Chemical analysis of cascara tea from wine coffee processing with a different fermentation times

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Abstract. Wine coffee is the result of processing coffee using a modified fermentation method. Currently, wine coffee is one of the most popular coffee products for coffee connoisseurs because of its strong and distinctive taste due to the fermentation process it goes through. Increased processing of wine coffee certainly increases the amount of waste produced. The aim of this research was to study the effect of fermentation time of wine coffee toward cascara tea quality. This study used a completely randomized design which consisted of 5 treatments and 3 replications. The treatment was fermentation times that consisted of F0 = control (no fermentation), F1 = 25 days of fermentation, F2 = 35 days of fermentation, F3 = 45 days of fermentation. The parameters analyzed were pH, total phenol and antioxidant activity. The results showed that the fermentation time of wine coffee affected the pH value of the cascara produced. Total phenol and antioxidant activity of cascara tea were not affected by fermentation time. It is necessary to analyze the level of consumer preference on the sensory quality of the resulting cascara tea.

1. Introduction

Indonesia as an agricultural country produces various kinds of export commodity plants, such as coffee, rice, corn, soybeans and various other plants. Indonesia is the fourth largest coffee producer and exporter in the world after Brazil, Vietnam and Colombia. Indonesian coffee production has been recorded steadily increasing since 1980 with a total of 294,973 tons/year to 637,539 tons in 2017. This production is expected to continue to increase in the following years [1].

In trade, the part of coffee used is green beans which will then be further processed into ground coffee. The coffee green beans obtain from coffee cherries that have undergone several steps of processing and generate considerable quantities of by-products. Depending on coffee processing method chosen, various by-products may be produced such as pulp, husk, silver skin and spent coffee grounds. Overall, the coffee products obtained from coffee processing can reach 45% [2].

In several countries such as Hawaii, Bolivia, Ethiopia and Yemen, the skin of the coffee pulp has begun to be used as a beverage in the form of herbal tea known as cascara tea. Cascara is a tea that is processed from the skin of the dried coffee pulp (Figure 1). Cascara has a distinctive aroma and flavor compared to other teas, the sweetness combined with the sour and slightly bitter taste makes it a very popular drink, the distinctive aroma such as cherries, mangoes, rose petals and even tamarind give a refreshing impression to its connoisseurs. What's more, with its high antioxidant content making it a healthy functional drink [3, 4].
Wine coffee is one of the products of coffee processing using the fermentation method. The processing of wine coffee is classified as a semi-washed process. As the name suggests, this processing will produce a wine taste sensation when enjoyed. This sensation appears as a result of the fermentation process carried out [5]. Currently, wine coffee is one of the most popular coffee products for coffee connoisseurs because of its strong and distinctive taste due to the fermentation process it goes through.

The processing of wine coffee is very complex, from the sorting stage to the final drying process. In Central Aceh district, Aceh Province, coffee farmers process wine coffee with different fermentation times. The process starts from picking the fruit from the coffee plantation, after which sorting is done, only the fully ripe fruits will be used. After that, washing is done, and the next process is drying for 2 to 4 hours in the sun. The coffee is then fermented in a plastic container in a vacuum and re-wrapped using a cloth or sack. Drying and fermentation are repeated every 5 days until the 25th, 35th or 45th day depending on which fermentation time is chosen [6]. Increased processing of wine coffee certainly increases the amount of waste produced. The aim of this research was to study the effect of fermentation time of wine coffee toward cascara tea quality.

2. Materials and methods

2.1 Raw material preparation

The raw material preparation process begins with the collection of Gayo Arabica coffee cherries obtained from coffee farmers in Bukit Sub-district, Bener Meriah Regency, Aceh Province. The coffee cherries are then sorted manually by taking perfectly ripe red fruits and soaking them in a container filled with water. Only fully immersed fruit will be used. After obtaining the best fruit, the coffee cherries are ready to be processed for wine coffee processing.

2.2 Processing (fermentation) of wine coffee and cascara production

The processing of wine coffee was carried out according to procedures commonly conducted by wine coffee producers in Central Aceh District. The coffee fruit is dried in the sun for 4 hours. The coffee from the initial drying is then weighed for each treatment as much as 3 kg and put into a clear plastic bag size 5 kg. Incubation (fermentation) was carried out at room temperature with varying times, namely for 15, 25, 35 and 45 days. Every five days of the fermentation process, the coffee cherries will be dried in the sun for 2 hours and wrapped again. One treatment was made without fermentation as a control. Each treatment was repeated 3 times. The fermented coffee was then dried in the sun until it reaches a moisture content of around 14%. Furthermore, the hulling process was carried out to separate the skin and coffee beans using a huller. The skin obtained was a cascara.

2.3 Cascara brewing process and chemical analysis

The cascara brewing process refers to [4]. Cascara as much as 3 g of cascara was brewed with 100 ml of hot water (± 90°C). The stirring process was carried out and left for 10 minutes. The cascara brew was filtered and the filtrate was analyzed chemically consisting of analysis of pH value, total phenol and antioxidant activity. pH analysis was performed with a pH meter. Total phenol was analyzed by spectrophotometer using the Folin-Ciocalteau method [7]. Antioxidant activity was carried out by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method [8].
2.4 Data analysis
The data obtained were analyzed using Analysis of Variance (ANOVA). Further tests were carried out with the Duncan Multiple Range Test (DMRT).

3. Results and discussion

3.1 pH value
The pH value shows the level of acidity of a product. The pH value of cascara tea obtained in this study ranged from 4.67-5.90 with a mean of 5.23. The average pH value of cascara steeping obtained in this study (5.23) was lower than the commonly known pH value of tea around 6 [9]. This indicates that cascara tea has a more sour taste. The results of the analysis of variance showed that the fermentation time had a very significant effect (p≤0.01) on the pH value of cascara tea (Figure 2).

![Figure 2](image-url)

*Figure 2. The Effect of Fermentation time on the pH Value of Cascara Tea (F0: without fermentation, F1: 15 days of fermentation, F2: 25 days of fermentation, F3: 35 days of fermentation, F4 of 45 days of fermentation).*

Figure 2 shows that there was a decrease in the pH value of cascara tea which fluctuates during the fermentation of wine coffee. However, overall, it can be seen that the pH value of cascara tea obtained from the control treatment (without fermentation) was higher than that of other fermented treatments. This shows that the fermentation of wine coffee produces a number of organic acids which contribute to lowering the pH. Coffee fruit fermentation is assisted by the presence of enzymes and microorganisms that are naturally present in coffee cherries, including yeast, bacteria and molds [10]-[12]. These microorganisms break down carbohydrates, especially simple sugars found in coffee cherries, into organic acids. Coffee fruit is known to contain carbohydrates with low molecular weight (monosaccharides, disaccharides and oligosaccharides) and high molecular weight (polysaccharides). The most common simple sugar found in coffee cherries is sucrose, in small amounts it is also found fructose, glucose, mannose, arabinose and rhamnose [13]-[15].

The coffee fruit itself is basically acidic because of the presence of organic acids such as citric, malic, quinate and chlorogenic acids that are naturally found in coffee cherries (Ginz). This can also be seen in the results of measuring the pH value of the control cascara (without fermentation) which is indeed in acidic conditions. However, with the fermentation process, this acidity will increase due to the increase in organic acids as metabolites of the fermentation process. Some of the organic acids produced during fermentation include lactic acid, acetic acid, butyric acid and other carboxylic acids [16]-[18]. Nurhayati et al., [2] states that the organic acids formed from the fermentation process will release protons so that the pH value is lower.
3.2 Total phenol
Phenolic compounds are components commonly found in plants such as fruits, vegetables, cereals and legumes. These compounds are also found in beverages extracted from plants such as wine, tea and coffee [19,20]. Polyphenols, including secondary metabolites in plants, function as bioactive components that have many benefits for human health and are non-toxic [21]. Ramirez Coronel et al., [22] reported that there are four main groups of polyphenols in coffee cherries, namely flavan-3-ols, hydroxycinnamic acid, flavanols, and anthocyans. Polyphenol compounds in coffee have antioxidant activity [23]. The total phenol value of cascara tea infusion in this study ranged from 0.50-0.86 mg GAE / ml with an average of 0.60 mg GAE / ml. The results of the analysis of variance showed that the wine coffee fermentation time did not have a significant effect (p> 0.05) on the total phenol of cascara tea produced.

3.3 Antioxidant activity
Antioxidants are substances or compounds that have the ability to inhibit, delay or prevent the oxidation process of other easily oxidized materials [24]. Coffee, tea and red wine are known as antioxidant-rich beverages [25, 26]. One of them comes from polyphenol compounds. Polyphenol compounds function as antioxidants through the primary antioxidant mechanism which breaks the chain of the oxidation process [24]. The antioxidant activity of cascara tea obtained in this study ranged from 67.28-73.33% with an average of 69.92%. The results of the analysis of variance showed that the time of wine coffee fermentation did not have a significant effect on the antioxidant activity of cascara produced.

4. Conclusion
Fermentation time of wine coffee affected the pH value of the cascara produced. Total phenol and antioxidant activity of cascara tea were not affected by fermentation time. It is necessary to analyze the level of consumer preference on the sensory quality of the resulting cascara tea. In addition, it is necessary to conduct a quality analysis of wine coffee as the main product so that the optimal time is known to produce the best quality for both products at once.

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