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Antioxidant Properties of Coffee Arabica from the Arjasari District that is Processed Naturally, Semi-Washed and Full-Washed

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Abstract.
Arabica coffee (*Coffea arabica L.*) planted in the Arjsari area has the quality of being a specialty coffee that has superior taste and quality. Post-harvest processing can affect the content of the compounds in coffee such that it will affect the quality of the coffee beans. The post-harvest process from coffee cherries to green coffee beans in a natural, semi-washed, and full-washed manner affects the physical form and taste quality of the coffee beans. This study aimed to determine the antioxidant properties of green coffee beans processed by three different post-harvest processes. The test was carried out in vitro using the DPPH (2,2-diphenyl-1-picryl-hydrazyl) method. Antioxidant activity can be seen from the IC50 value. Vitamin C with an IC50 value of 6.1899 ppm was used in comparison. The test results showed that the three ethanolic extracts of green coffee beans had very strong antioxidant properties when compared with the Vitamin C, with the IC50 values of natural, full-washed, and semi-washed ethanolic extract of green coffee beans, respectively being - 33.8648; 27.1245; and 26.9975 ppm.

Keywords: antioxidant, arabica coffee, coffea arabica L. post-harvest process

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1. INTRODUCTION

Arabica coffee is a widely consumed coffee variety because it has a delicious taste, is not too bitter, and a little sour. To get the best coffee flavor, coffee farmers choose ripe coffee cherries, namely red coffee cherries. Post- harvest processing can also affect the flavor and quality of the coffee beans, about 60% of the quality of green coffee beans determined by postharvest process activity [1]. One of the post-harvest operations is processing and drying. In general, there are post-harvest processing mechanisms for the dry and wet methods. Dry processing is called a natural process, wet processing is known as semi-washed and full-washed. These three methods can produce coffee beans that have different flavors. During the drying process, the coffee beans do not

experience dormancy but enter a germination period. Many physiological processes and bean metabolism begins at this stage, so this will affect the compound content in the coffee beans as well as the aroma and taste of coffee [2].

In the full-washed and semi-washed processes, a fermentation process occurs during washing. This causes a sour taste in the coffee produced [3]. This is also the basis for thinking that the post-harvest process will also affect the content of antioxidant compounds in the seeds so that the antioxidant activity of the three seeds will be different.

The flavor of each coffee bean can be influenced by the content of compounds in the coffee beans. The chemical compounds in coffee include caffeine, theobromine, theophylline, chlorogenic acid, diterpenoids, sugars, amino acids, and organic pollutants, all of which play an important role in determining taste, quality, and health effects [4]. Apart from making coffee having a distinctive taste, these compounds have pharmacological activities. Several studies on

coffee have shown that adequate coffee intake can reduce fat in the body and reduce diseases caused by oxidative damage such as type 2 diabetes, cardiovascular disease, Alzheimer's and Parkinson's [4].

Yashin et al, [5] stated that coffee is a good source of antioxidants. Compounds that act as antioxidants in coffee beans are phenolics compound, especially chlorogenic acid [6]. This research will prove the effect of post-harvest processes, namely natural, semi-washed, and full-washed processes that affect the antioxidant activity of the ethanol extract of coffee beans.

2. METHODS

2.1. Sample Collection

Green beans that are used in this research are Java Preanger Coffee. Origin from Mount Malabar, West Java, Indonesia. This coffee is planted and harvest by a local farmer in the Arjasari district with an altitude of 1000 – 1350 m high at sea level. The post-harvest of red coffee had done by Dhikr Coffee. The post-harvest process is naturally, semi-washed, and full-washed.

The post-harvest process is carried out using ripe coffee cherries, namely coffee cherries that are red in color, after being picked then they are denoted or put in water. Ripe coffee cherries have an ideal balance between sugar, free water content, and have

smooth mucilage so it make mechanical mucilage remover more easy. Therefore, some specialty coffee must a ripe coffee cherry.

The sunken coffee cherries are then processed, while the floating coffee cherries are discarded. After sorting, the natural process is carried out by drying them in a greenhouse until the moisture content is 12-13%. The semi-washed process (as known as the honey process) is done by peeled (depulping) sunken coffee cherries, then fermented for 12 hours, and then dried in the greenhouse until the moisture content is 12-13%. While the full-washed process is done by peeled (depulping) sunken coffee cherries, then fermented for 12 hours and then washed until there is no more pulp and then dried in the greenhouse until the moisture content is 12-13%. Furthermore, all of this dry coffee fruit is called unhulled, and then the horns are peeled using a huller to obtain green beans called natural, semi-washed, and full- washed coffee beans.

2.2. Phytochemical Screening and Extraction

Phytochemical screening was carried out qualitatively on natural, semi-washed, and full-washed coffee beans and ethanol extracts. 500 g of coffee beans were used each and extracted using 96% ethanol solvent.

2.3. Water Content Measurement

Water content measurements were carried out on natural, semi-washed, and full-washed coffee beans using the Azeotropy distillation method [7]. A total of 20 grams of Simplicia is put into a dry flask, then about 200 mL of saturated toluene is added. The captured water when toluene saturation is measured (n). The flask is heated carefully until all the water is distilled. The receiving tube is allowed to cool to room temperature. After the water and toluene have completely separated, read the volume of water to the nearest 0.05 mL. The volume read is referred to as the second distillation volume (n '). The moisture content value is calculated in percent (%) using the following formula. Measurement of water content using the following formula.

$$\text{water content (\%)} = \frac{n' - n \text{ volume of water (mL)}}{\text{sample weight (g)}} \times 100\%$$

In addition to measuring the moisture content, it also measures the moisture content of the coffee beans using a bean moisture meter with the WILE brand.

2.4. Antioxidant Activity

The antioxidant activity test was carried out using the DPPH method [8]. Measurement of antioxidant activity was carried out by reacting 2 ml each of the test material and the vitamin C comparison with 2 ml of DPPH solution into the chocolate vial. Then each mixture was homogenized using vortex and incubated for 30 minutes at room

temperature. After incubation, both the mixture of the test material and the comparison of vitamin C were measured for their absorption at a maximum absorption wavelength of 743.0 nm. From the absorbance value, the % inhibition value is obtained using the following formula. In addition to measuring the moisture content, it also measures the moisture content of the coffee beans using a bean moisture meter with the WILE brand.

% inhibition value = [(Ablanks – Asample)/Ablanks] × 100%.

Antioxidant activity is expressed by the IC50 value, which is the concentration of the sample that can reduce free radicals by as much as 50%. This value is obtained from the linear regression line equation between the concentration of the test material and% inhibition.

3. RESULTS AND DISCUSSION

3.1. Phytochemical Screening and Extraction

Phytochemical screening was carried out to qualitatively determine secondary metabolite compounds contained in coffee beans and coffee bean extracts. Phytochemical screening uses several reagents and results are indicated by the formation of color or deposits. In addition, by knowing the secondary metabolites in the extract, it can be concluded how many compounds can be extracted or extracted by the solvent used for extraction. The results of the screening can be seen in Table 1.

Based on the phytochemical screening data in Table 1, both green beans and ethanolic extracts of GBn, GBsw and GBfw, all three contain flavonoids, polyphenolates, tannins, monoterpenes and sesquiterpenes, steroids and terpenoids and quinones. In the three samples also, neither the green beans nor the ethanolic extract were found in saponins. From the results it was also seen that the secondary metabolites found in the green beans were also found in the extract. This shows that the extraction process is successful in extracting secondary metabolites from green beans. Compounds that act as antioxidants are polyphenols and flavonoids.

Table 1: Result of phytochemical screening.

Green Beans and Extract			
	Green Beans Natural	**Green Beans Semi-washed**	**Green Beans Full-washed**
Flavonoid	+	+	+
Polifenolat	+	+	+
Tanin	+	+	+
Saponin	-	-	-
Monoterpen & Sesquiterpen	+	+	+
Steroid & Terpenoid	+	+	+
Kuinon	+	+	+
(+) identified; (-) not identified,			

The extraction process for green beans was carried out using the maceration method with 96% ethanol as a solvent. Each sample used is 500 grams. The yield of the extract of each sample was 13.6974% GBn, 13.6575% GBsw sample, and 14.5566% GBfw sample.

3.2. Water Content Measurement

Measurement of water content is a non-specific parameter that aims to provide a minimum limit or range of water content in the material [7]. The results of measuring water content can be seen in Table 2.

Table 2: Result of water content and moisture of green beans.

	Water Content	**Moisture of green beans**
Green Beans Natural (GBn)	8.19%	12.56%
Green Beans Semi-washed(GBsw)	8.74%	12.53%
Green Beans Full-washed (GBfw)	4.99%	11.53%

Based on the results of measuring the water content of the azeotropy method, GBfw has a lower water content than the other two samples, namely 4.99%. The water content of GBn and GBsw were 8.19% and 8.74%, respectively. The maximum limit of the permissible water content is not more than 10% [7], this aims to prevent the growth of bacteria and fungi at the storage stage.

In addition, moisture measurements for green beans were also carried out using WILE, which is commonly used to measure the moisture content of grains including coffee beans. The measurement results of the green bean humidity level showed that

the three samples of GBn, GBsw and GBfw had relatively the same humidity values, namely 12.56%, 12.53% and 11.53%. These grades meet quality standards for specialty coffee beans. Ahmed et al (2018) said that a moisture content of green beans are 10% to 12% wet basis (w.b.), to avoid unwanted fermentation.

3.3. Antioxidant Activity Test

The antioxidant activity test of the ethanol extract of GBn, GBsw and GBfw was carried out using the DPPH (2,2- diphenyl-1-picrylhydrazyl) method [8]. Vitamin C solution was used as a comparison. The measurement of antioxidant activity was carried out at a maximum wavelength of 743.0 nm. The results of testing the antioxidant activity of Vitamin C and ethanol extract GBn, GBsw and GBfw as seen from the IC50 value can be seen in Table 3. The parameter used to determine the value of antioxidant activity is the IC50 value. This value is the value of the extract's effective concentration which is needed to reduce 50% of DPPH free radical activity. The lower the IC50 value of a test material, the stronger the antioxidant activity. This is because at low concentrations it can reduce 50% of DPPH free radicals. The calculation of the IC50 value was carried out using linear regression, comparing the

concentration with the absorbance of each sample after reacting with the DPPH free radical.

Based on the IC50 value in Table 3, it can be seen that the GBsw sample has a lower IC50 value than the other two samples, namely 27.1245 ppm. GBsw samples had the best antioxidant activity among the three. The GBfw sample has an IC50 value of 26,9975 ppm and the GBn sample has an IC50 value of 33.8648 ppm. When viewed from the IC50 value, both GBsw, GBfw and GBn have very strong antioxidant activity even though the IC50 value is much higher than vitamin C, which is 6.1899 ppm. The antioxidant activity of the three samples also includes very strong antioxidants because it has an IC value of less than 50 ppm. The antioxidant activity of the three samples cannot be separated from the presence of flavonoid and polivenolate compounds, which are antioxidant compounds in plants.

Coffee beans that are wet processed (semi-washed and full-washed) have a higher antioxidant value than the natural process. This is presumably because during the wet process more optimal fermentation occurs so that the synthesis of antioxidant compounds including polyphenols and flavonoids can be maximized. There ultimately affects the value of antioxidant activity.

Table 3: Result of antioxidant activity test.

	Concentration (ppm)	% inhibition	IC50
Vitamin C	12	90.5579 ± 0.24	
	10	82.2010 ± 1.18	
	8	66.7986 ± 3.23	6.1899 ± 0.23
	6	49.0437 ± 2,13	
	4	32.7451 ± 1.19	
	2	15.9200 ± 3.35	
Green Beans Natural (GBn)	60	81.9386 ± 2.30	
	50	73.2688 ± 3.43	
	40	63.3791 ± 0.40	33.8648 ± 4.06[a]
	30	48.5080 ± 3.17	
	20	36.4687 ± 0.18	
	10	20.8188 ± 1.47	
Green Beans Semi-washed (GBsw)	60	86.7951 ± 0.49	
	50	76.7917 ± 2.01	
	40	67.5093 ± 1.96	27.1245 ± 0.88[b]
	30	56.9934 ± 0.94	
	20	42.5382 ± 1.92	
	10	25.8854 ± 0.65	
Green Beans Full-washed (GBfw)	**60**	**85.4515 ± 3.51**	
	50	81.7360 ± 4.64	
	40	67.0380 ± 2.81	**26.9975 ± 2.45**[b]
	30	58.6890 ± 3.93	
	20	43.9872 ± 4.55	
	10	22.9162 ± 2.70	

4. CONCLUSION

In this study, it can be concluded that Arabica coffee beans (Coffea arabica L.) have very strong antioxidant activity. Where coffee beans processed semi-washed (GBsw) have the best antioxidant activity among the other three samples.

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