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Penambahan Kulit Semangka pada Susu Biji Nangka: Minuman Fungsional Kaya Antioksidan dan Senyawa Fenolik

Incorporating Watermelon Rind into Jackfruit Seed Drink: A Functional Drink Rich in Antioxidant and Phenolic Compounds

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ABSTRAK

Pangan fungsional dipercaya sebagai pengobatan karena kandungan gizi, fenolik, dan berbagai senyawa fitokimia. Biji nangka dan kulit semangka sering dibuang sebagai sisa makanan. Penelitian ini bertujuan untuk mengetahui aktivitas antioksidan, vitamin C, dan kandungan fenolik total dalam minuman biji nangka (JSD) dengan kulit semangka sebagai minuman fungsional. Aktivitas antioksidan diamati berdasarkan penghambatan DPPH. Hasil penelitian menunjukkan perbedaan yang signifikan antara formula berdasarkan vitamin C, kandungan fenolik total, dan aktivitas antioksidan ($p<0,05$) dengan JSD 2 sebagai formula terbaik. JSD 2 menunujukan vitamin C total felonik, dan tugas aktivitas antioksidan sebesar 37.83 ± 0.68 mg/100g; 29.86±0.60 mgGAE/g; 40.98±0.78%. Penambahan kulit semangka ke dalam JSD secara signifikan meningkatkan nilai gizi, aktivitas antioksidan, dan potensi kesehatan dari JSD.

Kata Kunci:
antioksidan, biji nangka, kulit semangka, minuman fungsional, total fenol

ABSTRACT

Functional foods are believed to be medicinal due to their nutritional content, phenolic and various phytochemical compounds. Jackfruit seeds and watermelon rind are often discarded as food waste. This study aimed to determine the antioxidant activity, vitamin C, and total phenolic content in jackfruit seed drink JSD with watermelon rind as a functional drink. Antioxidant activity was observed based on DPPH inhibition. The results showed significant differences between formulas based on vitamin C, total phenolic content, and antioxidant activity with JSD 2 as the best formula. JSD 2 showed total phenolic vitamin C, and antioxidant activity tasks of 37.83 ± 0.68 mg/100g; 29.86±0.60 mgGAE/g; 40.98±0.78%. The addition of watermelon rind into JSD significantly increases health potential.

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1. INTRODUCTION

The rising trend of non-communicable diseases (NCDs) is dominated by diabetes (Dyson, 2014). Diabetes Mellitus (DM) is a general term for heterogeneous disturbances of metabolism for which the main finding is chronic hyperglycemia. The cause is either impaired insulin secretion or impaired insulin action or both (Petersmann et al., 2019). DM is a common disease suffered by society, especially in Indonesia. International Diabetes Federation estimated that the prevalence of DM in Indonesia will increase from 5.1% in the year 2000 to 6.3% in 2030 (Mihardja et al., 2009). People with DM should be treated with antihyperglycemic drugs consistently, so that blood sugar levels can be controlled. Even though antihyperglycemic drugs can manage blood sugar levels, they also give some side effects for some people, such as nausea, dizziness, and increased heart rate, up to drug resistance (reduction of efficiency) (Nauck et al., 2021; Salehi et al., 2019). Antihyperglycemic drugs also can't be consumed excessively in people with DM who experience complications of chronic kidney disease. At the same time, there was a growing need for natural foods that can be used as a substitute for antihyperglycemic drugs and may lower the blood sugar levels of DM patients without burdening the kidneys and causing other side effects.

Nowadays, treatments of diseases including diabetes using natural foods are recommended because these plants contain various phytoconstituents which may possess antidiabetic activities (Salehi et al., 2019). One example is watermelon (Citrullus lanatus) which contains water, a carotenoid from vitamin A, vitamin C, vitamin K, citrulline, and also potassium which can reduce blood pressure (Ajiboye et al., 2020). Citrulline is highly concentrated in watermelon, especially in its peel and rind. Citrulline is a non-essential αamino acid that is very useful in the metabolic system. The effects of citrulline and watermelon extract supplementation on glycemia have been studied in animal models resulting in a significant decrease in serum insulin as good as in inflammatory biomarkers. Citrulline found in watermelon acts as a precursor nitric oxide (NO) by inhibiting the arginase enzyme which converts arginine into ornithine and urea. Diabetes and cardiovascular disease are upregulated by this enzyme. NO will decrease insulin levels and stimulate glycogenesis, so it can lower blood glucose levels (Azizi et al., 2020). In addition to the watermelon rind's benefits for lowering blood sugar levels, it also reduces food waste.

Other ingredients that are often thrown away and underutilized are seeds, such as jackfruit (Artocarpus heterophyllus) seeds (Hossain, 2014). However, jackfruit seeds contain useful nutrients such as amino acids, carbohydrates, polysaccharides, and lipids (Chai et al., 2021; Waghmare et al., 2019). They are also rich in starch, proteins, crude fiber, and phytonutrients, such as lignans and isoflavones, which have wide-ranging health benefits (Trejo Rodríguez et al., 2021). Jackfruit seeds also play a role in hypoglycemic activity, through α-amylase inhibitors (Salehi et al., 2019). Based on these facts, combining watermelon rind and jackfruit seeds into a functional drink may result in high nutrition value and several benefits, namely increased antioxidant content, added bioactive compounds, and prevent both metabolic and NCDs (Essa et al., 2021).

Since it does not come from animals, jackfruit seed drink may be a solution for people with lactose intolerance. Consuming jackfruit seed drinks can provide good health because of their content. Jackfruit seed is a nutritional drink because of the presence of proteins, monosaccharides, oligosaccharides, and polysaccharides, as well as omega-3 and omega-6

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fatty acids. This drink also provides bioactive ingredients, such as total dietary fiber, polyphenols, and antioxidant properties (Chai et al., 2021). The use of both jackfruit seeds with the addition of watermelon rind citrulline to lower blood sugar levels can be done to replace antihyperglycemic drugs (Salehi et al., 2019). This combination is also a vital pharmaceutical that acts on different potential drug targets involved in diseases, such as cancer, inflammation, obesity, and maintaining health of cardiovascular (Manivannan et al., 2020). This research aims to determine antioxidant activity, vitamin C, and total phenolic content in jackfruit seed drink (JSD) enriched with watermelon rind as a functional drink with high antioxidant and phenolic properties. The results of this study are expected to be the basis for exploring the potential antidiabetics and health benefits of JSD.

2. METODOLOGY

2.1 Formulation of JSD Enriched with Watermelon Rind

Jackfruit seed and watermelon rind were separated from the fruit, washed, and dried for 6 hours using a cabinet dryer. Then, the jackfruit seeds were mixed with water in a ratio of 1:4 and homogenized using a blender, resulting in the JSD. The JSD was then heated for 2 minutes at 85 °C before being put into a bottle when it was already chilled (Gunawan et al., 2021). This study analyzed 3 formulas of JSD, namely JSD0 (without any watermelon rind fortification), JSD1 (with 10% w/v of watermelon rind addition), and JSD2 (with 20% w/v of watermelon rind addition), with each formula consist of 50 mL JSD.

2.2 Determination of Vitamin C Content of JSD Enriched with Watermelon Rind

The vitamin C content of JSD was determined by the method proposed by (Manasa et al., 2021). A ten mL of JSD was mixed with 40 mL of 0.1 M CuSO4 solution. The reaction mixture was mixed thoroughly and kept at room temperature for 30 minutes. The mixture was then added with 20 mL of 2 N sulphuric acid, 20 mL of 10% potassium iodide, and 10 mL of distilled water. The mixture was titrated using a starch indicator while the released iodine was titrated against a 0.5 M sodium thiosulphate solution. The vitamin C content was reported as mg/100g.

2.3 Antioxidant Activity Assay of JSD Enriched with Watermelon Rind

Antioxidant capacity was measured based on the electron transfer mechanism using a 1,1-diphenyl2-picrylhydrazyl (DPPH) inhibition method proposed by Baliyan et al., (2022). A DPPH stock solution was made by dissolving 24 mg of DPPH in 100 mL of methanol, followed by filtration of DPPH stock solution using Whatman 41 filter paper distributed by PT. Laborindo Sarana. The DPPH stock solution should have an absorbance of 0.973 ± 0.02 at 517 nm. Antioxidant capacity of JSD was measured by mixing 3 mL of DPPH working solutions with 100 µL of JSD in a test tube while the combination of 3 mL of DPPH and 100 mL methanol was used as the control; followed by 30 minutes incubation in a dark room. Finally, the absorbance was measured at 517 nm. The antioxidant capacity was reported as % of antioxidant activity using the formula below:

$$\% \text{ of Antioxidant Activity} = [(A0 - A1) : A0] \times 100$$

A0 is the absorbance of the control and A1 is the absorbance of the sample specimen.

2.4 Quantification of Total Phenolic Content of JSD Enriched with Watermelon Rind

Total phenolic content was determined by combining 1 mL of JSD with 2.5 mL of 10% (w/v) Folin–Ciocalteu reagent (Aryal et al., 2019). After 5 minutes, 2.0 mL of Na2CO3 (75%)

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was added to the mixture and incubated at 50oC for 10 minutes with occasional stirring. After cooling, the sample was evaluated for absorbance at 765 nm using a UV Spectrophotometer (Shimazu, UV-1800) against a blank. The results were represented in milligrams per gram of gallic acid equivalents (mg GAE/g) of samples.

2.5 Statistical Approach and Data Management

The collected data were analyzed for their normality using the Shapiro-Wilk method. The determination of the best formula utilized one-way analysis of variance (ANOVA) along with Tukey's multiple comparisons test. All data were analyzed and visualized using GraphPad Prism version 9.4.0.

3. RESULTS AND DISCUSSION

Testing of vitamin C levels, total phenols, and antioxidant activity were carried out to determine the antioxidant activity of JSD since antioxidant is related to various health benefits and pathophysiology of the disease (Manoppo et al., 2021). The result of this analysis will provide insight into which is the best JSD formula in terms of vitamin C, total phenols, and antioxidant activity. In addition, testing these three parameters is also associated with the assumption that a higher level of vitamin C and total phenols will result in higher antioxidant activity in a food product (Hur et al., 2014). The result of the assays will be presented as below.

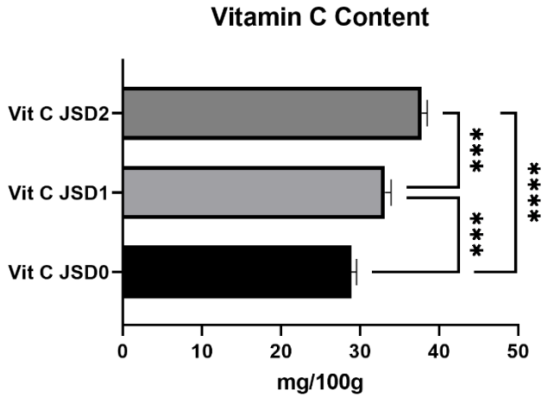

Figure 1. Vitamin C Content of 3 Different JSD Formulas.
*** p = 0.0005 – 0.0008; **** p < 0.0001.

Figure 1 showed that JSD2 holds the best vitamin C content compared to other formulas, significantly. The addition of watermelon rind was proved to increase vitamin C content in JSD. As mentioned by (Gladvin et al., 2017), watermelon rind contains a considerable amount of vitamin C even though it is lower than orange peel (Sir Elkhatim et al., 2018). Adding a higher concentration of watermelon rind resulted in a higher vitamin C content in JSD. Vitamin C protects cells from DNA damage and cell death caused by diabetes; one of them is through the improvement of structures and connective tissues in the spleen organs that play a role in the body's immune system (Özerkan et al., 2020). Vitamin C supplementation for DMT2 patients in the short term can improve glycemic control and blood pressure, while in the long term it can improve lipid profiles through a significant decrease in triglyceride levels and total cholesterol (Namkhah et al., 2021).

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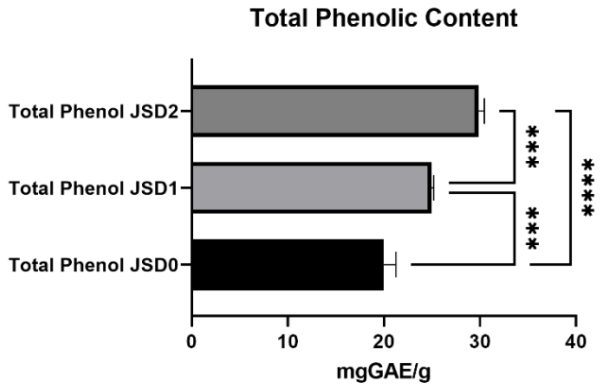

Figure 2. Total Phenolic Content of 3 Different JSD Formulas.
*** p = 0.0007 – 0.0008; **** p < 0.0001.

Figure 2, showed that the highest total phenolic content was found in JSD2, which differed significantly from other formulas. Adding watermelon rind to JSD affected the total phenolic content of JSD. As found by (Ho & Che Dahri, 2016), the addition of watermelon rind into food products will increase their total phenolic content. Watermelon rind also increases the nutritional value of food products by increasing the amount of protein (Chakrabarty et al., 2020). Dietary polyphenols had been widely known as an antidiabetic agent (Cao et al., 2019). Flavonoids – as one phenolic compound – reduce the development of diabetes and its consequences by controlling the activities of hepatic enzymes, regulating glucose metabolism, and altering lipid profiles (Al-Ishaq et al., 2019). Phenolic substances may also affect the molecular mechanisms of other metabolic regulators such as insulin, glucose transporters, hepatic enzymes, and other metabolic regulators (Martín & Ramos, 2021).

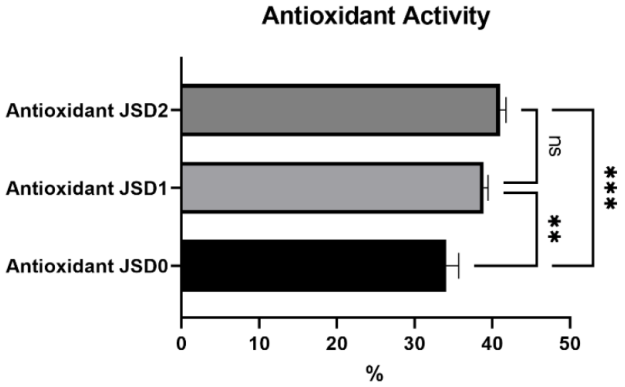

Figure 3. Antioxidant Activity of 3 Different JSD Formulas.
** p = 0.0038; *** p = 0.0006; ns p = 0.1225

Figure 3, showed that even though the antioxidant activity of JSD2 was the highest, it didn't differ significantly from JSD1. However, it can be concluded that the addition of watermelon rind does increase the antioxidant activity of JSD. Antioxidant activity may be contributed by vitamin C, phenolic compounds, and even other bioactive peptides and phytochemical compounds (Nowak et al., 2018). The increase of antioxidant activity is limited in a food product, as it may be a protective mechanism by food to prevent toxicological effects (Thorat et al., 2013). The antioxidant response is an important mechanism in fighting the development of diabetic diseases caused by excess ROS (Lima et al., 2022). Active control of ROS levels through antioxidants can reduce oxidative damage caused by oxidative stress to

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promote wound healing or improve conditions related to the pathophysiological mechanisms of diabetes. The study conducted by (Deng et al., 2021) concluded that ROS levels through antioxidants can reduce damage due to oxidative stress to accelerate wound healing.

Incorporating watermelon rind into JSD significantly increased the nutrition values, antioxidant activity, and the potential health benefits of JSD. Phenolic compounds and citrulline in the watermelon rind play a key role in increasing the health "functionality" of JSD, especially as an antidiabetic agent. Therefore, further research – both preclinical and clinical – is needed to identify the potential of JSD in preventing and managing diabetes and its related conditions. Moreover, using a watermelon rind extract as the base ingredient may potentially bring different results compared to this study. Here we conclude that a JSD combined with watermelon rind will increase its potential related to antidiabetic and antioxidant.

4. CONCLUSIONS

JSD2 exhibited high vitamin C, total phenolic content, and antioxidant activity. Incorporating watermelon rind into JSD significantly increased the nutrition values, antioxidant activity, and the potential health benefits of JSD. These antioxidant-related nutrients may contribute to many health-improving properties of JSD. Further research, such as inhibition of α-glucosidase or α-amylase or preclinical trial is needed to observe the dose-tolerance effect of JSD in preventing or ameliorating diseases such as diabetes-related parameters.

5. AUTHOR'S NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The author confirms that this article is free from plagiarism.

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