ANALYSIS OF TOTAL PHENOLIC CONTENT AND PHYTOCHEMICAL STUDY OF GINGER RHIZOME EXTRACT (*ZINGIBER OFFICINALE* ROXB.)

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ABSTRACT

Indonesia has long been known as a country producing spices that are very useful as spices and medicines, one of which is ginger (Zingiber officinale Roxb). Ginger is a herbal plant that is widely used as a flavoring, refreshing drink, herbal medicine, a source of antioxidants that act as herbal medicine for various diseases. Previous studies have stated that ginger has antioxidant and antimicrobial activity. This study aims to determine the total phenolic content and phytochemical studies of ginger rhizome extract. Ginger extract was obtained by the squeezing method then tested for total phenolic content using the UV-Vis spectrophotometry method using Folin-Ciocalteu reagent and phytochemical content studies were carried out. The results showed that the total phenolic content of ginger rhizome extract was 1.716200 mg GAE/g. Phytochemical studies of ginger extract revealed alkaloids, flavonoids, phenolics, saponins, steroids, and triterpenoids.

Keywords: flavonoids; phenolids; phytochemical studies of ginger extract contained alkaloids; saponins; steroids; triterpenoids

INTRODUCTION

Ginger, or Zingiber officinale, is a spice plant that has long been used as a traditional medicine. The ginger rhizome is the most valuable part of the plant, as it contains various bioactive compounds that contribute to its various therapeutic benefits. Ginger is known to contain various bioactive compounds such as gingerol, shogaol, paradol, and zingerone (Ahnafani et al., 2024). The use of herbal medicines derived from plants is currently gaining popularity among the general public as an alternative therapy that is just as important as medical therapy. Alternative therapies have few side effects. The compounds in herbal plants are usually balanced and mutually neutralizing (Suharto & Etika, 2019). The compounds in ginger rhizomes are also known to be beneficial as antioxidants, antitussives, analgesics, antipyretics, anti-inflammatories, lower cholesterol levels, prevent depression and impotence, and act as antimicrobials, among others (Rahayu et al., 2024). Ginger is also known to have strong antimicrobial effects. Ginger essential oil can fight various bacteria, fungi, and viruses. It boosts immunity and fights infections. This antimicrobial effect is also beneficial in maintaining oral health and preventing periodontal disease. This makes ginger a good choice (Ahnafani et al., 2024).

The compounds in ginger rhizomes are known to consist of volatile components, one of which is essential oil, and non-volatile components, one of which is oleoresin. Oleoresin provides a pungent aroma and has significant antioxidant potential. Active non-volatile phenolic compounds, such as gingerol and shogaol, found in ginger, have been shown to have antioxidant properties (Rahayu et al., 2024). Antioxidants can prevent or slow down oxidation. Oxidation reactions can lead to the formation of free radicals, which initiate chain reactions that can lead to cell damage (Fadlilah & Lestari, 2022). Antioxidants inhibit free radicals by donating one or more hydrogen atoms to the free radical, making the radical more stable and non-reactive. The human body contains enzymes that act as natural antioxidants. However, if free radicals enter the body in excess, additional antioxidants are needed. Antioxidants can be obtained naturally and synthetically (Pratama et al., 2022).

Various animal studies have shown that antioxidants delay or protect cells from oxidative damage caused by free radical reactions. Phenolic compounds have the tendency and ability to react with ROS (Reactive Oxygen Species), which can provide an antioxidant effect and eliminate the radicals, rendering them harmless to human cells (Gultom et al., 2021). Phenolic compounds are the largest group of compounds that act as natural antioxidants in plants. The hydrogen atoms in the hydroxyl groups of phenolic compounds can be donated to free radicals, thereby stabilizing the reactive free radicals. This ability gives phenolic compounds their potential as powerful antioxidant sources (Dhurhania & Novianto, 2018). This study aimed to determine the total phenolic compound

content in ginger juice extract using UV-Vis spectrophotometry and to determine the extract's phytochemical profile.

METHOD

Equipment and materials:

Shimadzu UV-Vis spectrophotometer, water bath, juicer extractor, volumetric flask, volumetric pipette, ginger, 50% gallic acid, ethanol, 50% Folin-Ciocalteau solution, 1% FeCl3, HCl, p.a. methanol, concentrated H2SO4, Mayer's reagent, Dragendorff's reagent, Wagner's reagent, ammonia, 10% AlCl3, acetic anhydride, and distilled water.

Research procedure:

Ginger extract was prepared using the squeezing method. 100 grams of fresh ginger was cleaned of impurities, washed under running water, and then dried. The ginger was placed in a juicer extractor to obtain ginger juice. The resulting ginger juice was used for spectrophotometric analysis of total phenolic content and phytochemical testing of the ginger extract. The next step was determining the operating time, measuring the maximum wavelength, and measuring the standard curve for gallic acid using the Folin-Ciocalteau reagent. Total phenolic content in ginger extract was determined by weighing 1 gram of ginger extract, transferring it to a 50 ml volumetric flask, dissolving it in distilled water to the mark, and homogenizing it. 1 ml of the solution was pipetted, added with 2 ml of 2% folin and 5 ml of sodium carbonate, allowed to stand for 38 minutes, and after 38 minutes, 10 ml was added with distilled water. Absorbance was then measured using UV-Vis spectrophotometry at a wavelength of 448 nm. This was replicated five times. Total phenolic content in the samples was calculated using a linear regression equation and expressed as gallic acid equivalents (GAE) per 100 grams of dry matter.

Phytochemical content was determined using qualitative tests, including alkaloids, flavonoids, phenolics, tannins, quinones, saponins, steroids, and triterpenoids.

Alkaloids

A 4 mg sample was weighed and dissolved in 3 mL of methanol and 5 mL of ammonia at a pH of approximately 8–9. The mixture was then filtered. Next, 2 mL of 2M HCl solution was added to the filtrate and shaken. The resulting sample was placed in four test tubes, each containing 5 drops. Tube 1 contained the blank solution, while tubes 2, 3, and 4 were mixed with 1 drop of Mayer, Wagner, and Dragendorff reagent. A positive result in this test is indicated by the formation of a white, brown, or orange precipitate in each solution (Oktavia & Sutoyo, 2021).

Flavonoids

1 mg of the solid ethanol extract was placed on a drip plate, then 10 drops of methanol were added, and stirred with a spatula until dissolved. Next, 6 pieces of Mg ribbon and 4 drops of concentrated HCl were added to the mixture. The appearance of a yellow, blue, orange, or red color indicates a positive result (Oktavia & Sutoyo, 2021).

Phenolics

1 mg of the solid sample is placed in a drip plate, then 10 drops of methanol are added, and stirred with a spatula until dissolved. Next, 6 drops of a 5% FeCl3 solution are added. A blue, green, purple, or reddish color indicates a positive result (Oktavia & Sutoyo, 2021).

Saponins

The extract is dissolved in hot distilled water, heated for approximately 5 minutes, and then filtered. The filtrate is then placed in a test tube and shaken. A positive saponin test is indicated by the formation of foam (Saadah & Tuland, 2020).

Tannins

1 mg of the solid sample is dissolved in ethanol, then the extract is boiled with water in a water bath, and then filtered. A 10% iron(III) chloride solution is added to 1 mL of the filtrate. A sample is considered positive for tannin if a dark blue or greenish-black color forms (Saadah & Tuland, 2020).

Steroids and Triterpenoids (Liebermann-Burchard Test)

A 1 mg solid ethanol sample is placed on a drip plate, 6 drops of anhydrous acetic acid are added, and then stirred with a spatula until dissolved. Next, one drop of concentrated H2SO4 is added. A purple to orange color indicates the presence of triterpenoids, while a blue or green color indicates the presence of steroids (Oktavia & Sutoyo, 2021).

RESULT

Table 1.
Absorbance of Standard Solutions of Various Concentrations at a Wavelength of 448 nm

Concentrations (ppm)	Corection (ppm)	Absorbance
30	30,24	0,208
40	40,32	0,280
50	50,4	0,409
60	60,48	0,435
80	80,64	0,492

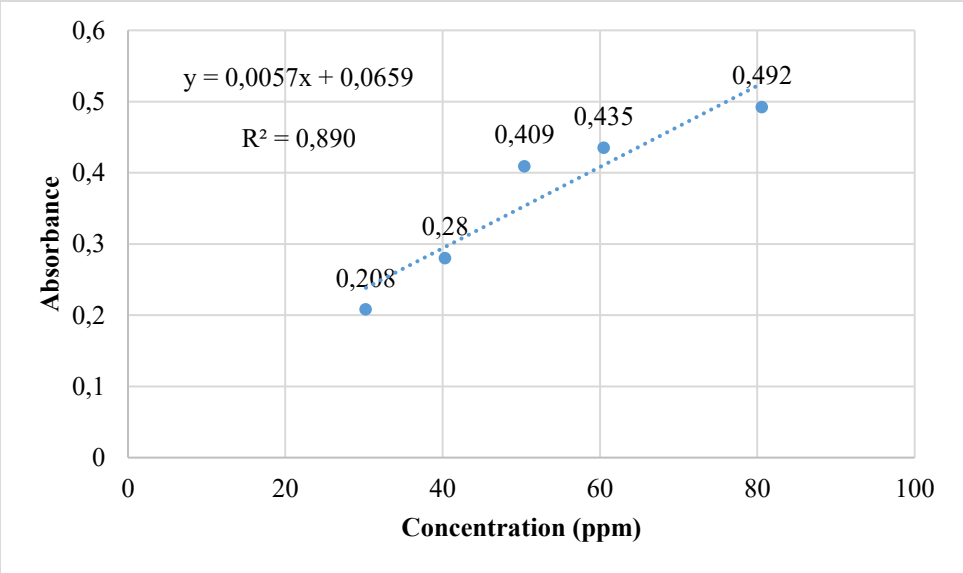

Figure 1. Gallic Acid Standard Curve

Table 2.
Results of Ginger Extract Measurement Using UV-Vis Spectrophotometry

Replication	Weigh	Absorbance	Mg GAE/g	Average
1	1,1772 g	0,842	1,7977	
2	1,2247 g	0,612	1,9421	
3	1,2571 g	0,427	1,3757	1,7162
4	1,2156 g	0,595	1,9076	
5	1,1822 g	0,459	1,5579	

Table 3.
Results of Phytochemical Content of Ginger Extract

No	Analysis	Result
1	Alkaloids	Positif
2	Flavonoids	Positif
3	Phenolics	Positif
4	Saponins	Positif
5	Tanins	Negatif
6	Steroids andTriterpenoids	Positif

DISCUSSION

Determination of total phenolic compounds in ginger (Zingiber officinale Roxb) extract was performed using UV-Vis spectrophotometry. This method was chosen because it can be used to analyze small amounts of substances and has relatively high analytical sensitivity. The Folin-Ciocalteu reaction was used to test the total phenolic compound content. The Folin-Ciocalteu reaction is based on the oxidation of phenolic hydroxyl groups. Phenolates (alkali salts) are oxidized by the reagent, and heteropoly acids are reduced in the molybdenum-tungsten (Mo-W) complex. Phenolic compounds only react in alkaline conditions, and the addition of sodium carbonate causes the protons in the phenolic compounds to dissociate into ions. The reaction between the phenol-hydroxyl groups and the Folin-Ciocalteu reaction produces phosphotungstate-phosphomolybdate, a blue color. The more intense the blue color, the greater the phenolate ion formation and the higher the phenolic content. High phenolic ions cause more heteropoly acids to be reduced, resulting in a more intense blue color (Pratama et al., 2022).

Qualitative phenolic testing first involves determining the maximum wavelength. This maximum wavelength provides the greatest absorbance, which is then used to determine the calibration curve and determine the phenolic content in the sample. The maximum absorption wavelength of phenolic was determined using a standard gallic acid solution at a concentration of 60 ppm and measured at a wavelength of 400-600 nm. The measurement results obtained a maximum wavelength of 448 nm with an absorbance value of 0.403. The purpose of measuring the standard curve is to determine the relationship between the solution concentration and its absorbance value, thus determining the sample concentration. After obtaining the absorbance measurement results of the phenolic standard solution, a standard curve was constructed that relates absorbance to concentration. The resulting line equation is y = (0.0057) x + (0.0659) with a correlation coefficient (y2) of 0.8909. From this line equation, y represents absorbance and x represents concentration.

Sample measurements were performed by weighing 1 gram of ginger extract, transferring it to a 50 ml volumetric flask, dissolving it with distilled water to the mark, and homogenizing it. 1 ml of the solution was pipetted, added to 2 ml of 2% folin and 5 ml of sodium carbonate, allowed to stand for 38 minutes, and after 38 minutes, 10 ml was added with distilled water. Five replicates were performed. The absorbance obtained from the fresh ginger extract measured within the absorbance range of 0.2–0.8. After obtaining the sample absorbance, the total phenolic content was calculated. The total phenolic content of the ginger extract sample was 1.716200 mg GAE/g.

The results of the phytochemical analysis of the ginger extract showed that it contains alkaloids, flavonoids, phenolics, saponins, steroids, and triterpenoids. A study found that ginger contains alkaloids that function as analgesics, cough suppressants, and migraine treatments. Furthermore, ginger flavonoids have analgesic, antitumor, antioxidant, anti-inflammatory, antibiotic, anti-allergic, and diuretic properties. Furthermore, ginger saponins have anticoagulant, anticarcinogenic, hypoglycemic, antioxidant, and anti-inflammatory properties. Ginger contains triterpenoids, which function as antioxidants and help treat diabetes and accelerate wound healing. Furthermore, ginger's active phenolic

compounds, such as shogaols and gingerols, function as antioxidants and help maintain heart health, promote weight loss, prevent colon cancer, and boost the immune system (Ahnafani et al., 2024).

CONCLUSION

The total phenolic content of ginger rhizome extract is 1.716200 mg GAE/g. Phytochemical studies of ginger extract revealed alkaloids, flavonoids, phenolics, saponins, steroids, and triterpenoids.

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