Chemical characteristics of cascara tea from several varieties of coffee in Aceh Province

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Abstract. In coffee processing, coffee husks are usually thrown out, creating a large amount of waste which can potentially pollute the environment. In several countries, coffee husks have been used as a drink and have a high selling value known as cascara tea. The aim of this study is to determine the differences in the chemical characteristics of cascara tea made from three coffee varieties in Aceh Province. This study used a randomized block design with coffee variety as the single factor, either Arabica, Liberica, or Robusta and analyzed by ANOVA. The parameters analyzed were pH value, total dissolved solids, total phenol, and antioxidant activity. The results showed that coffee varieties affected the pH value, total dissolved solids, and total phenol in the brewed cascara. However, coffee varieties do not affect the antioxidant activity of cascara tea. The average pH value of cascara tea obtained was 5.17, total dissolved solids was 0.54 °Brix, total phenol was 0.58 mg GAE/ml and antioxidant activity was 70.02%. The highest total phenolic compounds were obtained from Robusta coffee varieties with 0.64 mg GAE/ml. It is necessary to carry out further analysis of the volatile compounds and their correlation with the resulting cascara tea flavor.

1. Introduction
Coffee (Coffea sp) is a type of plantation crop that is widely cultivated around the world. This plant is included in the Rubiaceae family and the Coffea genus. Coffee not only plays an important role as a source of international commerce, but is also a source of income for approximately one and a half million Indonesian coffee farmers [1].

The part of the plant that is traded is the beans, which is generally obtained from two types of processing, namely, the wet method and the dry method. The dry method is done by removing the pulp, endocarp, and epidermis after it is dry, while the wet method is done when the pulp is still wet [2]. From these two processing methods, 40–45% of the waste of the entire process of coffee production will be produced. Pulp (red fruit skin) is the largest part of the waste produced and is known to contain nutrients such as carbohydrates (35%), protein (5.2%), fiber (30.8%), and minerals (10.7%). It also contains water (84.2%), protein (8.9%), sugar (4.1%), and contains polyphenolic compounds (chlorogenic acid, flavanols, anthocyanidins, catechins, routine, tannins, and ferulic acid [3], [4]. Up to now, coffee waste has not been used optimally in Indonesia.

In some countries, such as in Bolivia, Yemen and Ethiopia, coffee skin waste is processed along with the coffee bean, and has a high selling value. The result of these preparations is known as cascara.
steeped in hot water, cascara tea is a drink that is produced from the dry coffee skins and generates a distinctive taste and aroma [5]. Based on Juwita et al., [6], cascara contains chemical compounds such as alkaloids, tannins, and polyphenols. Unlike coffee, cascara has a sweet taste and a low caffeine content, so it is safe for consumption. In addition, Carpenter [7] stated that the antioxidant content which is available in cascara can be beneficial to maintain a healthy endurance.

Coffee, based on the cultivation location, is divided into three, namely, Arabica coffee, Liberica coffee, and Robusta coffee. Arabica coffee is grown at an altitude of around 1350–1850 meters above sea level which has a dry climate. Robusta coffee can be grown in the lowlands or on the coast, and the plants have a higher production rate than Arabica coffee. Meanwhile, Liberica coffee thrives in areas with high humidity with a hot climate. This caffeine content of Liberica coffee tends to be the same as Arabica coffee, but has a lower quality in terms of fruit and yields [8], [9]. All three of these types of coffee are found in various locations around Aceh Province. The Gayo Highlands are predominantly Arabica coffee; coffee in the southern and western parts of Aceh are predominately Robusta; Liberica varieties are found in Pidie Jaya.

Coffee waste from these various regions has not been used to its potential. The utilization of coffee waste is very limited and is only used as a natural fertilizer. Processing coffee waste into cascara is a great opportunity because the process is easy and simple and has high antioxidants and important nutrients. In short, this product is feasible to be developed. Different coffee varieties are suspected to produce different physicochemical characteristics of the cascara. So far, there has not been any report on the differences in cascara characteristics of different coffee varieties. The aim of this study is to determine differences in the chemical characteristics of cascara tea from three coffee varieties in Aceh Province.

2. Method

2.1 Sampling, preparation of raw materials and production of cascara

Sampling was sourced from Central Aceh, Pidie, and South Aceh. The raw materials for Robusta, Arabica, and Liberica coffee were sorted from the fresh coffee cherries. In this sorting, any low quality or irregular coffee cherry husks were discarded, ensuring the uniform, high quality of cascara. The coffee cherries were processed by wet processing, meaning the pulp and the beans were separated at the beginning of the process, while still wet. This was done using a pulper, then dried immediately in the sun until the moisture content was around 12%.

2.2 Cascara tea brewing

Cascara is brewed by following methods established by Yuliandri [10] and Limbong [11] with a few modifications. The brewing of cascara was carried out by weighing 2.5 grams of each cascara sample and adding 250 ml of hot water at 90 ºC. The cascara was brewed for 8 minutes, filtered, and set aside until it reached room temperature.

2.3 Product analysis

The parameters analyzed were pH value, total dissolved solids, total phenol, and antioxidant activity. The pH analysis was performed using a pH meter. The total dissolved solids were measured using a refractometer [12]. Phenol analysis was performed using a method devised by Folin-Ciocalteau [13] and the analysis of antioxidant activity was carried out using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method [14].

2.4 Data analysis

The data obtained were analyzed statistically by ANOVA (analysis of variance). If there was a significant effect on the treatment, the analysis continued and the Duncan's Multiple Range Test (DMRT) was used.
3. Results and Discussion

3.1 pH value

The pH or the degree of acidity is used to express the level of acidity or alkalinity of a substance, solution or object has. In tea drinks, usually the pH measured is 6, which is acidic [15]. The pH value obtained from steeping cascara tea in this study ranged from 5.09–5.3 with a mean of 5.17. This result showed that cascara tea is more acidic than the general tea. ANOVA results displayed that coffee varieties had a significant effect (P≤0.05) on the pH value of cascara tea as shown in Figure 1.

![Figure 1. The pH value of cascara tea from different varieties (the same notation shows no difference in the DMRT test of 0.05).](image)

Based on Figure 1, cascara tea from Arabica coffee skins has a higher pH value than Liberica and Robusta. This is thought to be related to the higher content of organic acids in Liberica and Robusta coffee. Organic acids found in coffee include citric, malic, quinic, and chlorogenic acids. Chlorogenic acid is the most common organic acid found in coffee cherries [16]. In general, it is known that the chlorogenic acid content in Robusta coffee is higher than Arabica coffee [17], [18]. The chlorogenic acid content of Liberica coffee is also higher than Arabica. According to Farah and Donangelo [19], the total chlorogenic acid content of the three coffee varieties were respectively 6.88% Arabica, 6.97% Liberica and 7.17% Robusta.

3.2 Total dissolved solids

The total value of dissolved solids steeping cascara tea from this study ranged from 0.40–0.60 °Brix with average of 0.54 °Brix. The results of the analysis of variety showed that coffee varieties had a very significant effect (p≤0.01) on the total dissolved solids. The total dissolved solids of cascara tea from different varieties can be seen in Figure 2.
In Figure 2, it can be seen that the total dissolved solids in cascara tea with Arabica coffee pulp was lower than in Liberica and Robusta. This shows that the dissolved components in the pulp of Liberica and Robusta coffee were higher. Dissolved solid components may consist of total sugar, pigments, vitamins, organic acids, and protein [20]. The sugar content in Arabica coffee is known to be higher than Robusta [17]. However, Robusta and Liberica coffee have a higher total dissolved solid because other dissolved solid components (other than sugar) are thought to be higher in these two varieties. This is reinforced by the lower pH value of Liberica and Robusta coffee which indicates that the organic acid content (as a component of dissolved solids) is higher.

3.3 Total Phenol

Phenolic compounds are common constituents found in commonly consumed plants such as fruits, vegetables, cereals, nuts, and in beverages made from plants such as grapes, tea, and coffee [21], [22]. These compounds are secondary metabolites from plants which are generally involved in the defense against ultraviolet radiation or pathogenic aggression. Phenolic compounds are grouped into different classes according to their basic chemical structure and in their polymerized form [22].

Total phenol analysis was performed using the Folin-Ciocalteau method. This method is performed by using a UV-Vis Spectrophotometer to interpret the number of phenolic compounds in cascara tea using gallic acid solution as the standard. The total phenol value of cascara tea ranged from 0.52–0.64 mg GAE/ml with an average of 0.58 mg GAE/ml. The results showed that coffee varieties had a very significant effect (p≤0.01) on the total phenol of cascara tea. The total phenol of cascara tea from different varieties can be seen in Figure 3.

Figure 2. Total dissolved solids of cascara tea from different varieties (the same notation shows no difference in the DMRT test, 0.05).
Figure 3. Phenol content of cascara tea from different varieties (the same notation shows no difference in the DMRT test of 0.05).

Figure 3 demonstrated that the highest phenol content is found in cascara tea from Robusta coffee pulp followed by Liberica and the lowest is Arabica. The largest group of phenolic compounds found in coffee is chlorogenic acid. It has been determined previously that Robusta coffee contains higher chlorogenic acid than Liberica and Arabica [17]-[19]. The differences in the value of chlorogenic acid cause the distinction in the total phenol content of these three coffee varieties. Phenolic compounds have received considerable attention as potential protective factors against several chronic degenerative diseases in humans such as cataracts, macular degeneration, neurodegenerative diseases, diabetes mellitus, cancer, and cardiovascular disease [23].

3.4 Antioxidant activity
Solichah et al. [24] claimed that the phenolic compounds in coffee peels act as antioxidants. The value of antioxidant activity obtained in this study ranged from 68.52–72.40% with a mean of 70.02%. The results of variance showed that coffee varieties had no significant effect (p>0.05) on the antioxidant activity of cascara tea. Thus, it can be said that the antioxidant activity content of cascara tea from these three coffee varieties is no different. Meanwhile, Saw et al., [25] reported that Liberica coffee has higher antioxidant activity than Robusta and Arabica.

4. Conclusion
Coffee varieties affected the pH value, total dissolved solids, and total phenols of cascara tea. Cascara tea from Arabica coffee husks had a higher pH value, but contained lower total dissolved solids and total phenols than Liberica and Robusta varieties. The average pH value of cascara tea obtained was 5.17, total dissolved solids was 0.54 °Brix, total phenol was 0.58 mgGAE/ml, and antioxidant activity was 70.02%. The highest total phenolic compounds were obtained in Robusta coffee varieties reaching 0.64 mgGAE/ml. It is necessary to carry out further analysis of the volatile compounds and their correlation with the resulting cascara flavor.

Acknowledgments
Thank you to Syiah Kuala University for funding this research through the 2020 Research Grant “Penelitian Lektor”. Thank you to Rizka Anindita and Akbar who have helped in the supply of raw materials and chemical analysis in the laboratory.
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