature, it can be indicated that the antibacterial activity against *S. aureus* and *E. coli* of the *G. mangostana* peel extracts possibly comes from xanthone and phenolic compounds in *G. mangostana* peel extracts.

The functional groups of compounds in *G. mangostana* peel were analyzed using FTIR spectroscopy. The FTIR spectra of *G. mangostana* peel extracts were recorded in the range of 4000 to 500 cm^{-1} and presented in Figure 2 and Table 2.

Table 2. Interpretation of functional groups of *G. mangostana* peel by FTIR spectroscopy

Functional group vibration	Wavenumber (cm^{-1})	Intensity
O-H, alcohols, phenol	3425,58	broad
C-H, alkane	2862,36-2924,09	sharp
C=C, alkene	1620,21	sharp
C=C, aromatics	1520	sharp
C-C, aromatics	1442	sharp
C-O, aldehyde, caraboxcylic acid, ester	1705	sharp

The prominent and broad band at 3425 cm^{-1} corresponded to O-H stretch with H-bonded, indicating the existence of phenols compounds in the *G. mangostana* peel. This existence of phenol also indicated by the vibration band around 1520 cm^{-1} that possibly is from C=C vibration of aromatics. The absorption bands around 2924 cm^{-1} and 1050 cm^{-1} indicated the peak of carboxylic acid groups. From this FTIR spectra, it can be concluded that *G. mangostana* peel possibly had polyphenol and flavonoid compounds. This result was also in accordance with literatures [18]. The antibacterial and the antioxidant of G. mangostana is possibly contributed from polyphenol and flavonoid compounds.

IV. CONCLUSION

In conclusion, *G. mangostana* collected from Sleman, Yogyakarta, Indonesia exhibit good antioxidant and antibacterial activity. *G. mangostana* peel extract showed good antibacterial activity against *E. coli* at lower concentration compared to *S. aureus*. The antioxidant activity of *G. mangostana* peel extract was higher than that of ascorbic acid as positive control. It is likely that the antioxidant and antibacterial activity was attributed to the phenolic and flavonoid compounds of *G. mangostana* peel extract.

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