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Effect of Pretreatment on Total Phenolic Content and Antioxidant Activities of Mangosteen (*Garcinia mangostana* L.) Aril

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ABSTRACT
Mangosteen (*Garcinia mangostana* L.) fruit, which is extensively cultivated in Indonesia, contains considerable amounts of phenolic compounds and has antioxidant activity. However, this fruit has a fast storage period, less than 14 days in good condition. Especially when the fruit aril has been separated from its pericarp, the aril has a shelf life of several hours and eventually loses phenolic compounds and antioxidant activity. This study aimed at finding appropriate pretreatment method to maintain the phenolic content of mangosteen aril prior its preparation to mangosteen juice. Pretreatment of mangosteen aril was carried out by thermal pretreatment (steaming for 15 minutes) and chemical pretreatment (soaking in 0.2% citric acid solution for 30 minutes). The effect of pretreatment on the juice texture, total phenolic content, and antioxidant activity were investigated. The total phenolic content was determined based on the Folin-Ciocalteu colorimetric method and the antioxidant activity of the aril was analyzed by DPPH radical scavenging assay. Antioxidant activity was expressed in 50% inhibition concentration (IC_{50}). The mangosteen juice prepared with citric acid soaked-aril show a better appearance compared to steamed and nontreated-aril, in which the juice look fresh and as the same color with fresh fruit. The highest total phenolic content of mangosteen juice obtained by using steam pretreatment, in which the total phenolic content of non-treated, steamed and citric acid soaked-treatment was 0.26, 0.55, and 0.41 mg GAE/g sample, respectively. Steam treated mangosteen juice also showed higher antioxidant activity (IC_{50} 107,000 µl), compared to nontreated one (IC_{50} 332,000 µl). From these results, we recommend to pretreat mangosteen aril with steaming before food processing, in order to maintain its phenolic content and antioxidant activity.

Keywords – antioxidant activity, mangosteen aril, pretreatment, steam, total phenolic content

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I. INTRODUCTION

Mangosteen (*Garcinia mangostana* L.) is a tropical fruit, mainly cultivated in Indonesia, Malaysia and Thailand. It is dark purple or reddish pericarp with white and juicy fruit and sweet or sourish taste [1]. This fruit contains considerable amounts of phenolic compounds, which are believed to be effective nutrients in the prevention of oxidative stress [2, 3].

Most of mangosteen fruit is consumed fresh or exported to foreign market. Recently, products such as mangosteen juices or dietary supplements have begun to be widespread around the world. Unfortunaltely, mangosteen has a fast storage period, less than 14 days in good condition. Especially when the fruit aril has been separated from its pericarp, the aril has a shelf life of several hours, thus difficult to preserve their fresh-like quality and high nutritional value for longer periods. Therefore, extending shelf-life by using several food processing, concentrating, and powdering could add value for mangosteen and create a new market.

The purpose of this research is to develop dry powder instant drink from mangosteen aril juice. The total phenolic content of mangosteen juice is dependent on the quality of aril prior to processing. However, after peeling, fruit aril of mangosteen is easily has many different changes such as loss of moisture, browning, release of nutrients, microbial

growth, or off-flavours [4]. All of these changes may be accompanied by degradation of bioactive compounds. Therefore, at first we must find most appropriate pretreatment method for improve the quality of mangosteen aril. Some studies have reported that mild heat treatment (such as hot water dips or infrared surface application) has shown some potential application for improving the quality of fresh-cut fruits [5]. Chemical preservatives such as citric, ascorbic, malic, and erythorbic acid are also commonly used in food industry for extend the shelf life of fresh fruit [6]. Nevertheless, there are still no reports on the use of steaming and citric acid soaking as a pretreatment of mangosteen aril. Therefore, the objective of the present study is to investigate the effect of aril pretreatment on the total phenolic content and antioxidant activity.

II. EXPERIMENTAL PROCEDURES

2.1. Materials

Mangosteen fruit is harvested from Purwakarta, West Java. 2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin-Ciocalteau reagent, ascorbic acid, gallic acid were purchase from Sigma Co (St. Lous, MO, USA). Sodium carbonate, citric acid, methanol, ethanol were purchased from Merck.

2.2. Sample preparation

Mangosteen aril was separated from its pericarp and washed with water. The aril was thoroughly homogenized in a domestic blenderand filtered to obtained mangosteen juice. Other preparation for fruit aril was by steaming and soaking in citric acid 0.2%. Fruit aril was steamed on boiling water for 15 minutes, while other fruit aril was soaked in citric acid solution for 30 minutes. After steaming and soaking process, fruit aril was blended and filtered to get steamed and soaked mangosteen juice.

2.3. Determination of antioxidant activity by DPPH radical scavenging

Antioxidant activity can be measured by DPPH radical scavenging activity method based on Ghafar et al (2010) method with some modification. A 50 µL of sample mixed with 1 mL 0.04 M DPPH in 80% ethanol, shaken and left to stand at room temperature for 30 minutes in a dark room. Ascorbic acid was used as positive control at concentration of 5, 10, 25, 50 and 75µg/mL. The negative control contained only DPPH solution, while the blank contained 80% ethanol. DPPH scavenging activity was measured using spectrophotometer at 517 nm. The scavenging effect was determined by the ratio of DPPH absorption decrease against the absorption of DPPH solution (negative control) using the following equation :

$$\text{Scavenging}\,(\%) = \frac{\text{Abs}_{(\text{control})} - \text{Abs}_{(\text{sample})}}{\text{Abs}_{(\text{control})}} \text{ x } 100$$

Inhibition concentration 50 (IC_{50}) value was obtained from the plotted graph of scavenging against concentration of sample (µg/ mL) [7].

2.4. Determination of total phenolic content

The total phenolics were determined by using Folin-Ciocalteu method. Gallic acid was used as a standard equivalent (in mg/g). Sample was prepared by diluted mangosteen aril juice by 10-fold dilution in distilled water. 200 µL of sample was mixed with 750 µL of Folin-Ciocalteau reagent. After 5 minutes, 750 µL of 6% sodium carbonate solution was added to the mixture and stand for 60 minutes room temperature. The absorbance was measured by UV-Vis spectrophotometer at 725 nm. Standard curve of gallic acid was prepared by the same procedure. The maximum concentration of gallic acid of 100 µg/mL was prepared with methanol solvent, from which a serial dilution was made to give concentrations of 70, 50, 30, and 20 µg/mL. Total phenolic content was expressed as µg gallic acid equivalent (GAE) per gram sample [7].

III. RESULTS AND DISCUSSION

Preparation of mangosteen juice by steaming in hot water or soaking in citric acid 0.2% was carried out to know the treatment effect on the total phenolic content and antioxidant activity, compared with mangosteen juice without any treatment. Physically, mangosteen aril fruit soaking in 0.4% citric acid was looking fresh and same color with fresh fruit, better than steaming- and without treatment-fruit aril. Steaming-fruit aril had soft texture and slightly brown in color, while without treatment-fruit aril had fresh texture aril and slightly brown in color.

Treatment and non treatment-fruit aril was blended and filtered to obtain mangosteen juice. Steamed- and citric acid soaked-mangosteen juice had a white to slightly brown in color while non treatment juice had a light brown in color. Citric acid soaked-mangosteen juice had a fresh smell like fresh fruit and sour taste. Steamed- and non-treatment mangosteen juice lose the fresh smell but they still taste sour. All treatment and non-treatment mangosteen juice was stored at freezer until further testing of total phenolic content and antioxidant activity.

Total phenolic content of mangosteen aril juice was carried out using Folin-Ciocalteu reagent based on Ghafar et al (2010) method with several modification. Total phenolic content test is a colorimetric reaction measured using UV/Vis spectrophotometer. This method is the easiest, fast and cheap method. The hydroxyl groups of phenols or polyphenols in plant extract will react specifically with Folin-Ciocalteu reagent. The yellow Folin-

Ciocalteu reagent will react to form a blue chromophore complex. The more phenolic compounds or polyphenols, the higher intensity of blue produced [8].

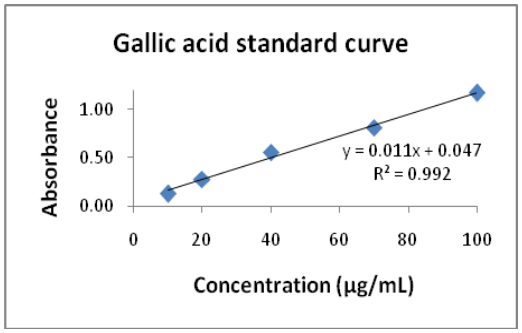

Figure 1. Gallic acid standard curve

Table 1. Total phenolic content in mangosteen juice

Treatment	Total phenolic content (mg GAE/g sample)
Non treatment	0.26 ± 0.036
Steamed	0.55 ± 0.035
Soaked in citric acid	0.41 ± 0.031

The results for the total phenolic content of mangosteen aril juices are summarized in Table 1. As shown in the table, steamed mangosteen juice exhibited the highest phenolic content than citric acid soaked one. The lowest total phenolic content was, as expected, the juice without aril pretreatment. These results indicated that the total phenolic content of mangosteen aril can protected by steaming process. Thus, the steaming process should be considered for optimal pretreatment method.

DPPH radical scavenging ability was evaluated to examine the antioxidant activity of mangosteen aril juice. DPPH is an oxidizing material which can be reacted with antioxidant compound. DPPH reduction will occur and change the violet color of DPPH to a pale yellow color. So, high scavenging activity of sample means high reduction of DPPH [9]. Each sample as well as the positive standard of ascorbic acid was measured in several series of concentration so that the 50% inhibition concentration (IC_{50}) of each sample was obtained. The IC_{50} value was determined by plotting on a graph of scavenging activity, where the value describes the total antioxidants needed to reduce the initial DPPH radical by 50%. Ascorbic acid is a high antioxidant compound that is used as a comparison for the antioxidant activity of the sample. Graphs of scavenging activity curves on ascorbic acid concentration can be seen in Fig. 2. IC_{50} values of ascorbic acid and each sample can be seen in Table 2.

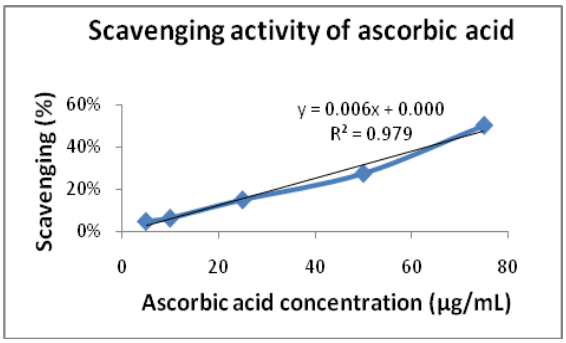

Figure 2. Scavenging activity curve of ascorbic acid

Table 2. IC_{50} value of ascorbic acid and mangosteen juice

Sample	Treatment	IC_{50} (µg/mL)
Ascorbic acid	-	83.16 ± 2.02
Mangosteen juice	Non treatment	332000 ± 7000
	Steamed	107000 ± 1855.93
	Soaked in citric acid	482333 ± 16252.56

The results showed that the antioxidant activity of ascorbic acid is much higher compared to the samples of mangosteen juice. Steamed-mangosteen juice show the highest antioxidant activity. The IC_{50} values of mangosteen juice ranged from 107,000 – 482,333 µg/mL, which means that their inhibition value is small.

IV. CONCLUSION

In conclusion, steam pretreatment is a promising method to protect the mangosteen aril from color change and losing of total phenolic content. Further investigation is needed to formulate the pretreated aril juice in dry powder form of instant drink.

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