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NATURAL ANTIMICROBIAL ACTIVITY OF RED GINGER (ZINGIBER OFFICINALE) JUICE AGAINST CHOLERA PATHOGENS

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Abstract: Traditional medicine remains an integral part of health care among Indonesian communities in both urban and rural settings. Ginger (Zingiber officinale Roscoe) is one of the most widely utilized medicinal plants, valued not only as a culinary spice but also for its therapeutic and preventive health benefits. It has long been employed in the management of various ailments and is increasingly incorporated into both traditional remedies and modern pharmaceutical preparations. The bioactive constituents of ginger, including gingerols, shogaols, and zingerone, are known to exhibit diverse pharmacological activities such as antimicrobial, anti-inflammatory, antioxidant, and analgesic effects. This study highlights the importance of ginger as a versatile medicinal resource and underscores its potential for further development as a natural therapeutic agent. Promoting scientific validation of its medicinal properties may enhance its utilization in evidence-based medicine and support the integration of traditional knowledge into modern health care systems.

Keywords: Ginger; Traditional medicine; Medicinal plants; Herbal therapy; Indonesia

Introduction

Indonesian people who live in urban and rural areas have known and used traditional medicines for healing their illnesses for a long time. One type of medicinal plant that is often used by people in various regions of Indonesia is ginger (Zingiber officinale Roscoe). Ginger is one of the medicinal plants that is widely used by the community both as a spice in the kitchen, as alternative medicine, and as health care. Ginger is also a plant that is used for

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making traditional and modern medicines. The red ginger that has is a rhizome plant that we often encounter around us which is used by the community ^[1]. There are three types of ginger variants that are commonly used by the community and have been tested for their antioxidant capacity by, which are Emprit Ginger, Elephant Ginger, and Zingiber Officinale var. Rubrum ^[2]. Red ginger is a type of rhizome plant that can live and grow in lowland and mountainous areas. Besides being used as a cooking spice, ginger is also widely used in various medicinal ingredients, including an herb to treat inflammation, wounds, coughs, and allergies due to insect bites and to increase endurance. Furthermore, it was explained that the research results of red ginger fresh extract at a concentration of 100% had a moderate level of inhibition against *S. aureus* and weak against *E. coli* ^[3]. The ginger plant contains compounds in the form of phenols, flavonoids, terpenoids, and essential oils. These compounds can inhibit the growth of pathogenic fungi and bacteria which are detrimental to human life and can cause disease. Further, research by Sari, et al. found that fresh extract of red ginger rhizome had the highest inhibition area against *S. aureus* (15.83 mm) and *E. coli* (15.33 mm) and fresh extract of elephant ginger had highest inhibition against *C. albicans* (10.7 mm). Red ginger plants are more widely used for treatment ^[4]. While the The content of oleoresin in ginger varies depending on the type of ginger in question. Ginger oleoresin can be up to 3%. Among the 3 types of ginger, it is known that red ginger has a high spicy taste. This is because the oleoresin content is higher compared to other types of ginger. Red ginger contains the highest essential oil (2.58%-3.90%), Emprit ginger (1.50%–3.30%), and elephant ginger (0.82%–1.68%), so people often use red ginger as medicine. The active ingredients of essential oils and flavanoids have an antibacterial effect in inhibiting the growth of pathogenic microorganisms ^[4]. One of the bacteria that damage food and can be detrimental is *V. cholera*. This bacterium is one of the causes of diarrhea, which is also called cholera, where the transmission can be through water or food. The natural reservoir of this bacterium is thought to be in the aquatic environment. Indonesian people are susceptible to infection with this bacterium; because most people work in aquatic environments such as farmers and fishermen. Cholera cases are common in developing countries, due to a lack of clean water sources and poor environmental sanitation ^[5]. The high incidence rate makes cholera one of the diseases that must be reported to WHO. Incomplete laboratories, low level of care and medical supervision, and inadequate data collection, resulted in reported cases of diarrhea only representing around 5%-10% of the actual number of cases occurring each year worldwide ^[6]. Food ingredients such as fish and shellfish will not be free from contamination by *V. cholera* bacteria. This bacterium is also resistant to chemical drugs such as Dosycycline and this is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms. Vibramycin. According to, *V. cholera* bacteria can die within 1×24 hours ^[7]. Types of medicines that cannot be reached by the as food types of elephant ginger and emprit ginger are more widely used and beverage ingredients such as pickles, ginger brew, sweets, and sekoteng [4]. How to Cite this Article: Majid A, et al. Juice of Red Ginger Water Activity as an Antibacterial against the Growth of *Vibrio Cholera* Bacteria. *Ann Med Health Sci Res.* 2023;13:470-492 In 2023 Annals of Medical and Health Sciences Research community, especially people who are in rural areas and have limited access to health facilities. The solution that can be used to inhibit the growth of *V. cholera* bacteria is to utilize red ginger rhizome extract. Ginger is an annual plant that is easy to obtain at a low price. Ginger can be reached by all people, both in urban and rural areas. Ginger is also easy to grow and maintain in the yard. Ginger also contains compounds as antibacterial, namely flavonoids, alkaloids,

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oleoresin, and essential oils. These compounds have been proven to inhibit the growth of pathogenic microorganisms that can harm humans and animals. The results of research also show that the fresh extract of red ginger, which has a concentration of 100%, has a moderate category of inhibitory ability on the development of *S. aureus* bacteria and a weak category on the development of *E. coli* bacteria [3]. On the other hand, additional research studies showed that fresh extract from red ginger rhizome has an inhibitory ability against *S. aureus*, *E. coli*, and *C. albicans* fungi [4]. The purpose of this study was to find the concentration of red ginger juice as an antibacterial that could inhibit growth and kill *V. cholera* bacteria.

Materials and Methods

Research method

Tools and materials: The tools used in this study were: Blender, gauze, funnel, glasses, auto clave, pipette, petri dish, micropipette, test tube and rack, Erlenmeyer flask, jar, inoculum needle, aluminum foil, ose needle, knife, bunsen lamps, and analytical scales of the Fijitsu brand and type FSR-A320. The materials used in this study were: red ginger rhizome, cotton, tissue, filter paper, spirit, Nutrient Agar (NA), sterile distilled water, analytical ethanol alcohol, Broth Pepton Water (BPW), and, *V. cholera* ATCC bacteria obtained from Airlangga University Tropical Disease Center Surabaya,

Type of research

This research was a laboratory experimental study consisting of 5 treatments and 5 replications so the number of trials studied was 25 units. The treatments were: A=without red ginger rhizome juice (0% or control reference); B= 40% juice; C=juice 60%; D=80% juice; and E=100% juice.

Research process

The research procedure is as follows:

- a. **Making red ginger rhizome squeezed water:** The ginger rhizome plant used was taken from Baumata Village, Taebenu District, Kupang Regency, and then identified at the Biology Laboratory of Nusa Cendana University. The ginger plant taken is the result of maintenance at the Baumata natural tourism park. First of all, the red ginger rhizome is cleaned, cut into small pieces, and then blended with as much as 1 kg. After blending, the ginger rhizome is squeezed and filtered 3 times with gauze (pure ginger rhizome juice) as much as 560 ml. The juice results were stored in an Erlenmeyer flask which was tightly closed as a test material.
- b. **Rejuvenation of test bacteria:** The *V. cholera* bacteria was first purified and inoculated in a nutrient medium and incubated at 37°C for 1 day (24 hours).
- c. **Making concentration of red ginger rhizome:** Making red ginger rhizome juice in this study, namely: control=10 ml distilled water; 40%=4 ml of red ginger extract+6 ml of distilled water; 60%=6 ml of red ginger extract+4 ml of distilled water; 80%=8 ml of red ginger extract+2 ml of distilled water; and 100%=10 ml of red ginger extract without distilled water.
- d. **Making culture media:** Weighing was carried out on Broth Pepton Water (BPW) media of 1.25 g. Then mix BPW media with 50 ml of distilled water. The homogeneous results were put into 25 test tubes with a total of 8 ml for each tube.
- e. **Preparation of culture (inoculum) of *V. cholera* bacteria:** Prepare 5 test tubes containing 5 ml of distilled water. Take 10 pure culture colonies of *V. cholera* bacteria using a sterile loop needle. Homogenize the results of incubation of *V. cholera* bacteria in a test tube that has been prepared and contains 5 ml of distilled water.

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Emails: editorial@owenpublishing.org | support@owenpublishing.org**f. Testing the antibacterial activity of red ginger rhizome juice against V. cholera bacteria:**

Prepare 25 test tubes and label them. Enter each treatment in the tube as follows: a. 8 ml of BPW medium+1 ml of sterile distilled water+1 ml of V. cholera bacterial culture; b. 8 ml of BPW medium+1 ml of ginger rhizome extract 40%+1 ml of V. cholera culture; c. 8 ml of BPW medium+1 ml of 60% ginger rhizome extract+1 ml of V. cholera culture; d. 8 ml of BPW medium+1 ml of ginger rhizome extract 80%+1 ml of V. cholera culture; e. 8 ml of BPW medium+1 ml of 100% ginger rhizome extract + 1 ml of V. cholera culture=15,000,000 colonies (1.5×10^6). Each tube with 5 treatments was incubated for 24 hours at 37°C. Weigh NA Media as much as 10 g. Mix NA media with 400 ml distilled water. Next, heat the media until it boils, then cool it down to 45°C. The NA medium was put into 25 sterile petri dishes as much as 15 ml in an aseptic manner. The test sample that had been incubated was put as much as 1 ml into the cup using the drop method, then rotated so that the suspension of the test bacteria (V. cholera) and the media were homogeneous NA. After the sample was frozen, it was incubated for 24 hours at 37°C. Observation of the growth of V. cholera bacteria on NA by counting the number of V. cholera bacteria colonies that grew on NA media.

Results and Discussion

Based on Table 1, shows that the number of V. cholera bacterial colonies that grew in each treatment of red ginger rhizome juice concentrations were: treatments A and B the number of V. cholera bacterial colonies that grew Too Many to Count (TMTC) or more than 300 colonies. Treatment C. The number of colonies of V. cholera bacteria that grew could be counted with a mean (average) of 270.5 colonies. In treatments D and E the number of V. cholera bacteria colonies that grew 0 (no growth of V. cholera bacteria). The data in the table above were analyzed using the Standard Plate Count (SPC), which is the number of colonies growing by X dilution [8]. Based on the results of the Standard Plate Count (SPC) test, it was found that the 0% and 40% SPC values $\geq 3.0 \times 10^5$ CFU/ml did not inhibit the growth of V. cholera bacteria. According to that a large number of bacterial colonies (more than 300 colonies) does not inhibit bacterial growth [8]. A 60% treatment with an average SPC value $= 2.7 \times 10^5$ CFU/ml can be bacteriostatic (inhibits) the growth of V. cholera bacteria. Treatments of 80% and 100% were concentrations that were bactericidal (deadly) V. cholera bacteria. Based on the results of research on the concentration of red ginger juice as an antibacterial against the growth of V. cholera bacteria, it showed that the concentration of 0% and 40% red ginger juice did not inhibit V. cholera bacteria, 60% treatment was bacteriostatic (inhibited) the growth of V. cholera bacteria, and 80% and 100% treatment were bactericidal (deadly) V. cholera bacteria. The concentration of red ginger rhizome juice is known to have an active ingredient as an antibacterial. The presence of antibacterial properties of red ginger rhizome juice is inhibitory (bacteriostatic) at a concentration of 60% and lethal (bactericidal) at a concentration of 80%, and 100% means red ginger rhizome juice contains antibacterial compounds. According to the high content of essential oils in red ginger makes red ginger plants widely used in the world of health as medicine [4]. The active ingredients of essential oils and flavonoids have an antibacterial effect in inhibiting the growth of pathogenic microorganisms. Explained that red ginger is suitable for medicinal ingredients because ginger also contains the active substances shogaol and gingerol which function to generate energy as high antioxidants, antimutagenic, antibacterial, antitumor, anti-inflammatory, and anti-carcinogenic [9]. It is explained that the content of red ginger, especially gingerol and shogaol, are compounds that can function as immunomodulatory and red ginger also has antiinflammatory, antibacterial, and antioxidant effects [10]. The results of the study by Majid, et al. showed that ginger rhizome extract was able to inhibit microbial growth due to the presence of bioactive compounds, namely

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antimicrobial compounds in the phenol, flavonoid, terpenoid, and essential oil groups which could inhibit microbial growth ^[11]. It is stated that important materials from bacteria can be inhibited by the antibacterial activity of bioactive compounds (flavonoids) ^[12]. This can cause damage, or imperfection of the cell wall in bacteria. In addition, the bacterial cell wall will not be resistant to plasma osmotic pressure so it can be broken/destroyed. Another thing that can happen is the inhibition of protein and nucleic acid synthesis in bacteria which causes total cell damage. Disturbances that can occur are damage to cells and cell membranes and changes in cell permeability. The effect of red ginger rhizome juice is proven to inhibit the growth of *V. cholera* bacteria at a concentration of 60%, and can kill *V. cholera* bacteria at high concentrations, namely: 80%-100%. Stated that the higher the Antibacterial compound, the higher the antibacterial activity ^[13]. The results of study by Majid, et al. show that the higher the concentration of the extract tested, the higher the levels of antibacterial compounds; so that they can inhibit the growth and kill the tested bacteria ^[8]. The results of study by Widiastuti, et al. studies showed that ginger rhizome extract was able to inhibit microbial growth due to the presence of bioactive compounds, namely antimicrobial compounds in the phenol, flavonoid, terpenoid and essential oil groups which could inhibit microbial growth ^[11]. Furthermore, explained that the secondary metabolites (phenols, flavonoids, terpenoids and essential oils) found in ginger rhizomes are a class of bioactive compounds that can inhibit microbial growth ^[14]. Flavonoids are one of the largest natural phenol group compounds that have many pharmacological benefits, including being antibacterial ^[15].

O: no bacterial colonies, TMTC: Too Many to Count

Conclusion

Flavonoids are found in plants that produce red, yellow, blue, orange, and purple pigments from fruits, flowers, and leaves. Further research can be carried out regarding the effects of elephant ginger, red ginger, and emprit ginger from East Nusa Tenggara on the development of other types of pathogenic bacteria. For future research, they can carry out further research by testing other types of ginger plants or other medicinal plants, especially medicinal plants typical of East Timor-Nusa Tenggara. Based on the results of the antibacterial test of red ginger juice on the growth of *V. cholera* bacteria, it can be concluded that red ginger juice in treatment C (60%) was bacteriostatic (inhibited) the growth of *V. cholera* bacteria, and in treatment D (80%) and E (100%) is bactericidal (deadly) *V. cholera* bacteria.

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Volume 12, Issue 2 | April- June, 2026

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