Antioxidant analysis of *Artocarpus heterophyllus* drink

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**Abstract.** Jackfruit leaves herbal drink is a functional beverage that contains a high antioxidant value. The addition of cinnamon and clove could improve the colour and aroma of jackfruit leaves herbal drink. The utilization of jackfruit leaves in herbal tea product is helpful to upgrade the usability of jackfruit leaves. This research aims to know the antioxidant capacity and antioxidant content (phenolics, flavonoids, tannins, saponins, gallic acid, kaempferol and quercetin) from 0.50%, 1% and 1.50% of jackfruit leaves. Herbal drink with the lowest hedonic score is 1 and the highest is 5. This research is including experiment research using Completely Random Design (CRD) with three kinds of treatment. The analyzed data using One Way ANOVA, if the treatments show a significant difference, then the analyzed data should be proceeded by Duncans Multiple Range Test with 5% confidence interval. The result is, the highest value of antioxidant capacity content (80.00 ppm), phenolics antioxidant (411.90 mg/l), flavonoids antioxidant (321.84 mg/l), tannin antioxidant (30.28 mg/l), saponin antioxidant (1.00 mg/l), gallic acid antioxidant (75.25 microgram/g), kaempferol antioxidant (22.38 microgram/g), quercetin antioxidant (32.33 microgram/g) in 1.5% *Artocarpus heterophyllus* drink. Base on the result, it can be concluded that the jackfruit leaves herbal drink product proven as a functional drink which contains a high antioxidant value.

1. **Introduction**

Food is a human need for a healthy life. Functional foods can be in the form of dietary items or food components that have benefits in improving health status [1] and reducing the occurrence of certain diseases [2]. The beverage is most commonly consumed throughout the world [3]. Beverage products are not only produced from *Camelia sinensis* leaves, but they can also be produced from other herbal ingredients or commonly referred to as herbal drinks.

Herbal drinks contain health benefits. In the Netherlands, the government recommends that drinking green or black tea about 3 cups can reduce people getting stroke and high blood pressure [4]. In a study, it is proven that the combined intervention of an herbal drink containing *Garcinia cambogia*, *Commiphora mukul*, and *Cyperus scariosus* can reduce body weight and blood sugar levels on people with diabetes [5]. In patients who consumed Chamomile tea for about 8 weeks, there was a reduction in glycosylated hemoglobin (HbA1c) and other diabetic serum markers, and this was accompanied by an increase in total serum antioxidant capacity and oxidative activity [6]. In a three-month clinical study, an herbal drink made from *Salacia reticulata* (a flowering plant from Sri Lanka), reduces HbA1c and the level of one anti-diabetes medicine needed by patients to treat the disease, but on the dose of the

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second medicine, it has no effect [7]. Herbal drinks can be made by infusing water with roots, leaves, flowers, and other parts of a plant [8]. This herbal drink contains many compounds and can play an important role in providing nutrients and chemicals to balance a low-quality diet [9]. Herbal drinks since long time ago used as a medical therapy in China and India [10].

*Artocarpus heterophyllus* is known to contain flavonoids, saponins, and tannins which act as antibacterial compounds [11] [12]. In addition, the result of the phytochemical test on *Artocarpus heterophyllus* shows that the compounds contributing to antioxidant activity come from the saponins and steroids. The antioxidant activity is mainly contributed by phenolic compounds, such as flavonoids, phenolic acid, and diterpene phenols [13] [14]. Various compounds that have antioxidant activity include carotene and vitamin C as well as polyphenolic compounds, such as epicatechin, catechin, gallocatechin, epigallocatechin, quercetin, quercitrin, isogercitrin, mycitracin, and gallic acid [15] [16]. The extract of *Artocarpus heterophyllus* leaves decreases the blood glucose level statistically significantly [12].

2. Materials and Methods

2.1. Materials

*Artocarpus heterophyllus*, cinnamon, cloves, sorbitol, and water are the ingredients needed in this research. The tools used to make the herbal drink are vacuum ovens, digital scale, measuring cups, pan, filter cloth, and stirrer. The tools used for chemical analysis include Erlenmeyer flask, micropipette, digital scale, mortar, pestle, vial, and spectrophotometer. *Artocarpus heterophyllus* drink processing is done through the process of sorting, washing, cutting, withering, drying, refining, weighing, and brewing. The *Artocarpus heterophyllus* used are leaves that are in the 5th order of the shoot. The formula of the herbal drink from *Artocarpus heterophyllus* can be seen in Table 1. The next activity is processing dried breadfruit leaves into herbal functional drinks by brewing. In the *Artocarpus* and drink with a percentage of *Artocarpus heterophyllus* being 0.5%, 1% and 1.5%.

2.2. Methods and analysis

This study is an experimental research with the experimental design being Completely Randomized Design (CRD). The treatment in this study is the difference in the percentage of *Artocarpus heterophyllus* used on herbal beverage products from *Artocarpus heterophyllus*. A1 = percentage of *Artocarpus heterophyllus* of 0.5%, A2 = percentage of *Artocarpus heterophyllus* of 1%, and A3 = percentage of *Artocarpus heterophyllus* of 1.5%; each the treatment is repeated twice. A test to determine the antioxidant capacity was conducted using the DPPH method. The DPPH free radical reduction method is based on the reduction of the DPPH free radical methanol solution colored by free radical inhibition. When the purple DPPH solution meets the material electron donors, the DPPH will be reduced, causing the purple color to fade and be replaced by color yellow originating from the picril group. As for the antioxidants (phenolics, flavonoids, tannins, saponins, gallic acid, kaempferol and quercetin), were test using the HPLC method. In herbal drink from *Artocarpus heterophyllus*, the data were statistically analyzed using One Way ANOVA with a significance level of 5%. If the significance level is p<0.05, it is stated that there is a significant difference in the herbal drink with different percentages. If p>0.05, it is stated that there is not any significant difference in the herbal drink with

| Ingredients                  | Formula 0.5% | Formula 1% | Formula 1.5% |
|------------------------------|--------------|------------|--------------|
| Dried *Artocarpus heterophyllus* | 5 g          | 10 g       | 15 g         |
| Cinnamon                     | 2.5 g        | 2.5 g      | 2.5 g        |
| Cloves                       | 1.25 g       | 1.25 g     | 1.25 g       |
| Sorbitol                     | 200 ml       | 200 ml     | 200 ml       |
| Water                        | 1000 ml      | 1000 ml    | 1000 ml      |

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different percentages. If the data analyzed using One Way ANOVA showed a significant difference in the treatment, the DMRT (Duncan’s Multiple Range Test) test would be conducted with a confidence level of 5%.

3. Results and Discussion

3.1. Antioxidant capacity

Based on the analysis result, the antioxidant capacity in the Artocarpus heterophyllus herbal drink indicates significant differences. The lowest antioxidant capacity in the Artocarpus heterophyllus herbal drink is obtained in the 0.5% percentage of which IC50 value with 94.534 ppm, while the highest antioxidant capacity in the Artocarpus heterophyllus herbal drink is obtained in the 1.5% percentage of which IC50 value is 80.002 ppm (Figure 1). The antioxidant capacity increases alongside the percentage of dried Artocarpus heterophyllus added to the herbal drink. It signifies that the higher the addition of Artocarpus heterophyllus, the smaller the IC50 value. IC50 value indicates the antioxidant activity contained. The smaller the IC50 value, the antioxidant activity increases [17]. Herbal drinks with 1.50 percentage Artocarpus heterophyllus have the highest oxidant activity. In addition, a compound is considered to have a very strong antioxidant activity if the IC50 value is less than 50 ppm, a strong antioxidant activity if the IC50 value is between 51-100 ppm, a moderate antioxidant activity if the IC50 value is between 101-150 ppm, and a weak antioxidant activity if the IC50 value is between 151-200 ppm [14].

Several studies have shown that Artocarpus heterophyllus contains many antioxidant compounds. Artocarpus heterophyllus is known to contain flavonoids, saponins, and tannins which act as an antibacterial [18]. In addition, the result of phytochemical test on Artocarpus heterophyllus shows that compounds which contribute to antioxidant activity come from the saponins and steroids. The antioxidant activity is mainly contributed by phenolic compounds, such as flavonoids, phenolic acid, and phenolic diterpene [14]. The result of the Artocarpus heterophyllus ethanol extract isolation shows a total of flavonoid compounds of 7.55 mg/g [19].

![Figure 1. Average antioxidant capacity.](image1.png)

![Figure 2. Average phenolic content.](image2.png)

3.2. Phenolic content

The phenolic content in the herbal drinks containing different percentages of Artocarpus heterophyllus indicates significant differences. The lowest phenolic content in the Artocarpus heterophyllus herbal drink was obtained in the 0.50%, while the highest phenolic content in the Artocarpus heterophyllus herbal drink was obtained in the 1.50% (Figure 2). The average phenolic content increases alongside the percentage of dried Artocarpus heterophyllus added to the herbal drink. It shows that the higher the percentage of dried Artocarpus heterophyllus added, the higher the phenolic content contained in the herbal drink. Herbal drinks which have higher phenolic content show a relatively less reduction in antioxidant capacity [17]. A study finds that consuming a beverage of Hibiscus sabdariffa, which is
popular in the United States, gives an anti-hypertensive response in people with hypertension [18]. *Hibiscus sabdariffa* contains high levels of phenols and anthocyanins [10] [20].

### 3.3. Flavonoid content

Based on the analysis result, the flavonoid content in the herbal drinks containing different percentages of *Artocarpus heterophyllus* shows a significant difference. The lowest flavonoid content in the *Artocarpus heterophyllus* herbal drink is obtained in the 0.5%, while the highest flavonoid content in the *Artocarpus heterophyllus* herbal drink is obtained in the 1.5% (Figure 3). The average flavonoid content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. It shows that the higher the percentage of dried *Artocarpus heterophyllus* added, the higher the flavonoid content contained in the herbal drink. The result of phytochemical screening on *Artocarpus heterophyllus* shows a positive result on flavonoid, saponin, and tannin [13].

![Figure 3. Average flavonoid content.](image)

### 3.4. Tannin content

Based on the analysis result, the tannin content in the herbal drink containing different percentages of *Artocarpus heterophyllus* shows significant differences. The lowest tannin content in the *Artocarpus heterophyllus* herbal drink is obtained in the 0.5%, while the highest tannin content in the *Artocarpus heterophyllus* herbal drink is obtained in the 1.5% (Figure 4). The average tannin content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. It shows that the higher the percentage of dried *Artocarpus heterophyllus* added, the higher the tannin content contained in the herbal drink. The result of phytochemical screening on *Artocarpus heterophyllus* shows a positive result on flavonoid, saponin, and tannin [18].

![Figure 4. Average tannin content.](image)

### 3.5. Saponin content

Based on the analysis result, the saponin content in the herbal drink containing different percentages of *Artocarpus heterophyllus* shows significant differences. The lowest saponin content in the *Artocarpus heterophyllus* herbal drink is obtained in the 0.5%, while the highest saponin content in the *Artocarpus heterophyllus* herbal drink is obtained in the 1.5%. The average saponin content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. It shows that the higher the percentage of dried *Artocarpus heterophyllus* added, the higher the saponin content contained in the herbal drink [21]. The result of phytochemical screening on *Artocarpus heterophyllus* shows a positive result on flavonoid, saponin, and tannin [22].
3.6. Gallic acid content
Based on the analysis result, the gallic acid content in the herbal drink containing different percentages of *Artocarpus heterophyllus* shows significant differences. The lowest gallic acid content in the *Artocarpus heterophyllus* herbal drink is obtained in the 0.5%, while the highest gallic acid content in the *Artocarpus heterophyllus* herbal drink is obtained in the 1.5% (Figure 6). The average gallic acid content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. It shows that the higher the percentage of dried *Artocarpus heterophyllus* added, the higher the gallic acid content contained in the herbal drink. A study conducted states that gallic acid can dissolve in ethanol, methanol, water, and ethyl [23]. The solvent used in this research is water it is making the gallic acid in the *Artocarpus heterophyllus* herbal drink can be optimally dissolved [24].

3.7. Kaempferol content
Based on the analysis result, the kaempferol content in the herbal drink containing different percentages of *Artocarpus heterophyllus* shows significant differences. The average kaempferol content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. It shows that the higher the percentage of dried *Artocarpus heterophyllus* added, the higher the kaempferol content contained in the herbal drink (Figure 7). Kaempferol is one of a polyphenol antioxidants founding fruits and vegetables [25].

3.8. Quercetin content
Based on the analysis result, the quercetin content in the herbal drink containing different percentages of *Artocarpus heterophyllus* shows significant differences. The lowest quercetin content in the *Artocarpus heterophyllus* herbal drink is obtained in the 0.5%, while the highest quercetin acid content in the *Artocarpus heterophyllus* herbal drink is obtained in the 1.5%g (Figure 8). The average quercetin
content increases alongside the percentage of dried *Artocarpus heterophyllus* added to the herbal drink. Quercetin is the major flavonoid in many common foods which is kind of flavonols. Quercetin is found in many common foods including apples, tea, onions, nuts, berries, cauliflower, cabbage and another food [26].

The increase in the addition of dried *Artocarpus heterophyllus* is associated with an increase in the content of antioxidant components in *Artocarpus heterophyllus* drinks. The content of phenolics, flavonoids, tannins, saponins, gallic acid, kaempferol and quercetin was higher in drinks with added dried *Artocarpus heterophyllus* by 1.50% compared to those added with 0.50 and 1%. This is because *Artocarpus heterophyllus* contain high levels of phenolics, flavonoids, tannins, saponins, gallic acid, kaempferol and quercetin components.

4. Conclusions
The results of the analysis of all the components studied showed that the higher the addition of dried *Artocarpus heterophyllus*, the increased content of each component. The *Artocarpus heterophyllus* drink which has the highest antioxidant component is a drink with a jackfruit leaf enhancer by 1.50%.

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