

Comparison of Antioxidant and Compound Content of Herbal Tea as A Functional Drink for Patients With Type 2 Diabetes Mellitus

Rahmawati Nuraeni¹, Nunung Kurniasih²

^{1,2}Department of Chemistry, UIN Sunan Gunung Djati Bandung, Indonesia

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ABSTRACT

Type 2 diabetes mellitus is a metabolic condition characterized by high levels of glucose in the blood. People with Diabetes Mellitus need to regulate blood glucose levels by following a strict medical diet, especially in terms of sugar intake. Herbal plants contain antioxidant compounds that can reduce blood glucose levels. This study generally aims to compare the antioxidant power value and compound content of various types of herbal tea. The method used is a literature study using sources through Science Direct and Google Scholar. The results of the review show that plants that can be used as antioxidants and herbal teas that are useful in preventing type 2 diabetes mellitus from various plants that are used as comparison materials can have potential as antioxidants due to the presence of several secondary metabolite compounds such as flavonoids, tannins, saponins, and alkaloids. 50 Of the plants obtained, those that contain antioxidant activity with the strongest category are soursop leaves (*Annona Muricata* L.) with an IC value of 9.846 ppm. 50 The antioxidant activity with the weakest category is Ciplukan (*Physalis angulata*) leaves with an IC value of 812.96 ppm. For a little water content of 1.425% in soursop leaves, which indicates that soursop leaf herbal tea is better consumed by patients with type 2 diabetes mellitus, it has the potential to be used as an alternative functional drink.

Corresponding Author:

Rahmawati Nuraeni,

Chemistry Department, Faculty of Science & Technology, UIN Sunan Gunung Djati Bandung

Jl. A. H. Nasution No. 105, Cibiru, Bandung, Indonesia. 40614

Email: rahmawatinuraeni279@gmail.com

1. INTRODUCTION

Diabetes mellitus, or DM, is one of the most serious challenges to human health in the 21st century. Type 2 diabetes mellitus is a global health issue that has increased rapidly in recent years. Diabetes can lead to complications in various organs in the body over some time, including nerve, kidney, and eye damage, as well as serious cardiovascular diseases. Diabetes mellitus currently ranks as the 6th leading cause of death worldwide.

According to the WHO, the number of people with diabetes is expected to increase significantly to reach 16.7 million by 2045. Diabetes occurs due to a lack of insulin, a hormone that regulates blood sugar levels, causing uncontrolled and elevated blood sugar levels in the body. In addition to the lack of insulin, an unhealthy lifestyle can also trigger diabetes. Genetic factors can also double a person's risk of developing diabetes. Indonesia is the third most biodiverse country in Asia, after India and China, having rich resources of medicinal plants with the potential to act as hypoglycemic agents. Indonesia is known for having a variety of plants that have properties to maintain a healthy body. With an increasingly busy lifestyle that tends to be instantaneous, it is important to have a nutritional intake that can maintain health. One of them is leaves, which have benefits for maintaining a healthy body, especially when people are busy with their activities. What is commonly known by the public comes from the tea plant. In addition, there are also herbal teas made from various other ingredients, such as leaves, roots, seeds, stems, and fruits from plants other than tea plants. Herbal teas have varied benefits depending on the main ingredient.

Herbal tea, which is a blend of tea and herbs, has refreshing properties as well as the potential to prevent or aid in the treatment of diseases. To produce quality tea, three main processes are required, namely withering, fermentation, and drying, which affect the quality, especially aroma, of the final tea. Herbal teas are classified as functional beverages because they contain polyphenols and or flavonoids that have antioxidant activity to fight free radicals. Today, the commercial market has offered a variety of herbal tea products with diverse ingredients and benefits. Tea processing continues to be developed to enhance the nutritional value and flavor of the products. Existing tea products, such as herbal tea, organic tea, and other variations, show the diversification in the tea industry.

Natural antioxidants derived from plants have become a popular alternative as a source of antioxidants (Putu & Satriyani, 2021). Indonesia has great potential in finding new antioxidant compounds due to its biodiversity (Kumalasari et al., 2019). Several studies have shown that plants, including herbal plants, have the potential as antioxidants that can protect the body from free radicals and antidiabetes (Dinda & Ridwanto, 2022). The DPPH (2,2-Diphenyl-1-Picrylhydrazyl) method is used to evaluate antioxidant activity by measuring the level of reactivity to the compound being tested (Rumyaan et al., 2022). Strong absorption of DPPH is characterized by a color change to dark violet at a wavelength of 517 nm (Kameliani et al., 2020).

Based on the above description, the problem formulation is obtained, namely how the activity of alternative antioxidant compounds for the treatment of type 2 diabetes mellitus in various herbal plant leaves using the DPPH method based on the review of several kinds of literature. This writing aims to compare the antioxidant power value and compound content of various types of herbal tea with the DPPH method based on the review of several kinds of literature, in addition to herbal plant leaves, as well as DPPH testing methods. The articles that have been obtained are then further analyzed to answer the problem formulation based on the articles reviewed.

2. METHOD

The method applied in the preparation of this review article includes a comprehensive literature analysis using two main data sources, namely ScienceDirect and Google Scholar. The references included relevant journal articles, theses, and books that met certain inclusion and exclusion criteria. Journal inclusion criteria included publishing in the range of 2018 to 2023, with keywords such as "Type 2 Diabetes Mellitus", "Functional Drinks", "Secondary metabolites", "Herbal Plants", and "Antioxidants". Which includes water content tests, antioxidant tests, and the content of compounds in various types of herbal plants.

3. RESULT AND DISCUSSION

Table 1. Test results on mung bean and kidney bean samples

No.	Types of Herbal Tea	Methods	Water Content (%)	Compound Content	IC ₅₀ (ppm)	Description
1.	Ciplukan leaf herbal teabag + ginger powder	DPPH	8,80	Phenol, Flovanoid	812,96	Widiyana et al (2021)
2.	Soursop Leaf Herbal Tea	DPPH	1,4255	Flavonoids, Alkaloids, Tannins, Saponins	4,028	Endawati (2022)
3.	Samama leaf tea + Nutmeg mace	DPPH	10,82	Flavonoids	122,90	Khadijah et al (2019)
4.	Noni leaf + cinnamon + stevia tea bags	DPPH	7,66	Flavonoids	747,132	Nurminabari (2019)
5.	Mango leaf herbal tea	DPPH	7,41	Phenol	31,83	Pulungan et al (2022)

In Indonesia, there are a variety of plants that have potential as free radical scavengers or antioxidants. Plant parts that can be used as antioxidants include leaves, where many antioxidant compounds such as flavonoids, terpenoids, saponins, and tannins are found. The DPPH method has the advantage of being simpler, faster, and easier to analyze, and more sensitive to samples with small concentrations. However, the use of the DPPH method is limited to organic solvents, making it difficult

to analyze hydrophilic compounds. In soursop leaves a compound will be considered a very strong antioxidant if its IC₅₀ value is less than 50 ppm. If the IC₅₀ value is between 50-100 ppm, the compound is categorized as strong, while compounds with IC₅₀ values between 100-150 ppm have moderate antioxidant activity. A compound is considered to have weak antioxidant activity if its IC₅₀ value ranges between 151-200 ppm.

The addition of imprint ginger powder in this study has shown an increase in the water content of ciplukan leaf herbal tea bags. Along with the increase in the amount of esprit ginger powder added, the water content of the tea also increased. The imprint ginger powder used has a moisture content of 7.04%, according to the findings of [2], which states that imprint ginger powder has a moisture content that ranges from 7 to 12%. Moisture content is important because it affects the freshness and durability of food. If the moisture content in dried tea is too high, the tea can become moist and susceptible to damage [5]. The tea quality standard set by SNI states that the maximum moisture content of tea is 8% [1]. have the potential to reduce blood glucose levels through several mechanisms, including stimulating insulin production by pancreatic β -cells, triggering insulin receptor activation, repairing pancreatic β -cell damage with antioxidant activity, inhibiting the conversion of carbohydrates to glucose, and reducing glucose absorption in the small intestine (Hanhineva, 2010). Flavonoids present in vegetables and medicinal herbs are also believed to have positive effects on diabetes by improving blood sugar regulation, lipid profile, and antioxidant levels.

According to research conducted by Widiyana (2021), ginger contains natural antioxidant compounds in significant concentrations and is proven effective in inhibiting diabetes. Based on the antioxidant activity analysis, the IC₅₀ value of ciplukan leaf herbal tea enriched with imprint ginger powder ranged from 812.96 ppm. This finding indicates that ciplukan leaf herbal teabags added with imprint ginger powder have low antioxidant activity, with IC₅₀ values exceeding 200 ppm. In general, the antioxidant strength level of a compound can be categorized as very strong if its IC₅₀ value is less than 50 ppm, strong for IC₅₀ values between 50-100 ppm, moderate for IC₅₀ values between 101-150 ppm, weak if IC₅₀ values between 151-200 ppm, and very weak if IC₅₀ values exceed 200 ppm [10]. One of the important chemical components in soursop leaves is flavonoid, which is one type of secondary metabolite. The presence of flavonoids in plant leaves is influenced by the photosynthesis process, so young leaves have lower flavonoid levels. Flavonoids are natural compounds that belong to the phenolic group. Flavonoid compounds have been shown to have strong biological effects, including antioxidants that can lower blood sugar levels, inhibit platelet clumping, stimulate nitric oxide (NO) production to dilate blood vessels, and inhibit cancer cell growth. In addition, flavonoids act as antioxidants by reducing free radicals and have antimicrobial or antibiotic effects. The antioxidant activity test was conducted using the DPPH method.

Determination of water content in simplisia is very important to set the maximum limit of water content in it. High water content can be a suitable environment for the growth of bacteria and fungi that can damage the compounds contained in it. The requirement for the water content of samples by the standard is that it should not exceed 10%. The test results showed that the highest water content in soursop leaf simplisia was 1.425%, indicating that the simplisia met the set water content standard. The antioxidant activity of soursop leaves showed an IC value₅₀ of 4.028 ppm. The reason is the drying process which increases the concentration of active substances in the tea leaves. The low-temperature drying process can cause oxidation which triggers a decrease in antioxidant content, as antioxidants are susceptible to oxidation at low temperatures and can disappear.

Water content is a crucial factor in food ingredients as it can affect the appearance, texture, and flavor of food. Moisture content in an herb is an important parameter used to evaluate the condition of the herb. Based on the data, the herbal simama leaf has the highest moisture content of 10.82%. Although the moisture content in the five formulations of Samama and mace is still below the standard for dry simplisia, which is less than 10%, this can be overcome by extending the drying time to reduce the moisture content of the sample or simplisia. The presence of water in food also plays a role in influencing damage to food because microorganisms can use water for growth. According to a study conducted by Khadijah (2019), the antioxidant content of Samama leaves (*Anthocephalus macrophyllus*) was 122.90 ppm. The addition of mace resulted in a decrease in the antioxidant activity and toxicity value of Samama leaf simplisia, which was influenced by the proportion of young and old leaves used. 50 According to [7], an extract is considered an antioxidant if its IC value is less than 200 ppm.

In noni-leaf herbal tea, when cinnamon was added, there was an increase in water content to 7.66%. This increase is caused by the hygroscopic nature of cinnamon which can absorb water. The more cinnamon added, the greater its ability to absorb water, so that water absorption increases. Cinnamon has a hygroscopic ability that allows it to absorb and release water, both in the form of liquid and water vapor. In the extraction process, it is thought that cinnamon absorbs the added water intentionally to

increase the efficiency of the extraction process. In noni leaves, it is found that the antioxidant activity has an IC50 value of 747.132, which indicates that this antioxidant activity is weak because the IC50 value is > 500. Because the antioxidant activity analysis was carried out using a methanol solvent. According to the principle of polarization, a compound dissolves in a solvent with the same degree of polarity. Flavonoids, which are polar compounds because they contain sugars, tend to dissolve in polar solvents. Flavonoid compounds are antioxidant compounds that affect noni leaves. The high antioxidant activity in dried noni leaves with methanol solvent shows that the characteristics of flavonoid compounds in noni leaf extracts have the same level of polarity as methanol. Therefore, noni leaf extract contains the highest amount of flavonoids.

In herbal mango leaf plants, the water content was found to be 7.41%, this is due to the presence of active cells in young leaves that play a role in the physical and chemical growth of leaves, thus requiring more water. Biochemical processes such as photosynthesis utilize water as a source for leaf growth. Molyneux (2004) explained that water acts as a basic ingredient in biochemical reactions, including photosynthesis, which also has a key role in the formation of color pigments in plant leaves. In addition, water has a function in transporting nutrients to the leaves. The phenol content in a material is related to antioxidant activity, whereas mango leaf tea has an antioxidant phenol of 31.83 ppm. A decrease in antioxidant activity can also be caused by the cessation of biosynthesis of new secondary metabolites during the ripening process.

4. CONCLUSION

Plants that can be used as antioxidants and herbal teas that are useful in preventing type 2 diabetes mellitus from various plants that are used as comparison materials can have potential as antioxidants due to the presence of several secondary metabolite compounds such as flavonoids, tannins, saponins, and alkaloids. 50 Of the plants obtained, those that contain antioxidant activity with the strongest category are soursop leaves (*Annona Muricata* L.) with an IC value of 9.846 ppm. The antioxidant activity with the weakest category is Ciplukan (*Physalis angulata*) leaves with an IC value 50 of 812.96 ppm. It can be seen that soursop leaves have a small water content of 1.425%, which indicates that soursop leaf herbal tea is better consumed by patients with type 2 diabetes mellitus, potentially as an alternative functional drink.

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