Utilization of mangrove fruit (*Rhizophora stylosa*) as an alternative to low caffeinated drinks

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Abstract. A drink that is synonymous with high caffeine content, namely coffee. One way to produce low-caffeine drinks is to make drinks from mangroves (*Rhizophora stylosa*). The content of compounds in mangrove fruit (*Rhizophora stylosa*) can be used as processed materials that can be consumed and provide benefits to human health. The purpose of this study was to determine the effect of roasting time on caffeine content. This research was experimental using a Completely Randomized Design (CRD). The treatments used were variations of roasting time, namely P0 (0 minutes), P1 (45 minutes), P2 (50 minutes) and P3 (55 minutes). The results of roasting time has a significant effect on each parameter tested. The treatment at the roasting time of 55 minutes (P3) had the best value on the parameters of colour, flavour, texture, moisture content and caffeine content. In this study, it was found that all treatments of roasting time from P0, P1, P2 and P3 had caffeine content values far below 2%, according to SNI 01-3542-2004 with a maximum of 2% and a minimum of 0.9%. The best content value was at P3 (treatment with roasting time 55 minutes) of 0.814%, which is the best result of low-caffeine mangrove drinks.

1. Introduction
Drinks that are synonymous with high caffeine content are coffee. The majority of the world's people like coffee. Coffee usually comes from various types of selected coffee beans. Making coffee into coffee grounds goes through several stages including drying, roasting, cooling and grinding [1]. Roasting is the key to the stages of ground coffee production [2]. In this process, there is the formation of a distinctive aroma and taste of coffee that arises due to heat treatment.

An average cup of coffee contains 100-150 mg of caffeine. Caffeine is efficacious to increase sensory stimuli and motor reactions, dilate blood vessels and increase the speed of thinking. While the negative effects of caffeine will be toxic if consumed in excess, causing chronic anxiety, restlessness, irritability, insomnia, muscle twitching and diarrhea [1]. Efforts to reduce caffeine levels in coffee can be done by using decaffeination technology. However, the technological process is still considered too expensive so that the price of processed non-caffeine coffee products circulating in the market is very expensive [3]. Many researchers are making alternatives to non-caffeine drinks from a variety of grain ingredients other than coffee.

Mangrove fruit that has been processed into flour contains fiber (35.4%), protein (17%), fat (14%), water (11.8%), ash (1.2%), and quite high antioxidants and able to ward off free radicals up to 71% [4]. The complex content of compounds contained in it makes mangrove fruit (*Rhizophora stylosa*) a material that can be used as processed materials that can be consumed and provide benefits for human
health. The research on making low-caffeine drinks from mangrove fruit (*Rhizopora stylosa*) was carried out with variations in the length of roasting time, so that people could know the roasting time of good quality mangrove fruit. The roasting process is very crucial in processing because it has a complex function. In addition to developing aroma, roasting also determines the taste, color and moisture content of the ingredients. Parameters that affect roasting are roasting time and temperature. The optimum combination of temperature and time can produce a product with a strong aroma.

2. Materials and methods
The study was conducted in January – March 2021 at the Chemistry & Analysis Laboratory, Faculty of Fisheries and Marine Affairs, Airlangga University, Surabaya. Mangrove (*Rhizophora stylosa*) samples were obtained from Mangrove Forest Gunung Anyar, Surabaya. The research method used is an experimental method using a Completely Randomized Design (CRD) consisting of one factor, namely the use of fruit mangrove (*Rhizophora stylosa*) in the manufacture of powdered drinks with variations in roasting time consisting of 4 treatments and 3 replications to obtain 12 experimental units.

The main parameter in this study is test caffeine content with UV-Vis spectrophotometry. While the supporting parameters in this study were organoleptic tests and water content tests with moisture analyzer. Data analysis used Analysis of Variance (ANOVA) test and continued with Duncan’s Multiple Distance test.

3. Results and discussion

3.1 Organoleptic Test

The overall acceptance test includes the organoleptics test or the panelists’ preference level for the aroma, color and texture of mangrove drinks. Assessment of the organoleptics test of mangrove drinks in terms of aroma, color and texture which is influenced by the length of the roasting time. When roasting occurs, the heat propagation of the roasting tool to the mangrove fruit, the longer the roasting time, the more the compounds contained in the mangrove fruit evaporate. The results of analysis of variance (Anova) showed that the difference in roasting time was significantly different (P < 0.05) on the overall acceptance of the hedonic test of mangrove drinks, which means somewhat liking. It can be seen in Table 1.

### Table 1. Organoleptic Test Results

| TREATMENT | RESULT            | ORGANOLEPTIC STANDART |
|-----------|-------------------|-----------------------|
|           |                   | SNI 01-3542-2004      |
| P0        | 2.75 ± 1.05b      |                       |
| P1        | 3.25 ± 0.82a      | 4                     |
| P2        | 4.00 ± 1.06a      |                       |
| P3        | 3.75 ± 1.38a      |                       |

Note: Different superscripts in the same column show significant differences (p<0.05).

3.2 Water Content Analysis

The role of water content in mangrove powder is to maintain the durability of mangrove powder storage, as well as affect the taste, aroma and taste of mangrove drinks. The water content test is carried out using amoilstore analyzer. The numbers listed on the display indicate the water content of the sample in percent (%). The results of analysis of variance (Anova) showed that the difference in roasting time had a significant effect (P < 0.05) on the moisture content of mangrove powder. The highest average water content of mangrove powder is at P0 of 13.857% and the lowest is at P3 of 10.687%. Stated that the water content decreased when the temperature and roasting time increased...
[5]. This is because the greater the difference between the heating medium and the coffee grounds, the faster the heat transfer process and the faster the evaporation of water. The results of the water content analysis can be seen in Table 2.

**Table 2. Water Content Analysis Test Results**

| TREATMENT | RESULT | WATER CONTENT ANALYSIS |
|-----------|--------|------------------------|
| P0        | 13.85 ± 0.82<sup>b</sup> | SNI 01-3542-2004       |
| P1        | 11.99 ± 0.82<sup>a</sup> | Max 7                  |
| P2        | 11.92 ± 0.32<sup>a</sup> |                        |
| P3        | 10.68 ± 0.58<sup>a</sup> |                        |

Note: Different superscripts in the same column show significant differences (p<0.05).

### 3.3 Determination of Caffeine Levels

Determination of the caffeine content of the mangrove powder sample (Rhizophora stylosa) was carried out by the extraction method. Extraction of each sample was carried out with three repetitions. The following is a picture of mangrove powder and the extraction process using a separating funnel. The caffeine content of the mangrove powder sample (Rhizophora stylosa) in this study can be seen in Table 3.

**Table 3. Caffeine content value**

| TREATMENT | RESULT | pH STANDART |
|-----------|--------|-------------|
| P0        | 0.79 ± 0.00<sup>b</sup> | SNI 06-2588  |
| P1        | 1.07 ± 0.01<sup>a</sup> | Min = 0.9   |
| P2        | 0.92 ± 0.11<sup>a</sup> | Max = 2     |
| P3        | 0.81 ± 0.01<sup>a</sup> |             |

Note: Different superscripts in the same column show significant differences (p<0.05).

The results of analysis of variance (Anova) showed that the difference in roasting time had a significant effect (P < 0.05) on the caffeine content of mangrove powder. The highest average caffeine content of mangrove powder at P1 of 1.078% and the lowest at P0 of 0.793% which was used as a
control, so that the treatment of roasting time with the lowest value was at P3 for 55 minutes with the lowest caffeine content value of 0.814%.

The results showed a decrease in the percentage of caffeine content in mangrove powder due to the long roasting time affecting the evaporation process of compounds such as aldehydes, acetic acid, furfural, ketones, alcohol and formic acid which are volatile. The roasting process also functions to remove the toxic properties of mangroves, this is due to maintaining the health and safety of consumers. Mangrove fruit (Rhizophora stylosa) contains flavonoids and tannins, during the roasting process these ingredients evaporate and form a distinctive aroma in mangrove drinks. The tannin content in mangrove fruit is removed when soaking with whiting, this aims to eliminate the toxic nature so that it is safe and not harmful if consumed, but further tests need to be done in this regard.

Caffeine content of a drink in SNI 01-3542-2004 with a maximum of 2% and a minimum of 0.9% caffeine content. In this study, it was found that all the roasting time treatments of P0, P1, P2 and P3 had caffeine levels far below 2%, so in this study H0 was rejected and H1 was accepted. This means that mangrove drinks can be used as an alternative to low-caffeine drinks, with the lowest caffeine content value at P3 (55 minutes roasting time treatment), which is the lowest yield of low-caffeine mangrove drinks.

4. Conclusion
Utilization of mangrove fruit (Rhizophora stylosa) can be used as an alternative to low-caffeine drinks with a roasting time of 55 minutes (P3). The lowest caffeine content value at P3 was 0.814% which was the result of low-caffeine mangrove drinks. In this study, mangrove drink produced from mangrove fruit (Rhizophora stylosa) can be used as an alternative to low-caffeine drinks according to SNI 01-3542-2004 with a maximum of 2% and a minimum of 0.9% caffeine content.

5. References
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6. Acknowledgments
Mangrove fruit characterization (Rhizophora stylosa) is carried out before being used as a beverage product and further testing of heavy metal content in mangrove drinks is carried out so that consumer safety is maintained, and to avoid poisoning.