**Physicochemical Characteristics of Robusta Coffee Beans *(Coffea canephora)* fromLampung with Pineapple (*Ananas comosus L.)* Juice Infusion**

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**Abstract.** Robusta coffee (*Coffea canephora*) is one of the leading commodities in Indonesia. Lampung province is one of the largest coffee production centers in Indonesia with an area of 161,162 ha with production up to 133,243 tons. Robusta coffee (*Coffea canephora*) has a lower acidity, bitter taste and higher caffeine content than other types of coffee. Therefore, it is necessary to add pineapple juice to robusta coffee. Pineapple juice contains the protease enzyme, namely bromelain, which can break down protein compounds and help release mucus on coffee beans, so it can improve the quality and taste of Robusta coffee. The purpose of this study was to observe the physicochemical characteristics of robusta coffee beans in Lampung with pineapple juice soaking. The type of coffee beans used were red cherry beans and coffee beans with two different qualities, namely commercial and fine robusta that had been through the drying process. This study used the method of soaking coffee beans with 80% pineapple juice for 32 hours then physically and chemically tested. Physical tests consist of color while chemical tests include moisture content and pH. Data analysis used one-way ANOVA through SPSS software with an alpha value of 0.05. The results of the study showed that there was a significant effect (p <0.05) on the difference between coffee beans on pH and moisture content values, while it did not have a significant effect (p> 0.05) on color. Chemical quality values in the form of pH of red cherry beans, fine robusta, and commercial are pH 5.4; pH 4.8; and pH 5. 1 and moisture content of 10.6%, 9.5%, and 10%. The physical quality values of red cherry, fine robusta, and commercial in the form of color values are L values of 46; 46.6; and 44, a value of 1.55; 1.26; and 2, b values of 8.66; 8.63; and 7.69. The yield values of red cherry, fine robusta and commercial are 38.7%, 96.6% and 98.9% first, second, and third level headings (first level heading)

# INTRODUCTION

Indonesia is one of the countries with the largest coffee producer in the world after Brazil. Coffee is an export commodity with quite high economic value both in Indonesia and the world market [1]. Coffee is one of the most popular drinks for many people for various purposes. As a result of the large number of requests to fulfill these needs, coffee processing is mostly carried out by various small industries. This continues to be done in order to increase the added value of the coffee so that it can be consumed properly by the community. Coffee processing is aimed at improving or improving quality, both in terms of taste and the contents of the coffee in accordance with health recommendations [2].

Coffee (*Coffea*) is a type of plant that belongs to the Rubiaceae family with the ability to grow in tropical and subtropical regions. Coffee has various compounds that are its main characteristics, such as caffeine, chlorogenic acid, quinolic acid, trigonelin, and other compounds. One type of coffee that is widely grown and cultivated is Robusta coffee [3]. Robusta coffee *(Coffea canephora)* is the most widely cultivated and developed type of coffee in the Indonesian plantation sector. Lampung is one of the centers for national coffee production and export needs [2]. The Robusta coffee plantation area in Lampung has a total area of ​​161,162 ha with a production capacity of 133,243 tons. Robusta coffee has distinctive characteristics in the form of a taste that is quite strong and more bitter than Arabica coffee [4].

Robusta coffee marketing is mostly done in fresh to dry forms. The taste which tends to be bitter and sour triggers an increase in stomach acid for anyone who consumes it. The bitter and sour taste in Robusta coffee is caused by the presence of caffeine. Caffeine is very famous for its ability as a compound that can improve the performance of one's physical activity and concentration. However, consuming excessive caffeine can cause digestive disorders, nervousness, muscle tremors, and insomnia. Therefore, it is necessary to develop robusta coffee processing so that it can continue to be consumed without causing side effects. One form of the development of robusta coffee processing is to use the pineapple soaking method with a concentration of 80%. [1]. Soaking can be done by utilizing materials such as pineapples.

Pineapple fruit is a leading annual fruit commodity in Indonesia and without us knowing that pineapple juice contains a protein that can reduce caffeine in coffee beans, thereby improving the physico-chemical content and taste of coffee, apart from the pineapple enzymes in the papaya fruit as well can reduce caffeine levels in coffee beans but in several studies that have tried to show that pineapple juice is more effective than papaya fruit skin because in addition to reducing caffeine levels it can also produce coffee bean characteristics with the highest seed pore development [5]. The robusta coffee fermentation technique uses the wet fermentation method by soaking the coffee beans in a solvent, namely pineapple juice by utilizing a protease enzyme from pineapple called bromelain. Bromelain contained in pineapple juice can break down protein compounds so that it can accelerate the release of mucus in coffee beans and reduce caffeine levels in coffee [6]. According to the results of research conducted by [6] decaffeination through a fermentation process using pineapple juice can reduce caffeine levels from 2.27% to 1.15% with the best fermentation time of 36 hours. It can be concluded that these results prove the benefits of the bromelain enzyme present in pineapple in reducing caffeine levels.

Bromelain belongs to the class of sulfhydryl proteases which contain proteolytic enzymes or can decompose protein compounds, in addition to this Bromelain enzymes can hydrolyze proteins containing peptide bonds into simpler amino acids, so they can be used to ferment coffee beans. [7]. Both young and old pineapples contain the bromelain enzyme, but there are differences in concentration in young and old or ripe pineapples, young pineapples contain more bromelain enzymes than ripe pineapples [8]. The bromelain enzyme contained in pineapple juice, besides being able to reduce caffeine levels in coffee, will also reduce the bitter taste of coffee, make the smell more fragrant and increase free amino acids in coffee. [9]. Therefore this robusta coffee immersion study was conducted to see the effect of pineapple juice on pH, water content, yield and color parameters of robusta coffee.

**MATERIALS AND METHODS**

Furthermore, these divided in three subsections specifically materials, methods and data analysis methods.

**Materials**

The materials used in this study were aquadest, pineapple honey and 3 levels of robusta coffee beans samples, namely fine robusta, red cherry, and commercial. The coffee bean with the highest grade is the red cherry which is harvested when the coffee bean is red, which means it has a perfect level of maturity and has not undergone a drying process. Coffee beans with the second level, namely fine robusta that have been sorted and selected are perfect beans. For coffee beans with the lowest level, commercial is a coffee bean with a high level of defects.

**Methods**

The first step is making pineapple juice with concentration of 80%. Pineapple with this type of honey pineapple and then the fruit flesh is separated and weighed as much as 1200 g then added water up to 1500 L for each sample and stirred until smooth. Each coffee bean was washed with aquadest so that it was clean from dirt and then weighed as much as 2 kg and then placed in a container and mixed with 80% pineapple juice then flattened and the container was tightly closed. Soaking is carried out for 32 hours with stirring every 2 hours to ensure that all parts of the coffee beans are submerged in the pineapple juice. After soaking the coffee beans in pineapple juice, they are then washed with distilled water until they are clean from the pineapple juice, then dried in the sun for 96 hour until the moisture content is around 12%.

**Data Analysis Methods**

Yield calculations were carried out by comparing the weight of coffee beans before soaking and drying in the sun with after being given treatment. The yield can be calculated by equation 1:

Procedur analysis of pH value were dissolved of 10 g coffee bean samples in distilled water heated to 100 °C and then the pH was calculated using a pH meter (METTLER TOREDO ph meter) until the indicated pH value was stable. Coffee bean color testing uses a colorimeter (C5-10 colorimeter) to determine the L, a, and b values. Testing the water content was carried out using the oven drying method using a sample of 5 grams and then placing it in a petri dish which had previously been dried and weighed to determine the weight of the cup, then dried in an oven (Memmert oven) for 4 hours at 105 °C. After being heated, the cup is placed into the desiccator and then weighed and calculated by equation 2:

Information:

* W: weight before drying (g)
* W1: sample weight & dry cup (g)
* W2: weight of empty cup (g)

The data that has been obtained will then be analyzed using one way ANOVA (Analysis of Variance) with Tukey's follow-up test using a 95% confidence level using the SPSS (Statistical Program for Social Science) application.

**RESULTS AND DISCUSSION**

**Determination of Moisture Content**

The results of testing the water content have significant results. The water content values ​​obtained for red cherry, fine robusta, and commercial seeds were 10.6%; 9.5%; and 10%. The three coffee beans are soaked in pineapple juice with a concentration of 80%. According to the results of research conducted by [10] that the water content in coffee beans after soaking with 80% pineapple juice for 36 hours is 5%, different from the results of research that has been done. The highest water content in red cherry coffee beans and the lowest in fine robusta coffee beans. Red cherry coffee beans have the highest water content because red cherry coffee beans do not go through a drying process before soaking. Red cherry coffee beans are only done by peeling the pulp without drying it and then soaking it with pineapple juice. Meanwhile, fine robusta seeds undergo a drying process before soaking. So that there is a difference in the water content of the initial raw material, red cherry seeds have a higher water content compared to other coffee beans so that after soaking with 80% pineapple juice has the highest water content. The results of testing the water content can be seen in **FIGURE 1.**

**FIGURE 1.** Graph of Robusta Coffee Moisture

**Determination of pH**

The results of testing the pH value in this study had results for fine robusta, commercial, and red cherry, respectively, which were 4.8, 5.1, and 5,4 (acid). Based on data analysis using one way ANOVA with a significance level of 0.05, soaking coffee beans using pineapple juice with a concentration of 80% for 32 hours had a significant effect on the pH of the coffee beans. According to research data [11] non-fermented coffee has a pH level of around 6.5. Coffee soaked using pineapple juice experienced a significant decrease in pH. this is due to the formation of organic acids when soaking takes place which affects the pH level of the coffee so that the acidic properties of the coffee increase and the pH level of the coffee decreases [11]. The results of testing the pH value can be seen in **FIGURE 2.**



**Determination of Color**

Based on the results of the tests that have been carried out and then analyzed using one way ANOVA, soaking coffee beans in pineapple juice showed no significant difference. The coffee beans whose color intensity was measured did not go through the roasting process so that they did not cause significant color changes. The color test results for each coffee bean from fine robusta, red cherry and commercial coffee beans obtained brightness values of 44.66, 46.02, 44.14. These results show the lowest brightness values obtained for commercial coffee bean types. According to [12], the gradual roasting process will cause a change in the color of the coffee beans from brown to black. The results of the tests can be seen in **FIGURE 3** to **FIGURE 5.**

**FIGURE 3.** Graph of Robusta Coffee L Value

**FIGURE 4.** Graph of a Value Robusta Coffee

**FIGURE 5.** Graph of b Value Robusta Coffee



1. (b) (c)

**FIGURE 6.** Robusta Coffee (Red Cherry Beans, Commercial Beans, and Fine Robusta Beans)

**Determination of Yield**

Results Measurement of the yield value in this study, obtained the results for fine robusta, commercial, and red cherry were 96.6%;98.95%; and 38.7% respectively. This shows that there is a real influence from the treatment of coffee varieties and quality on the yield of decaffeinated coffee. The highest yield value was found in fine robusta coffee beans and the lowest in red cherry coffee beans. Red cherry coffee beans have a low yield because there is a layer of mucus that sticks to the pulp, when soaked the layer of mucus will be dissolved by enzymes. After the drying process, the red cherry seeds need to be separated from the epidermis so that the yield value of the red cherry coffee beans decreases. While fine robusta has the highest yield value. Fine Robusta coffee beans are coffee beans with good coffee quality.

According to [13], the better the quality of the coffee, the better the coffee yield. The yield value is also related to the quality of the coffee produced, the higher the yield value, the more coffee beans produced. According to [14] coffee beans with an optimum level of maturity will form chemical compounds that reach perfection, so that the level of maturity can affect the content of chemical compounds in coffee beans. Coffee beans with a maturity level that is not optimal or green with yellow experience the formation of imperfect chemical compounds, which can affect the yield and quality of coffee beans. The results measurement of the yield value can be seen in **FIGURE 7.**

**FIGURE 7.** Graph of Robusta Coffee Yield

**CONCLUSIONS**

The treatment of soaking coffee beans with pineapple juice at a concentration of 80% had a significant effect (α=0.05) on pH, water content and yield and had no significant effect (α=0.05) on color parameters. The pH test parameters obtained pH values ​​in the range 4.82-5.44, water content parameters obtained values ​​in the range 9.50% -10.75%, and yield testing in the range 38.7% -98.95%. Other effects of soaking pineapple juice can also be determined by carrying out further tests such as testing for caffeine, total phenols, total acids and microbiology.

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