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Comparison Of Polyphenol Antioxidant Levels In Fig Plant Leaves, Skin, And Flesh Using The DPPH Method

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ABSTRACT

Fig plants (Ficus carica) are known to have potential as a source of antioxidants, especially from the polyphenol content found in the leaves, skin, and fruit flesh. This study aims to compare the antioxidant activity of polyphenols in three parts of the fig plant using the DPPH (2,2-diphenyl-1-picrylhydrazyl) test method to measure free radical inhibition. Extraction was carried out using 96% ethanol, and antioxidant activity was tested at concentrations of less than 100 ppm. The results showed that fig leaves had the highest antioxidant activity with an inhibition percentage of 75.991%, followed by fig flesh at 56.559%, and fig skin at 48.925%. ANOVA test analysis showed significant differences between the three parts of the plant with a significance value of p of 0.004 (<0.05), which confirmed that fig leaves have higher antioxidant potential than the skin and fruit flesh. This study provides useful information for the development of fig-based health products.

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INTRODUCTION

Indonesia as a developing country has limitations in dealing with health problems, where infectious diseases are still high, but the prevalence of degenerative diseases is increasing. According to the results of basic health research conducted by the Health Research and Development Agency (RKD) in 2023, the main causes of death were stroke (19.42%), followed by tuberculosis, hypertension, and injury (6.5-7.5%), and diabetes mellitus and tumors (each 5.7%). Therefore, degenerative diseases are a serious health problem and are the leading cause of death in Indonesia.(1)

One of the diseases of antioxidant deficiency is oxidative stress. Oxidative stress plays an important role in the pathophysiology of the aging process and various degenerative diseases, such as cancer, diabetes mellitus and its complications, and atherosclerosis which underlies heart disease, blood vessels and stroke. Antioxidants are very much needed by the

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body to overcome and prevent oxidative stress and can inhibit free radicals. Antioxidants found in plants are used to ward off free radicals, plants that can be used as antioxidants usually contain carotenoid compounds, flavonoids, polyphenols and allyl sulfides. These antioxidants are found in abundance in fruits, vegetables and grains. The color of fruits and vegetables is a pigment that is useful as an antioxidant.(2)

Fig plants (Ficus carica L.) are plants that have many benefits in every part of the plant, one of which is the leaves because they have high antioxidants such as flavonoids. Fig leaves are thought to be able to treat various diseases such as cardiovascular, respiratory tract, gastrointestinal, as well as antispasmodic and anti-inflammatory. Other benefits of fig plants are as antibacterial, anticancer, increase bone density, can lower cholesterol and lower high blood pressure.(1–3)

Figs are fruits that have almost reached the stage of overall perfection. There are several active secondary metabolite compounds found in fig plants, especially phenolic compounds which are excellent antioxidants for improving human health. All parts of the fig plant can be used in herbal medicine and have proven efficacy in treating various health problems and diseases.

Fig skin contains many polyphenol compounds, namely flavonols, anthocyanins and catechins. In a study conducted by Arumugam (2018), it was shown that the methanol extract of fig skin has a higher total phenol content and antioxidant activity compared to fig flesh. The study to be conducted uses ethanol solvent which is able to extract more chemical compounds compared to water and methanol. In addition, recommendations regarding Figs are contained in the Quran, QS.At-Tin. Testing of non-enzymatic antioxidant activity in plants and food ingredients can generally use a water-based method 2,2-diphenyl-1-picrylhydrazyl (DPPH) (reaction with free radicals), Ferric Reducing Antioxidant Power (FRAP) (reduction-oxidation reaction). The many antioxidant activity test methods can provide varying test results.(4,5)

This is due to the influence of the chemical structure of antioxidants, sources of free radicals, and different physicochemical properties of sample preparations. Therefore, based on the description above, the author wants to conduct a study on the comparison of polyphenol antioxidants in leaves, skin, and flesh of fig plants.

This study aims to compare the antioxidant activity of polyphenols found in the leaves, skin, and flesh of fig plants using the DPPH method. One of the main focuses is to determine the total polyphenol content in extracts from each part of the fig plant and measure its antioxidant activity. Thus, this study is expected to provide a deeper understanding of the differences in antioxidant content in each part of the fig plant and its potential in the health sector.

Specifically, this study will identify the parts of the fig plant that have the highest antioxidant activity, both from the leaves, skin, and flesh of the fruit. By knowing the parts that are richest in polyphenols and have the best antioxidant activity, the results of this study can be the basis for the use of fig plants in various health applications, such as natural supplements or additives in the pharmaceutical and functional food industries.

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RESEARCH METHODS

This study is an experimental study aimed at identifying antioxidant activity in fig plants using the DPPH method with a Microplate reader. This study will compare the polyphenol content and antioxidant activity in three parts of the fig plant, namely the leaves, skin, and flesh of the fruit. With this method, it can be seen which part has the highest antioxidant potential and can be further utilized in the health sector.

The subjects of the study were determined based on inclusion and exclusion criteria to ensure the validity of the results. The samples used must come from the same variety, in healthy condition, and taken from the same location to maintain consistency of analysis. In addition, sample processing processes, such as drying or storage, are carried out uniformly to prevent degradation of active compounds. Samples that do not meet the criteria, such as coming from different varieties or showing signs of disease and chemical contamination, will be excluded from the study.

This research was conducted at the Pharmacognosy-Phytochemistry Laboratory, Faculty of Pharmacy, Muslim University of Indonesia from November 2024 until completion. The independent variables in this study were the parts of the fig plant tested, namely leaves, skin, and fruit flesh, while the dependent variables were antioxidant activity and total polyphenol content measured using the DPPH method. Data analysis was carried out by comparing the IC50 values of each part of the plant to determine which part had the strongest antioxidant activity.

The research process includes several main stages, starting from the preparation of DPPH solution to the antioxidant activity test. DPPH solution is prepared with a certain concentration to test the sample's ability to ward off free radicals. In addition, a comparison solution in the form of vitamin C is also made in various concentrations as a positive control. Antioxidant activity testing is carried out by mixing sample extracts in various concentrations with DPPH solution, then incubated for 30 minutes before being analyzed using a Microplate reader.

The results obtained will be analyzed using the Anova test statistical method to see if there are significant differences in the antioxidant activity of polyphenols in the leaves, skin, and flesh of the fig plant. The data will be presented in the form of IC50 values, which indicate how effective the extract is in counteracting free radicals. With this analysis, the study is expected to provide scientific information on the part of the fig plant that has the highest antioxidant activity and the potential to be further developed in the pharmaceutical and health industries.

RESULTS AND DISCUSSION

Results

This research was conducted at the Pharmaceutical Research Laboratory of the Muslim University of Indonesia with an implementation time during November-December 2024. This study aims to compare the antioxidant activity of fig leaf, fruit, and skin extracts using the DPPH method.

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Table 1. Results of Antioxidant Activity Tests on Fig Leaves

Concentration (Ppm)	Absorbance	%Inhibition	IC50	Antioxidant Activity
20	0.437	53,162	10.167	
40	0.384	58,842	10.167	
60	0.348	62,701	10.167	Very Strong (IC_{50} < 50 ppm)
80	0.285	69,453	10.167	
100	0.224	75,991	10.167	

Based on observations of the table on fig leaves, the highest inhibition percentage was obtained at 75,991 from a concentration of less than 100ppm. Based on the image below, the extract samples were made with 5, namely, 20, 40, 60, 80 and 100 pm. The test results show that the concentration is directly proportional to the inhibition percentage, high concentrations will produce high inhibition percentages.

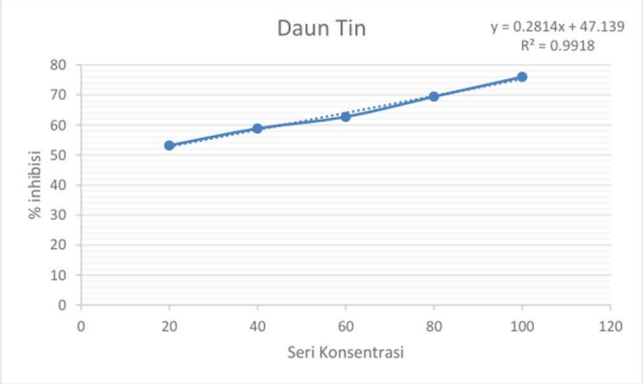

Figure 1. Fig Leaf Concentration Series Results

Table 2. Results of Antioxidant Activity Test on Figs

Concentration (Ppm)	Absorbance	%Inhibition	IC50	Antioxidant Activity
20	0.809	13.011	89,557	
40	0.741	20,323	89,557	
60	0.638	31,398	89,557	Strong (IC_{50} 50-100 ppm)
80	0.517	44,409	89,557	
100	0.404	56,559	89,557	

Based on observations of the table on figs, the highest inhibition presentation was obtained at 56,559 from a concentration of less than 100ppm. Based on the image below, the extract samples were made with 5, namely, 20, 40, 60, 80 and 100 pm. The test results show that the concentration is directly proportional to the inhibition percentage, high concentrations will produce high inhibition percentages.

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Figure 2. Fig Fruit Concentration Series Results

Table 3. Results of Antioxidant Activity Test on Fig Fruit Skin

Concentration (Ppm)	Absorbance	%Inhibition	IC50	Antioxidant Activity
20	0.546	41,290	107,867	
40	0.521	43,978	107,867	
60	0.509	45,269	107,867	Currently
80	0.486	47,742	107,867	(IC_{50} 100-150 ppm)
100	0.475	48,925	107,867	

Based on observations of the table on fig skin, the highest inhibition percentage was obtained at 48,925 from a concentration of 100ppm. Based on the image below, the extract samples were made with 5, namely, 20, 40, 60, 80 and 100 pm. The test results show that the concentration is directly proportional to the inhibition percentage, high concentrations will produce high inhibition percentages.

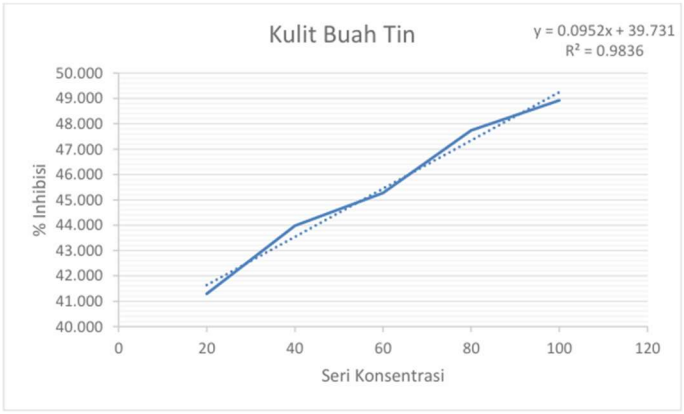

Figure 3. Fig Skin Concentration Series Results

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Table 4. Comparison of Antioxidant Activity at 100ppm Concentration

Antioxidant Activity	Concentration 100 ppm
Leaf	75,991
Meat	56,559
Skin	48,925

Based on the comparison of % inhibition with a concentration of 100ppm, it was found that the Leaf value showed a figure of 75.991, the Fig flesh showed a value of 56.559 and the Fig skin showed a figure of 48.925. Thus it can be seen that the comparison of polyphenol antioxidant activity in the Leaves, Skin, and Fruit Flesh of the Fig plant based on the highest concentration of 100ppm is in the Fig Leaves, amounting to 75.991.

Table 5. Comparison of Antioxidant Activity Using Anova Test

Concentration	Antioxidant Activity			F	Sig.
	Leaf	Skin	Meat		
20	53,162	41,290	13.011	9,046	0.004
40	58,842	43,978	20,323		
60	62,701	45,269	31,398		
80	69,453	47,742	44,409		
100	75,991	48,925	56,559		
Average	64.02980	45.44080	33,14000		

The results of the SPSS analysis with the One Way Anova test *on* the antioxidant activity between fig leaves, figs, and fig skins obtained the following data: From the results of the Anova test above, it can be seen that the F value is 9.046 and the significance p is 0.004. Because the significance value of p is 0.004 <0.05, it means that Ho is rejected and H1 is accepted. Based on this, it means that the hypothesis stating "There is a significant difference in the antioxidant activity of polyphenols between the leaves, skin, and flesh of figs" has been proven.

The descriptive results of the average polyphenol antioxidant activity in fig leaves, figs, and fig skins show that the average polyphenol antioxidant activity in fig leaves shows an average of 64.02980, fig skin shows an average of 45.44080 and fig flesh shows an average of 33.14000. Thus, it can be seen that the highest average polyphenol antioxidant activity is found in fig leaves, at 64.02980.

Discussion of Polyphenol Antioxidant Content in Fig Plant Leaves

Fig leaves (Ficus carica) are known to have complete secondary metabolite content, including flavonoids, tannins, saponins, alkaloids, and terpenoids, which provide various health benefits. Research shows that fig leaf extract has high antioxidant activity, with higher concentrations producing higher inhibition. Polyphenols in fig leaves act as powerful antioxidants that can protect cells from free radical damage and have the potential to prevent degenerative diseases such as cancer and heart disease.

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In addition to being an antioxidant, fig leaves also have hypoglycemic properties and can help lower cholesterol levels in diabetics. Its flavonoid content plays a role in cell protection, while its polyphenols have the potential to inhibit the growth of cancer cells. Various studies support the pharmacological benefits of fig leaves, which have also been used traditionally to treat wounds, as a herbal medicine for hemorrhoids, and a natural laxative for children.

The antioxidant efficacy of fig leaves is influenced by environmental factors and extraction methods, which can affect the levels of polyphenols obtained. The DPPH test method is often used to measure the free radical scavenging capacity of fig leaf extracts, indicating their potential in health product formulations. In addition, studies have shown that figs also have similar health benefits, including reducing the risk of heart disease and inflammation.

With increasing public awareness of natural ingredients, fig leaf extract has great potential in the health and food industry. Further development of supplement formulations or food products based on fig leaf extract can provide a natural alternative to improve health. Further studies on the bioavailability and mechanism of action of bioactive compounds in the body are still needed to optimize their benefits.

Polyphenol Antioxidant Content in Fig Fruit Skin

The results showed that fig skin has significant antioxidant activity, with the highest inhibition percentage of 48.925% at a concentration of 100 ppm. Higher extract concentrations produce greater antioxidant activity. This is in line with previous studies that found that fig skin contains higher levels of total phenols than its flesh, with main compounds such as flavonols, anthocyanins, and catechins playing a role in counteracting free radicals.

Polyphenols in fig skin act as powerful antioxidants that protect cells from oxidative damage. Research shows that flavonoids in fig skin have the potential to reduce the risk of chronic diseases such as cancer and heart disease. In addition to flavonoids, other compounds such as phenolic acids and tannins also contribute to the antioxidant effect and support health with anti-inflammatory and immune-boosting properties.

The polyphenol content in fig skin is influenced by variety, growing conditions, and maturity stage. Environmental factors can cause variations in polyphenol levels, which need to be taken into account in further research. The potential of fig skin in the health industry is increasingly attractive, both as a raw material for supplements and as an antioxidant-rich food product.

In addition, the antioxidant properties of fig skin can be utilized in the cosmetic industry to protect the skin from free radicals that accelerate aging. The use of fig skin in various fields requires further research, especially regarding the bioavailability and mechanism of action of its active compounds in the human body.

Polyphenol Antioxidant Content in Fig Fruit Flesh

The test results showed that the highest inhibition presentation in fig flesh reached 56,559 with a concentration of less than 100 ppm. The extract concentration test at 20, 40, 60, 80, and 100 ppm showed a linear relationship, where the higher the concentration, the higher the inhibition produced. Figs themselves have antioxidant content that can bind

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carcinogenic compounds that cause cancer, with the main bioactive compounds such as phenols, flavonoids, and terpenoids contributing to their biological activity.

Polyphenols in fig flesh are known to have strong antioxidant activity, which plays a role in protecting cells from damage caused by free radicals. This compound can inhibit fat peroxidation, thereby helping to reduce the risk of degenerative diseases such as cancer and heart disease. Research shows that flavonoids in figs function as antioxidant agents that can prevent DNA damage, boost the immune system, and reduce inflammation.

Factors such as plant variety, growing conditions, and stage of ripeness can affect the polyphenol content of fig flesh. Studies also show that figs are rich in vitamin C, fiber, and minerals, which provide additional benefits for digestive health and the immune system. With the combination of bioactive compounds and essential nutrients, fig flesh consumption has the potential to provide positive effects on overall health.

In the development of health products, fig flesh can be used as raw material for supplements and food products rich in antioxidants. Increasing public awareness of the importance of consuming natural ingredients increasingly opens up opportunities for further research on the bioavailability and mechanism of action of active compounds in figs, which contribute to the health and food industries.

Comparison of Antioxidants Between Polyphenols in Leaves, Skin, and Fruit Flesh of Fig Plants

From the results of the Anova test, the F value is 9.046 with a significance of p = 0.004 (<0.05), so Ho is rejected and H1 is accepted. This proves that there is a significant difference in the antioxidant activity of polyphenols between fig leaves, skin, and flesh. The highest average polyphenol antioxidant activity is found in fig leaves (64.02980), followed by fig skin (45.44080) and fig flesh (33.14000). Inhibition observations show that fig leaves have the highest percentage of inhibition (75.991) compared to skin (48.925) and flesh (56.559) at a concentration of <100ppm.

The flavonoid content in fig leaves plays a role in antioxidant activity because it can donate hydrogen atoms to stabilize free radicals. Research by Qodriah et al. (2021) supports this finding, showing that the highest polyphenol compounds are found in fig leaves and fruits, while flavonoids are more dominant in the sap. The use of 96% ethanol in antioxidant extraction has proven effective, as shown by research by Sylvia D et al. (2020), which obtained a total phenolic content of 7.09 mg/g GAE. 96% ethanol was chosen because it can dissolve polar and semi-polar compounds and is easily evaporated.

The three parts of the fig plant have varying antioxidant content. Fig leaves are rich in flavonoids and phenolic acids, which contribute to antioxidant, antidiabetic, and anti-inflammatory activities. Fig skin also contains high amounts of polyphenols, while fig flesh, although having lower antioxidant activity, is rich in vitamins, minerals, and fiber that are beneficial to health. This variation in content is influenced by geographic location and environmental conditions.

The use of fig plants as a source of antioxidants is very potential, both in the form of health supplements and food and beverage products. For example, fig leaf extract can be used as a supplement, while the skin and flesh can be used in the food industry. Further

research is needed to understand the bioavailability and mechanism of action of its bioactive compounds in order to optimize its health benefits.

CONCLUSION

Based on the results of the study, the polyphenol antioxidant content in fig leaves, skin, and flesh showed significant variations. Fig leaves had the highest inhibition percentage of 75,991 from a concentration of less than 100ppm, followed by fig flesh at 56,559, and fig skin at 48,925. These results indicate that fig leaves have higher antioxidant activity than other parts. In addition, statistical analysis using the ANOVA test showed a significant difference in polyphenol antioxidant activity between the three parts of the fig plant, with a significance value of p of 0.004 (<0.05). The highest average polyphenol antioxidant activity was found in fig leaves, which was 64.02980. This finding confirms that fig leaves have greater potential as a source of antioxidants than the skin and flesh of the fruit.

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