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(RESEARCH ARTICLE)

Phenolic compound and antioxidant activity of Indonesian ginger leaves (*Zingiber officinale* Roscoe var Roscoe)

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Abstract

Ageing causes an increase imbalance oxidant and antioxidant that induce degenerative diseases. Fruit, vegetable and other plant are known have chemical compound as antioxidant such as phenolic. That's why study of phenolic compound and antioxidant activity in plant is very important. Information of phenolic compound and antioxidant activity of ginger (*Zingiber officinale* Roscoe var Roscoe) in rhizomes numerous but less information in leaves. The aim of these research to determine antioxidant activity and phenolic content of leaves and rhizome Indonesian *Zingiber officinale* Roscoe var Roscoe. This research was conducted with descriptive quantitative research using dried ginger in decoction and infusion extraction method. Phenolic compound was determination with Folin-Ciocalteu method and DPPH method was used for antioxidant activity by using UV-VIS Spectrophotometer. Based on Mann Whitney U test showed that phenolic compound in infusion leaves lower (4.47±0.47 mg GAE/g) than rhizomes (12.3±0.26 mg GAE/g) at α 0.05 and antioxidant activity in infusion of rhizomes (50.21 ± 0.56 %) higher than in leaves (33.97±2.79 %). Based on independent t-test total phenolic compound in decoction of rhizomes were higher (23.89±0.66 mg GAE/g) than in leaves (18.23±0.57 mg GAE/g) and antioxidant activity in rhizomes (65.93±0.92 %) higher than in leaves (56.22±5.56 %). The conclusion of these research is total phenolic compound and antioxidant activity on leaves lower than in rhizomes, but still more than 50% in infusion and decoction extraction method.

Key words: Phenolic Compound; Antioxidant Activity; Ageing; Degenerative Disease

1. Introduction

Ginger (*Zingiber officinale*), especially *Zingiber officinale* Roscoe have been used for a long time as a medicine, herbal and an important cooking spice throughout the world [1]. Based on American Food and Drug (FDA) ginger be recognized safety and no side effects if in moderate consumption [2]. Drink and spices from ginger are more popular in Indonesia beside as a traditional medicine and in most case use the rhizomes. Rhizomes of *Zingiber officinale* Roscoe has been known to be effective for several diseases including sore throat, muscular pain, cough, arteriosclerosis, hyperlipidemia, cardiovascular complication, etc [3, 4]. Lately research showed that leaves and flowers of some ginger species possess chemical compound as an antioxidant and have an impact on health (medicinal potential), event tough less information about total phenolic content and antioxidant activity on leaves and flower, therefore research about antioxidant activity and phenolic content in leaves of ginger is still an important thing [2].

Ginger has a lot of chemical compounds, among others phenolic compound and terpenes, gingerol, shogaols and paradols are the mayor active constituents in phenolic compound of ginger [5]. Terpene is belonged to the group of

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Ginger has a lot of chemical compounds, among others phenolic compound and terpenes, gingerol, shogaols and paradols are the mayor active constituents in phenolic compound of ginger [5]. Terpene is belonged to the group of

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essential oil of *Zingiber officinale* and particularly consisting of monoterpene, sesquiterpene hydrocarbon. A zingiberene, geranial, ar-curcumene, β -bisabolene, β -sesquiphellandrene and neral are most abundant compound in essential oil of ginger (Figure.1) [4].

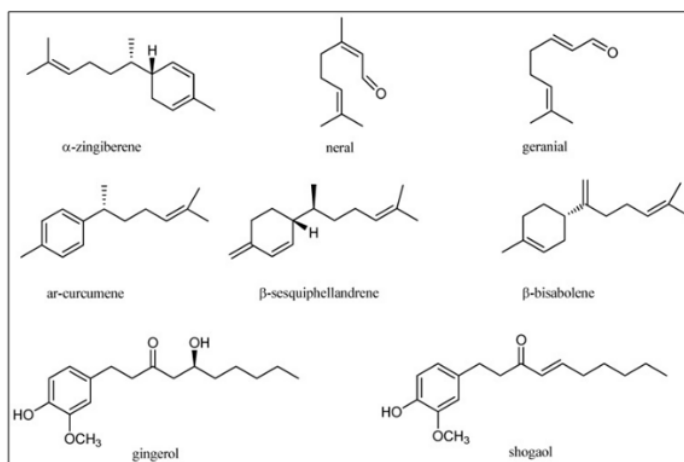


Figure 1 Chemical structure of the most components of *Zingiber officinale Roscoe* [4].

People in the world have been used medicinal plant since a long time ago with take part of the plant among others root, rhizomes, fruits, or seed to treat various diseases. *Zingiber officinale Roscoe* is one that widely used as a remedy for controlling diseases like diabetes, gastrointestinal, cardiovascular, cancer [6]. Ginger is utilized for gastrointestinal problem in western medicine, in Ayurveda system ginger and milk or water for infant colic. Generally, the medicinal part of ginger is rhizomes [7, 8]. Bekkouch and co-workers stated that hot infusion of ginger rhizome from *Zingiber officinale Roscoe var Roscoe* decrease the TNF- α expression in lipid tissue. *Zingiber officinale Roscoe var Roscoe* contribute to treat cardiovascular and hyperlipidemia [3]. Ginger with high hydrostatic presser extract method decrease obesity and inflammation [9]. Park and colleagues stated that steamed ginger ethanolic extract is a potent as an anti-obesity agent in clinical trial. Rhizomes of ginger has been extensively research but information about another part of plant such as leaves is still less information, therefore research on this matter still need to be done [10].

Antioxidant from plant protect the body from free radical and ROS (reactive oxygen species) that formed in the body through normal metabolism such as respiration and immune function. ROS involve hydroxyl radicals ($\text{OH}\cdot$), superoxide anion radical ($\text{O}_2\cdot^-$), hydrogen peroxide (H_2O_2), Nitrogen oxide, superoxide anion ($\text{O}_2\cdot^-$) that can diffuse the cell membranes and influence oxidative metabolism and over production of ROS can causes oxidative damage to many molecules in the body like DNA, protein, lipid [11]. The aim of the present study is to determine the antioxidant activity and total phenolic compound from Indonesian ginger leaves and rhizomes extract of *Zingiber officinale Roscoe Var Roscoe* by using decoction and infusion extraction method.

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2. Material and Methods

2.1. Plant Materials

Leaves and rhizomes of ginger (*Zingiber officinale Roscoe var Roscoe*) were obtained from Malang region, with approximate age of 6 months. The obtained leaves of gingers were then washed, thinly sliced, and then put in the blender for grinder, then were added by as much as 250 mL water, then put in boiling water for 10 minutes (decoction) and added boiling water for 10 minutes (infusion) [12]. The same procedure was also done for the rhizomes of the ginger.

2.2. Reagent and Chemicals

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Folin-Ciocalteu phenol reagent, Na_2CO_3 , gallic acid from Sigma Aldrich, DPPH (1,1-diphenyl, 2 picrylhydrazyl) from Sigma Aldrich were all prepared in analytical grades.

2.3. Determination of Total Phenolic Compound

Total phenolic content determination based on modified method [12]. The steps were 1 mL sample (1 mg/mL) was added into 1 mL Folin–Ciocalteu phenol reagent, and then incubated for 5 minutes. It was then added with 10 mL of Na₂CO₃ 7 %, then with 13 mL of distilled water, shaken and incubated in dark environment with the temperature of 23 °C. The samples were measured by UV-VIS Spectrophotometer at the wavelength of 750 nm. The total of phenolic content was then determined by comparing with a standard curve of gallic acid where the total of phenolic acid was indicated by the value of mg GAE/g of dry sample.

2.4. Antioxidant Activity Determination

Antioxidant activity determination was also conducted based on a modified method based on the previous research [12]. Liquid solution of 24 mg DPPH in 100 mL of methanol and stored at a temperature of 20 °C. DPPH can be used by dissolving DPPH in methanol. The samples were measured wavelength at 517 nm with UV-VIS spectrophotometer. 3 mL DPPH was then added to 100 µL of sample (concentration might vary from 10-500 µg/ mL). Mixed until homogeny and incubated in the dark room for more or less 15 minutes in room temperature. The absorbance was read by the spectrophotometer.

3. Results

Table 1 Data of phenolic compound of leaves and rhizomes of ginger

Extraction methods	Extract sources	Phenolic content (mg GAE/g)
Infusion	leaves	4.37 ± 0.20
	rhizomes	12.13 ± 0.47
Decoction	leaves	18.57 ± 0.60
	rhizomes	23.89 ± 0.66

^a all analytes were analyzed at three replicates measurement (all analysis are the means of triplicate measurement ± standard deviation a: expressed as mg Gallic acid (GAE)/ g of dry plant material).

Table 2 Data of antioxidant activity of leaves and rhizomes of ginger

Extraction methods	Extract sources	Inhibition (%)
Infusion ^a	leaves	33.97 ± 2.79
	rhizomes	50.05 ± 0.56
Decoction ^a	leaves	55.22 ± 5.56
	rhizomes	66.37 ± 0.92

^a all analytes were analyzed at three replicates measurement

4. Discussion

A plant is made up of many thousands of chemical compounds as a bioactive and isolation of such compound takes long time [13]. The extraction and isolation process bioactive compound need to be developed but maceration, infusion and decoction that are often use for traditional medicine, because it's easy to do [14]. Total phenolic content (TPC) and antioxidant activity (AOA) of leaves ginger in this study were obtained from decoction and infusion extraction method. Base on Mann Whitney U test and independent t-test showed that total phenolic content (data at Table 1.) and antioxidant activity (data at Table 2.) in rhizomes higher than in leaves in infusion and in decoction extraction method. The different metabolite levels in parts of the plant indicated the overall nutritional properties and the distribution of the phytochemicals a cross different organ of plants of the same species.it is therefore necessary to comparatively metabolite profile of the different part of plant of the same species [15].

Result in this research different from previous research by Ghasemzadeh showed young gingers showed leaves have higher total phenolic content and antioxidant activity than rhizomes [6]. Furthermore, based on study in *Zingiber*

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zerumbet was showed that the older the plant age the rhizomes had higher Total phenolic content and antioxidant activity compare to leaves and vice versa at the age 3, 6, and 9 months. This research used Zingiber officinale Roscoe var Roscoe at 6-month stage of growth and the research result was showed rhizomes have higher total phenolic compound and antioxidant activity than leaves, this means that the same as previous research [16].

Although antioxidant in leaves were lower than rhizomes but, in this research, and the previous research still rich than 50% and therefore ginger leaves can be an alternative for uses in the field of medicine. Nano emulsion of from leaves volatile oil effective on *Streptococcus* mutant. Ginger leaves also used as an anti-salmonella, *Staphylococcus aureus*, and *E.coli* [17].

5. Conclusion

Phenolic compound and antioxidant activity leaves of *Zingiber officinale Roscoe var Roscoe* is lower than rhizomes, but both leaves and rhizomes have antioxidant activity more than 50 % in decoction extraction method.

5 Compliance with ethical standards

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Disclosure of conflict of interest

We have no conflict of interest between the authors.

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