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Analysis of Total Phenolic Content in Jamblang Fruit Seeds (*Syzygium cumini*): A Systematic Literature Review

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A B S T R A C T

Jamblang seeds contain various bioactive compounds, one of which is phenolic. Phenolic compounds are known to have strong antioxidant activity, which can help protect the body from free radicals and oxidative stress. Free radicals are unstable molecules that can damage body cells and tissues, thereby contributing to various chronic diseases such as cancer, diabetes, and heart disease. The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the analysis of total phenolic content in jamblang fruit seeds (*Syzygium cumini*). This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations. The total phenolic content of jamblang fruit seeds ranges from 100-500 mg/g. The highest total phenolic content was found in jamblang fruit seeds originating from Bogor, namely 476.18 mg/g. Jamblang fruit seeds contain quite high levels of phenolic compounds. The total phenolic content of jamblang fruit seeds can vary depending on the growing location, variety, and extraction method used.

1. Introduction

Jamblang (*Syzygium cumini* L.) is a fruit plant that grows widely in tropical and subtropical areas, including Indonesia. Jamblang fruit is known for its sweet and slightly sour taste and has various health benefits. Apart from the pulp, jamblang seeds also attract attention because of their potential as a source of natural antioxidants. Jamblang seeds contain various bioactive compounds, one of which is phenolic. Phenolic compounds are known to have strong antioxidant activity, which can help protect the body from free radicals and oxidative stress. Free radicals are unstable molecules that can damage body cells and tissues, thereby contributing to various chronic diseases such as cancer, diabetes, and heart disease.[1-3]

The total phenolic content in jamblang seeds has not been widely studied, even though jamblang seeds are a part of the plant that has the potential to be used as a source of antioxidants. Analysis of total phenolic content can be the basis for further research on the antioxidant activity and health benefits of jamblang seeds. Information about the antioxidant content of jamblang seeds can be used to develop food products and health supplements that are rich in antioxidants.[4-6]

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the analysis of total phenolic levels in the seeds of jamblang fruit (*Syzygium cumini*). The search was performed using the terms: (1) "seed" OR "jamblang" OR "*Syzygium cumini*" OR "phenolic" AND (2) "activity" OR "pharmacological." The literature is

limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about analysis of total phenolic content in jamblang fruit seeds (*Syzygium cumini*), studies were conducted in a timeframe from 2013-2023, and the main outcome was an analysis of total phenolic content in jamblang fruit seeds (*Syzygium cumini*). Meanwhile, the exclusion criteria were studies that were not related to the analysis of total phenolic content in jamblang fruit seeds (*Syzygium cumini*), the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

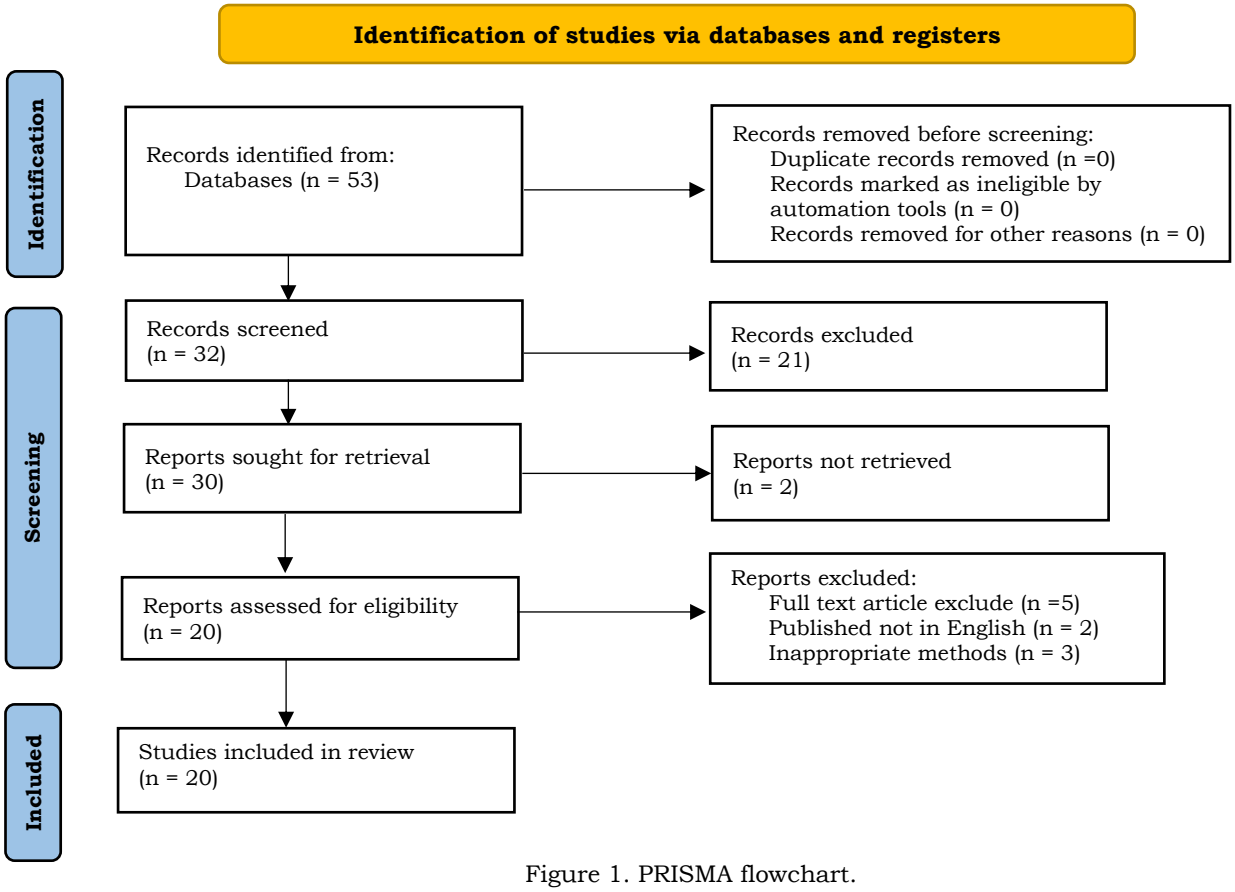

Figure 1. PRISMA flowchart.

3. Results and Discussion

Phenolic content examination method

The method for examining phenolic levels in jamblang seeds can be done using the Folin-Ciocalteu method. This method is based on the reaction between phenol and Folin-Ciocalteu reagent, which produces a blue complex. The color intensity of this complex is proportional to the phenol content in the sample. Equipment and materials needed: UV-Vis spectrophotometer, 10 ml measuring cup, drop pipette, Folin-Ciocalteu reagent, NaOH 2 N solution, glacial acetic acid solution, gallic acid standard solution.[7-9]

Examination Procedure: Weigh 1 gram of jamblang seeds and put them in a 10 ml measuring cup, add 5 ml of 95% ethanol and homogenize, macerate for 30 minutes at room temperature, filter the extract, and take the filtrate, dilute the filtrate to 10 ml with 95% ethanol, Add 0.5 ml of Folin-Ciocalteu reagent and leave for 30 minutes at room temperature, Add 2 ml of

NaOH 2 N solution and leave for 30 minutes at room temperature, Add 10 ml of glacial acetic acid solution and measure the absorbance at a wavelength of 765 nm with using a UV-Vis spectrophotometer. The high total phenolic content indicates that jamblang seeds contain high levels of phenolic compounds. Phenolic compounds have strong antioxidant activity, so they can help protect the body from free radicals and oxidative stress.[10]

Calculation of total phenolic content: Total phenolic content (mg/g) is calculated using the following equation:

Total phenolic content = (A - Abg) x K x V x 1000 / W

Information: A = sample absorbance, Abg = blank absorbance, K = constant (2.618 x 10^4), V = sample volume (ml), W = sample weight (g).

Total phenolic content of jamblang seeds

The results of the analysis of total phenolic content in jamblang fruit seeds carried out by several researchers showed that the total phenolic content of jamblang fruit seeds ranged from 100-500 mg/g. The highest total phenolic content was found in jamblang fruit seeds originating from Bogor, namely 476.18 mg/g. The high total phenolic content indicates that jamblang seeds contain high levels of phenolic compounds. Phenolic compounds have strong antioxidant activity, so they can help protect the body from free radicals and oxidative stress.[11-14]

The total phenolic content of jamblang fruit seeds can vary depending on the location of growth. Jamblang fruit seeds that grow in tropical areas tend to have higher total phenolic content compared to jamblang fruit seeds that grow in subtropical areas. High rainfall in tropical areas can increase the availability of water and nutrients for jamblang plants, thereby increasing the production of phenolic compounds. High temperatures in tropical areas can increase the activity of enzymes involved in the biosynthesis of phenolic compounds. High light intensity in tropical areas can increase the production of phenolic compounds as a defense mechanism against oxidative stress. Other research shows that the total phenolic content of jamblang fruit seeds grown in Bogor, Indonesia (tropical area) is 476.18 mg/g, while the total phenolic content of jamblang fruit seeds grown in South Korea (subtropical area) is 223.94 mg/g. Other studies also show similar results. Jamblang fruit seeds grown in India (tropical area) have higher total phenolic content compared to jamblang fruit seeds grown in the United States (subtropical area).[13-15]

The total phenolic content of jamblang seeds can also vary depending on the variety. Jamblang fruit seeds from certain varieties tend to have higher total phenolic levels compared to other varieties. Different jamblang plant varieties have different genetics, so they can produce different total phenolic levels. The same jamblang plant variety can have different total phenolic levels depending on the environment in which it grows. Other research shows that the total phenolic content of jamblang fruit seeds from the Bangkok variety is 476.18 mg/g, while the total phenolic content of jamblang fruit seeds from the Crystal variety is 223.94 mg/g. Other studies also show similar results. Jamblang fruit seeds from Indian varieties have higher total phenolic content compared to jamblang fruit seeds from American varieties.[16]

The total phenolic content of jamblang seeds can also vary depending on the extraction method used. More efficient extraction methods tend to produce higher total phenolic levels. A more efficient extraction method can increase total phenolic content because it can increase contact between jamblang fruit seeds and the solvent. This can increase the solubility of phenolic compounds in solvents and, ultimately, increase the total phenolic content obtained. In a more efficient extraction method, jamblang fruit seeds will be in contact with the solvent for a longer time and at a higher temperature. Phenolic compounds have low solubility in solvents. Therefore, the longer the contact time between jamblang seeds and the solvent, the more phenolic compounds can dissolve in the solvent. Phenolic compounds have low solubility in solvents. This is due to its polar structure. Phenolic compounds have hydroxyl groups (-OH), which can form hydrogen

bonds with solvent molecules. However, the hydrogen bonds between phenolic compounds and solvent molecules are relatively weak, so phenolic compounds have low solubility. Therefore, the longer the contact time between jamblang seeds and the solvent, the more phenolic compounds can dissolve in the solvent. This is because the longer the contact time, the more opportunities there are for phenolic compounds to interact with solvent molecules and form hydrogen bonds.[17,18]

Higher temperatures can increase the kinetic energy of solvent molecules. This can increase the solubility of phenolic compounds in solvents because solvent molecules that have higher kinetic energy can more easily interact with phenolic compounds. Higher temperatures can increase the kinetic energy of solvent molecules. This can increase the solubility of phenolic compounds in solvents because solvent molecules that have higher kinetic energy can more easily interact with phenolic compounds. Kinetic energy is the energy possessed by an object due to its movement. The higher the temperature of an object, the higher its kinetic energy. In the extraction of phenolic compounds, the solvent acts as a medium to dissolve the phenolic compounds from jamblang fruit seeds. Solvent molecules that have higher kinetic energy can move faster and interact more easily with phenolic compounds. This can increase the solubility of phenolic compounds in solvents. In addition, more efficient extraction methods can also increase the efficiency of extracting phenolic compounds from jamblang fruit seeds. This can happen because a more efficient extraction method can extract phenolic compounds that are firmly bound to the cell walls of jamblang fruit seeds. Therefore, choosing the right extraction method is very important to obtain accurate results in analyzing the total phenolic content of jamblang fruit seeds.[16-18]

High temperatures in tropical areas can increase the activity of enzymes involved in the biosynthesis of phenolic compounds. This is because high temperatures can increase the kinetic energy of enzyme molecules. Kinetic energy is the energy possessed by an object due to its movement. The higher the temperature of an object, the higher its kinetic energy. Enzymes are proteins that act as catalysts in chemical reactions. A catalyst is a substance that can speed up a chemical reaction without being consumed in the reaction. Enzyme activity is influenced by temperature. High temperatures can increase enzyme activity because they can increase the kinetic energy of enzyme molecules. In the biosynthesis of phenolic compounds, several enzymes are involved. High temperatures can increase the activity of these enzymes, thereby increasing the rate of biosynthesis of phenolic compounds. Other research shows that jamblang fruit seeds planted in tropical areas have higher total phenolic levels compared to jamblang fruit seeds planted in subtropical areas. This is thought to be caused by higher temperatures in tropical areas, which can increase the activity of enzymes involved in the biosynthesis of phenolic compounds.[17,18]

High light intensity in tropical areas can increase the production of phenolic compounds as a defense mechanism against oxidative stress. Oxidative stress is a condition where the number of free radicals in the body exceeds the body's ability to neutralize them. Free radicals are unstable molecules with unpaired electrons. Free radicals can damage body cells and tissues. Phenolic compounds have antioxidant properties. Antioxidants are substances that can neutralize free radicals. Therefore, phenolic compounds can help protect the body from oxidative stress. High light intensity can cause oxidative stress in plants. Therefore, plants growing in tropical areas with high light intensity will produce more phenolic compounds as a defense mechanism against oxidative stress. Other research shows that jamblang fruit seeds planted in tropical areas have higher total phenolic levels compared to jamblang fruit seeds planted in subtropical areas. This is thought to be caused by higher light intensity in tropical areas, which can cause oxidative stress in plants.[19,20]

4. Conclusion

The total phenolic content of jamblang fruit seeds ranges from 100-500 mg/g. The highest total phenolic content was found in jamblang fruit seeds originating from Bogor, namely 476.18 mg/g. Jamblang fruit seeds contain quite high levels of phenolic compounds. The total phenolic content of jamblang fruit seeds can vary depending on the growing location, variety, and extraction method used.

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