

Review Article

Phytochemical and Traditional Uses of Red Ginger: A Review (*Zingiber officinale* var. *rubrum*)

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Abstract: Red ginger (*Zingiber officinale* var. *rubrum*) is one of the herbal plants that have been widely known by Indonesian for generations. This plant is easy to obtain and has various health benefits. Therefore, it is necessary to obtain information about the phytochemicals and their traditional uses. The search for information was carried out by studying literature from various sources such as official books, Google Scholar and Garba Digital References (GARUDA) in the 2011-2021 range. The results showed that red ginger plants contain chemical compounds in the form of gingerols, shogaols, homovanilyl alcohol, alkaloids, flavonoids, saponins, tannins, phenolics, steroids, triterpenoids, and essential oils. Red ginger is commonly used by the community as a cold medicine, as well as for indigestion, urine laxative, natural antioxidant, as an analgesic, and others. With the content of these compounds, red ginger is also reported to have antibacterial, anti-inflammatory and antiemetic activity.

Keywords: Red ginger, *Zingiber officinale* var. *rubrum*, phytochemical review, traditional uses.

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INTRODUCTION

Red ginger is a type of rhizome that is widely used as traditional medicine in Indonesia. Red ginger has a bitter and spicy taste that is higher than other types of ginger. Besides being used as a cooking ingredient, empirically red ginger is also used as a component of various medicinal herbs [1]. The efficacy of red ginger has been widely studied including its effectiveness as antibacterial, anti-inflammatory and antiemetic [2]. Red ginger has been known for generations as a traditional medicine that is able to overcome various diseases, such as colds, rheumatism, cough with phlegm and migraine as well as used to neutralize flatulence, warm the body, improve digestion, and maintain stamina [3].

Red ginger can be classified as follows:

Kingdom : Plantae
Sub kingdom : Tracheobionta

Super Division : Spermatophyta
Division : Magnoliophyta
Class : Liliopsida
Subclass : Commelinidae
Order : Zingiberales
Family : Zingiberaceae
Genus : Zingiber
Species : *Zingiber officinale* var. *rubrum*

Red ginger/*sunti* ginger (*Zingiber officinale* var. *rubrum*) has a rhizome with a weight between 0.5-0.7 kg/clump. The structure of the red ginger rhizome is small in layers and the rhizome is red orange to red, the size is smaller than other gingers. The diameter of the rhizome can reach 4 cm and the height is between 5.26-10.40 cm. The length of the rhizome can reach 12.50 cm [4].



Fig-1: Red ginger (*Zingiber officinale* var. *rubrum*) [5].

Part used: fresh rhizome

Prohibition: pregnancy and children under 2 years

Warning: taken during pregnancy, can abort the womb, large doses >6 can cause gastric ulcers.

Side effects: increase stomach acid

and international journals in the last ten years (2011-2021). Data search in this review article was conducted by using official books, Google Scholar and Garba digital references with keywords as follows: red ginger, *Zingiber officinale* var. *rubrum*, phytochemical reviews, and traditional uses.

DATA COLLECTION METHODS

In preparing this review article, the reserchers used library research techniques by looking for theoretical references that are relevant to the cases or problems found. Articles were collected from national

Phytochemical review

The content of the red ginger plant is summarized in Table 1.

Table-1: Phytochemical content of the red ginger plant (*Zingiber officinale* var. *rubrum*)

No.	Plant Part	Extraction Method	Solvent	Compounds contained	Reference
1	Rhizome	Room temperature percolation	Ethanol	Gingerol and shogaol	[6]
2	Rhizome	Maceration	Methanol	Zingiberene, beta-sesquiphellandrene, alpha-curcumene and trans-beta farnesene	[7]
3	Rhizome	Maceration	Methanol	Alkaloids, flavonoids, phenols, triterpenoids	[8]
		Fractionation	N-hexane	Alkaloids, flavonoids, phenols, terpenoids and steroids	
		Fractionation	Ethyl acetate	Alkaloids, flavonoids, phenols, terpenoids, 3,5-octadiene, zingerone, pentane, 1,6,10-dodecatrien-3-ol and benzeneacetic acid	
4	Rhizome	Maceration	Methanol	Flavonoids, tannins, saponins, alkaloids and terpenoids	[9]
5	Leaf	Graded maceration	N-hexane	Alkaloids, terpenoids	[10]
			Chlorophorum	Alkaloids, steroids, tannins	
			Ethyl acetate	Alkaloids, steroids, flavonoids, tannins,	
			Methanol	Alkaloids, flavonoids terpenoids, tannins	
6	Rhizome	Water distillation	water	Z-citral, citral, 1,8-cineole (Eucalyptol), Camphene Geranly acetace, linallol, alpha-pinene, 5-heptan-2one,6-methylar-curcumane, alpha-terpineol, L-zingiberene,myrcene, beta-sesquiphellandrena, bornyl acetate, limonene oxide, 3-cyclohexene-1carboxaldehyde, 1,3,4trimethyl, beta-bisabolance, 2-nonanone, (-)-caryopphyllene oxide, 2-undecanone (cas) 2-hendecanone	[11]

Gingerol isolation in red ginger rhizome has been carried out optimally and the content has been identified. The research method used includes the red ginger extraction process using the room temperature percolation extraction technique with ethanol solvent, followed by the isolation of gingerol with the addition of KOH solution at a concentration of 0.1 N; 0.5 N; 1.0 N. Based on the results of research and identification that has been carried out on the red ginger sample, it can be concluded that the water content of the red ginger sample studied was 9.70%, with an oleoresin content of 8.72%. The largest crude weight of gingerols was obtained at a concentration of KOH 1.0 N, which was 0.61g, while the concentration of KOH which produced the largest % abundance of gingerols was at a concentration of 0.5 N, which was 6.13% [6].

The identification of red ginger rhizome content has been carried out using the GC-MS method. The rhizomes were macerated with 96% ethanol solvent, then evaporated using a rotary at 55°C and then continued with GC-MS analysis. The injector temperature used was 80°C and the detector temperature was 250°C, while the column temperature used was the programmed temperature, starting at 80°C for 5 minutes and then slowly changing it with a temperature increase of 5°C / minute until the temperature reached 250°C (constant) within 45 minutes. Red ginger ethanol extract is known to contain the highest chemical compounds in the third peak, namely zingiberene (45.99%), followed by farnesene (22.60%), beta-sesquiphellandrene (19.61%), alpha-curcumene (10.91%) and the lowest was trans-beta farnesene (0.89%). The most abundant compound is zingiberene which is a compound that produces the distinctive aroma of ginger which is very strong [7].

The content of secondary metabolites in extracts and fractions of red ginger (*Zingiber officinale* var *amarum*.) has been analyzed by phytochemical screening. Red ginger rhizome was macerated with methanol and then fractionated with n-hexane and ethyl acetate. Extracts and positive fractions containing alkaloids were tested with Dragendorff's reagent. Tests of flavonoid compounds with mg band and concentrated HCl also showed positive results for all fractions and extracts. In addition, phenolic compounds and saponins were also found in all samples. However, steroid/triterpenoid compounds were only confirmed to be present in the n-hexane fraction by testing with Lieberman-Burchard reagent. Antioxidant activity was measured by the DPPH method and the IC₅₀ values were 32.19 ppm for the total extract, 35.63 ppm and 25.69 ppm for the n-hexane and ethyl acetate fractions, respectively. In the ethyl acetate fraction which has the highest antioxidant activity, further analysis was carried out to determine the compound content using GC-MS. The identification results yielded 27 peaks of compounds and 5 dominant compounds, namely 3,5-

octadiene, zingerone, pentane, 1,6,10-dodecatrien-3-ol and benzeneacetic acid [8].

Phytochemical analysis and testing of antioxidant activity of red ginger rhizome have been carried out using the DPPH method. Ginger rhizome was macerated for 72 hours with methanol and obtained an extract with a yield of 8.05%. Phytochemical screening was carried out to identify the presence of tannins, flavonoids, saponins, alkaloids and terpenoids. The screening results showed that the extract contained all the compounds tested. The antioxidant activity test showed that the red ginger rhizome extract was classified as having very strong free radical scavenging activity with an IC₅₀ 10.35 g/mL [9].

The antibacterial activity of red ginger leaf extract was tested against *Staphylococcus epidermidis* and *Escherichia coli* bacteria. Extraction was carried out by graded maceration with n-hexane, ethyl acetate, chloroform and methanol as solvents. The results of phytochemical screening found the presence of alkaloid compounds in all extracts. Confirmed tannin compounds were present in all extracts except n-hexane. Terpenoid compounds were only found in n-hexane and methanol extracts, while steroids were only found in chloroform and ethyl acetate extracts. Only ethyl acetate and methanol extracts were confirmed to contain flavonoid compounds and none of the extracts contained saponins. All extracts are known to have potential as antibacterials through testing by the diffusion method. Of the four extracts, the greatest inhibition against *Staphylococcus epidermidis* was at a concentration of 20% red ginger leaf chloroform extract of 18.90 mm. Meanwhile, the inhibitory power against *E. coli* was 17.84 mm at a concentration of 20% n-hexane extract [10].

GC-MS analysis was conducted to determine the chemical composition of red ginger essential oil. Red ginger rhizome oil was obtained through the process of distillation of water using a Stahl apparatus. The distillate was then separated using anhydrous Na₂SO₄ to obtain pure essential oil. GC-MS analysis was performed with a SHIMADZU GCMS-QP2010S, Rxi 5MS column with a length of 30 m and a diameter of 0.25 mm. Column conditions were set in column oven temperature of 50°C, initial time of 5 minutes, 5°C/minute rate of temperature and final temperature of 240°C. The active compound of red ginger essential oil was identified based on the spectral ratio of Wiley 229.Lib. The main chemical composition of red ginger essential oil is Z-citral (23.32%), citral (18.87%), 1, 8-cineole (12.18%), camphene (11.87%), geranyl acetpinene. (2.6%), 5-hepten-2-one, 6-methyl- (2.32%), and ar-terpineol (2.05%) [11].

TRADITIONAL USES

The traditional uses of red ginger plants are summarized in table 2.

Table-2: Uses of red ginger plants traditionally

No	Plant Parts	Making potions	Traditional Uses	References
1	Rhizome	A mixture of red ginger rhizome and white turmeric (<i>Curcuma zedoaria</i> Rosc.) is boiled in 250 ml of water. Drink for 5 days	Urinary laxative	[12]
2	Rhizome	Red ginger rhizome is washed and crushed, boiled with water until it releases steam then strained in a cold state. The concoction can be drunk 1 time a day as much as 1 and a half cups	Increase endurance	[13]
3	Rhizome	Red ginger rhizome is cleaned and blended, the results are filtered and boiled until boiling together with cloves, cinnamon, Javanese chili, cardamom then sugar is added, and keep stirring until it becomes thick and finally becomes powder (after being blended again and filtered)	Warm the body, relieve coughs, overcome colds, increase appetite, prevent blood clots and treat rheumatism	[14]
4	Rhizome	The herb is made by smoothing red ginger rhizomes then adding enough water, boiled until boiling, filtered. Honey or sugar can be added	Gout, fever, stomach pain, cough, thrush, whooping cough, bleeding gums, high blood pressure, paralysis, acne and phlegm	[15]
5	Rhizome	Red ginger compress	Reduce osteoarthritis pain in the elderly	[16]
6	Rhizome	Warm compress with red ginger	Decrease the intensity of arthritis pain	[17]
7	Rhizome	Warm compress using grated red ginger.	Reduction of pain in patients with goutarthritis	[18]
8	Rhizome	Warm water compress with boiled ginger: prepare a small container or towel, wash 5 rhizomes and thinly sliced into 1 liter of water. Boil the sliced ginger until it boils, pour it into a container, take a towel moistened with boiled ginger water, then squeeze a little, and put it on the sore part.	Promote blood circulation	[19]
9	Rhizome	Red ginger rhizome is peeled and washed with running water. Red ginger is sliced and then boiled with 400 ml of water until it boils, cooled and then drunk.	Reduce menstrual pain	[20]
10	Rhizome	Squeezed red ginger	Inhibits the growth of bacteria that cause dental plaque (<i>Aggregatibacter actinomycetemcomitans</i>)	[21]

Diureticum is a compound that can stimulate urine output. Gingerol, curcumin and flavonoid compounds found in red ginger-white turmeric are known to have activity diuretic. The synergistic properties of the two compounds are known to increase the rate of blood filtration in the glomerulus which affects the formation of urine. The test was carried out using a quasi-experimental method with a pre-test post-test design. The test was carried out by giving 250 mL of boiled red ginger-white turmeric per day for 5 days. Data analysis showed that administration of boiled red ginger-white turmeric proved to be efficacious as a urine laxative, which was characterized by increased urine output intensity, urine pH and urine NaCl levels, as well as urine color that was getting lighter and clearer [12].

Red ginger is reported to be efficacious to increase endurance. The concoction is made from a

mixture of red ginger, lime, and cinnamon. All ingredients are washed and crushed, boiled with water until it releases steam, then filtered in a cold state, and can be added with brown sugar. The herb can be taken 1 time a day as much as 1 and half cups [13].

Red ginger-based ingredients have many benefits including warming the body, relieving coughs, overcoming colds, increasing appetite, preventing blood clots and lowering cholesterol, as a natural antibiotic and antioxidant. This concoction can be made by cleaning the red ginger rhizomes and blending; the results are filtered and boiled until boiling together with cloves, cinnamon, Javanese chili, cardamom. Sugar can be added as a sweetener. The ingredients are continuously stirred until thick and finally become powder (after being blended again and filtered) [14].

This herb from the Province of East Kalimantan, Indonesia, is empirically used to treat gout, fever, stomach pain, cough, canker sores, whooping cough, bleeding gums, high blood pressure, paralysis, acne, and tinea versicolor. The concoction is made from a mixture of red ginger, curcuma, aromatic ginger and water. All the ingredients are grated and added enough water, then boiled and filtered after boiling. The ingredients can also be added with sugar or honey and taken 2 times a day 1 cup while warm [15].

Red ginger is known to be very suitable for making herbs and is more widely used as medicine because of its compound content. Its contents of essential oils, high oleoresins and gingerol are thought to be able to block the production of prostaglandins so as to reduce pain. The effect of giving red ginger compresses on reducing osteoarthritis pain in the elderly has been studied by pre-experiment with one group pre-test and post-test design with control group. Analysis of the data using the Paired-Sample T test showed that there was an effect of giving red ginger compresses to reducing osteoarthritis pain in the elderly with an average reduction in pain scale of 3.16. The results of the Mann-Whitney test showed that the average reduction in pain scale in the intervention group was 2.26 and the control group was 1.16, meaning that there was a difference between giving red ginger compresses to reducing osteoarthritis pain in the elderly [16].

Arthritis pain is a common musculoskeletal disease in the elderly. Disorders of the musculoskeletal system are characterized by the appearance of joint pain and stiffness resulting in a decrease in the physiological abilities or quality of life of the elderly. In this study, the effectiveness of warm red ginger compresses and warm lemongrass compresses were analyzed on reducing the intensity of rheumatoid arthritis pain in the elderly. This research design used a quasi-experimental research design with two group's pre-posttest design. Group 1 was treated with warm ginger compresses, while group 2 was treated with warm lemongrass compresses for seven whole days. The results of the Wilcoxon Signed Ranks Test, and the Mann Withney U Test showed that there were differences in the effectiveness of red ginger compresses and lemongrass compresses on reducing rheumatoid arthritis pain in the elderly. The average reduction in pain in red ginger and lemongrass warm compresses was 19.50 and 11.50, respectively [17].

Gout arthritis is a metabolic disease characterized by severe pain, redness, and tenderness in the joints. This study was conducted to determine the effect of giving warm compresses using grated ginger on changes in pain scale in patients with gout arthritis. This study used a pre-experimental design with one group pretest posttest. The results of pain measurements in respondents who amounted to 30 people the average

value of patients before and after warm compresses decreased from 3.73 to 2.50. The results of the analysis using the Wilcoxon Signed Ranks Test showed that there was a significant effect of giving warm compresses using grated red ginger to reduce pain scale in patients with gout arthritis [18].

Joint disease is one of the public health problems in Indonesia with the main complaints of joint pain and stiffness. In this study, an analysis of the effect of warm red ginger boiled water compresses on complaints of joint disease was carried out. The research design was a pre-experimental one-group pre-posttest design. The research instrument was an observation sheet: joint pain (intensity, duration, and quality), range of motion, family caregiver performance. The analysis test using the Wilcoxon test showed that there were significant differences in the intensity, duration and quality of joint pain, range of joint motion before and after giving a warm compress of red ginger boiled water by the caregiver and improving the sleep quality of 23 patients (76.67%). A warm compress of red ginger boiled water by family members has an effect on reducing or eliminating the patient's joint disease complaints [19].

Menstrual pain is a natural thing experienced by women while menstruating, but menstrual pain has normal limits. If the menstrual pain is felt excessive then it must be overcome. The effectiveness of red ginger boiled water on the intensity of menstrual pain was tested on 73 respondents by giving ginger boiled water once a day during menstruation. Statistical tests with the Wilcoxon test showed that giving red ginger boiled water 7,047 times could help reduce pain during menstruation. The content of red ginger has proven to be very useful as a non-pharmacological therapy for menstrual pain or dysmenorrhea [20].

Aggregatibacter actinomycetemcomitans is a pathogenic bacterium in plaque that causes periodontal disease, one of which aggressive periodontitis. Red ginger juice can inhibit bacterial growth because it contains essential oils, oleoresin, flavonoids, polyphenols and saponins which have antibacterial activity. In this study, a comparative test was carried out on the condition of the bacteria after administration of red ginger juice. From the results of statistical tests, it was concluded that the inhibitory power of red ginger juice against *Aggregatibacter actinomycetemcomitans* increased with increasing concentration [21].

CONCLUSION

Red ginger is rich in compounds that are beneficial in medicine. Red ginger plants are reported to contain compounds of alkaloids, flavonoids, saponins, tannins, phenolics, steroids, triterpenoids, essential oils, gingerols, shogaol and homovanilyl alcohol. Several studies have found that red ginger has the potential to increase endurance, to be used as urine laxative, have

an analgesic, anti-inflammatory, and anti-bacterial characteristics, as well as being useful in other traditional medicine.

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