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Sansevieria trifasciata extract effectively inhibit the growth of *Escherichia coli* bacteria, in vitro

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ABSTRACT

Sansevieria trifasciata is a plant that has the potential to kill pathogenic bacteria due to its content. An experimental study with a laboratory experimental design was carried out to test the inhibition of *Sansevieria trifasciata* extract against *Escherichia coli* in vitro. Antibacterial testing of *Sansevieria trifasciata* extract was carried out at concentrations of 5%, 10%, and 40% to explore the growth of *Escherichia coli* by maceration method and using 96% ethanol. The medium used was Mueller Hinton Agar which had previously been inoculated with the test microbe (*Escherichia coli* ATCC 25922) and then the results obtained were compared with the control group for comparison. The ethanol extract of *Sansevieria trifasciata* with concentrations of 5%, 10%, and 40% could inhibit the growth of *Escherichia coli* bacteria with the average diameter of the inhibition zone respectively 6.63 mm, 5.42 mm, and 6.55 mm compared to the diameter of the *Escherichia coli* on the control variable + using the previous ciprofloxacin, namely 20.4 mm, 20.8 mm and 20.4 mm. *Sansevieria trifasciata* has good inhibition against the growth of *Escherichia coli* bacteria with low or high concentrations.

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1. INTRODUCTION

One of the illnesses that threatens the aquaculture business is bacterial disease [1], [2], reported that from several types of microbial contaminants, it is known that bacteria are one type of microbe that is no less important in causing infectious diseases for humans under certain conditions. In the current state of contemporary healthcare, there are many antimicrobial agents that are no longer useful in treating infectious diseases, primarily because of the emergence of microbial resistance [3]. Many bacteria can cause both communicable and noncommunicable diseases. Some of the bacteria that cause respiratory and digestive tract infections are *Escherichia coli and S. aureus*. Exploring bioactive substances that can be used to treat pathogenic microorganisms resistant to currently available medicines is extremely beneficial [4]. The discovery of novel antimicrobial agents from natural sources, such as bacteria, fungi, and plants, is becoming increasingly popular [5]. A significant supply of novel drug molecules is found in natural products, particularly microbial and plant products [6].

In the current state of contemporary healthcare, there are many antimicrobial agents that are no longer useful in treating infectious diseases, primarily because of the emergence of microbial resistance [3]. Many bacteria can cause both communicable and non-communicable diseases. One of the bacteria that causes respiratory and digestive tract infections is *Escherichia coli*. Exploring bioactive substances that can be used to treat pathogenic microorganisms that are resistant to the medicines currently available is extremely beneficial [4]. Finding novel antimicrobial agents from natural sources like bacteria, fungi, and plants is becoming more and more popular right now [5]. A significant supply of novel drug molecules is found in natural products, particularly microbial and plant products [6].

In cases involving infections, alternative antibacterial agents can be used with herbal remedies to reduce adverse effects [7]. One of them is *Sansevieria trifasciata*. About 70 species of the *Asparagaceae* family's *Sansevieria* are found around the world. They are primarily found in arid or semi-arid areas of the tropical and subtropical regions, and Their territory includes the islands of the Indian Ocean and Southeast Asia as well as Africa [8], [9]. Rhizomatous xerophytic perennial plants from this genus typically grow in tropical and subtropical regions of the globe [4]. In Indonesia, *Sansevieria trifasciata* is simple to grow and has therapeutic promise. The leaves of *Sansevieria trifasciata* are rigid, rounded, and rough. These plants are spread across the tropics and subtropics from Africa to Southeast Asia and the Indian Ocean [10]. Within their geographic distribution, these plants are used for a variety of ethnobotanical purposes. These plants hold a significant place among the plant genus groups used to treat a wide range of immune-compromised diseases [11], [12]. This species has historically been used to cure a variety of conditions, including colds, diarrhea, coughs, respiratory system inflammation, swelling, lumps, bruises, boils, venomous snake bites, and hair fertilizer [13], [14]. For its pharmacological properties, such as antitumor, antioxidant, capillary permeability inhibitory action, and antidiabetic anaphylaxis, *Sansevieria trifasciata* has been investigated [13]–[16].

The large amount of antibacterial content present in *Sansevieria trifasciata* made researchers interested in examining the potential inhibition of *Sansevieria trifasciata* on *Escherichia coli* bacteria. *Sansevieria trifasciata* has been shown to have antibacterial properties in numerous investigations [17], [18]. Dicarboxylic acids, phenols, steroidal saponins, flavonoids, saponins, coumarins, homoisoflavanones, and fatty acids are among the phytochemicals of *Sansevieria trifasciata* that are extremely advantageous for human health [10], [13], [19]–[21]. There have been reports of a number of bioactive substances in Sansevieria that have antimicrobial properties, including 3,4-dimethoxybenzoic acid, quinolones, palmitaldehida, delta-undecalactone, 1,2-benzene-dicarboxylic acid [22].

The number of factory-made anti-bacterials that fail to function properly due to immunity from bacteria, is the main thing that underlies researchers to look for sources of antibiotics that can be used as alternative substitutes. *Sansevieria trifasciata* is known to have many benefits due to the many substances that are very good for humans. Ingredients such as saponins have been known as anti-bacterial ingredients in various types of antibacterials. The use of the difussion method in this study is expected to be able to provide effective and significant results in discovering the inhibitory ability of *Sansevieria trifasciata* against bacteria that may appear. Previous researchers have never found the antimicrobial effect of the *Sansevieria trifasciata* plant against inhibition of *Escherichia coli* bacteria. As in the Kumar and Kumari [23] in 2015 which explained that the potential of bioactive secondary compounds and the potential antimicrobial activity of Sansevieria roxburghiana leaf extract. antibacterial screening revealed significant antibacterial activity against *Proteus vulgaris*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Escherichia coli* [24]. The plant used as an anti-bacterial before was not *Sansevieria trifasciata*, for this reason researchers will find out more about how *Sansevieria trifasciata* is able to inhibit the growth of *Escherichia coli* bacteria. Researchers tested ethanolic extracts and their fractions for their ability to fight bacteria due to the presence of these different chemical compounds. A non-toxic organic solvent called ethanol is used to extract bioactive plant components. The multilevel maceration technique was used to prepare the extract in this study, which is a new development from this research. The novel aspect of this study is evaluating the effectiveness of extracts from *Sansevieria trifasciata* against the growth of bacteria *Escherichia coli*.

2. METHOD

The Central Laboratory of Molecular Engineering Research Unair Surabaya conducts in vitro laboratory experimental study as part of this research. The key variable is the *Sansevieria trifasciata* concentration response to the presence of *Escherichia coli* at 5%, 10%, and 40%, respectively. Antimicrobial activity test was carried out using the diffusion method. As much as 20 μL of the test solution (supernatant from fermenting endophytic bacteria) was absorbed on a 6 mm diameter sterile disc paper. The disk which has been infused with the test solution is placed on the surface of the solid Mueller-Hinton agar (MHA) media, Mueller-Hinton agar (MHA) is the best medium for routine antimicrobial susceptibility testing using the Kirby-Bauer disc diffusion method for non-fastidious bacteria (aerobe and facultative anaerobe). The MHA media had previously been inoculated with the test microbes (*Escherichia coli* ATCC 25922), The strain ATCC 25922 is a commonly used quality control strain, particularly in antibody sensitivity assays and was originally isolated from a human clinical sample collected in Seattle. Positive control used ciprofloxacin while for negative control used sterile aquadest. The process of making *Sansevieria trifasciata* extract by maceration method and using

96% ethanol solvent. Ciprofloxacin was chosen as the positive control because ciprofloxacin is a fluoroquinolone drug group which has the function of inhibiting bacterial deoxyribonucleic acid synthesis, thereby inhibiting microbial resistance and is a broad-spectrum antimicrobial.

Figure 1 shows the measurement of antimicrobial activity using a power zone resistor. This research was started by making *Sansevieria trifasciata* leaf extract with ethanol solution which is a polar extractor. As a basic principle in this study is that the administration of *Escherichia coli* bacteria. in the extract of *Sansevieria trifasciata* into the media is expected to inhibit the growth of bacteria. The growth inhibition can be seen by the presence of an inhibition zone on the agar media. The extraction method used is the well method because it is more suitable and practical for testing herbs or drugs derived from plants. This method allows the extract to diffuse optimally because the material will meet directly with the growth media to the bottom of the media which is made on the germ growth medium. The study used Gram-negative *Escherichia coli* bacteria where these bacteria can cause nosocomial infections.

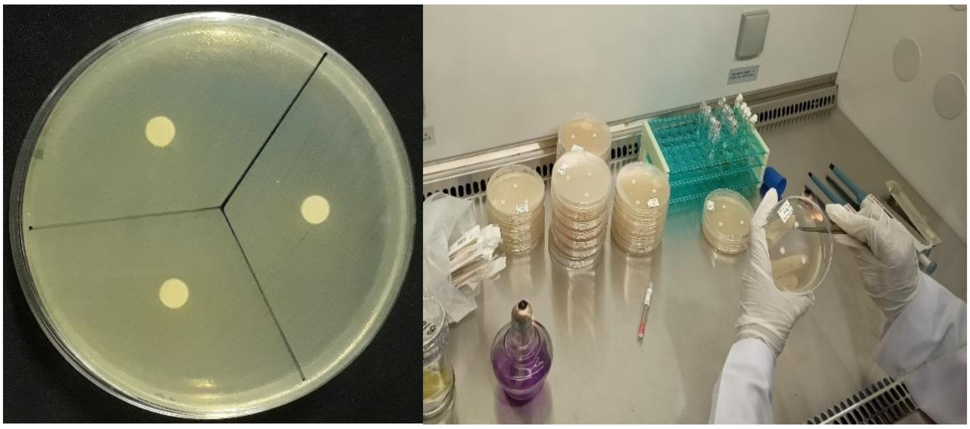

Figure 1. Measurement of antimicrobial activity using a power zone resistor

3. RESULTS AND DISCUSSION

Measuring the width of the inhibition zone Take a *Sansevieria trifasciata* extract, in inhibiting the growth of *Escherichia coli*, using the method Anti-microbial diffusion inhibition of microbes to 5%, 10%, and 40% doses. The medium used was MHA for test sample antimicrobial to growth of *Escherichia coli*. Can be seen in Table 1.

Tabel 1. Results of measuring the diameter of the inhibition zone (mm) of *Sansievera trifasciata* on *Escherichia coli* bacteria

No	Sample	Inhibition zone diameter (mm)			Average inhibition zone (mm)
		Repetition 1	Repetition 2	Repetition 3	
1	ST 5%	6.9	6.5	6.5	6.63
2	ST 10%	5.4	5.4	5.45	5.42
3	ST 40%	6.25	6.3	7.1	6.55
4	C+	20.4	20.8	20.4	20.53
5	C -	No zone of inhibition of bacteria			

Information
ST : *Sansevieria trifasciata*
C+ : Control positive using ciprofloxacin
C - : Control negative using Aquades

Observations on the test bacteria *Escherichia coli* as presented in Table 1 can be noted that distilled water does not have the inhibition of bacterial growth as a negative control by not finding bright zones in the media containing distilled water. This is inversely proportional to the ciprofloxacin reference solution as a positive control which appears to have a large and very conspicuous inhibition zone compared to the three test solutions. The test solution for *Sansevieria trifasciata* extract in Table 1 with a concentration of 5% has shown an inhibition of the growth of *Escherichia coli* bacteria. The inhibitory effect was stronger at higher concentrations, namely at concentrations of 10% and 40%. This proves that the extract of *Sansevieriae trifasciata* has an antimicrobial effect against *Escherichia coli* bacteria. The results of observations can be seen in Figure 2.

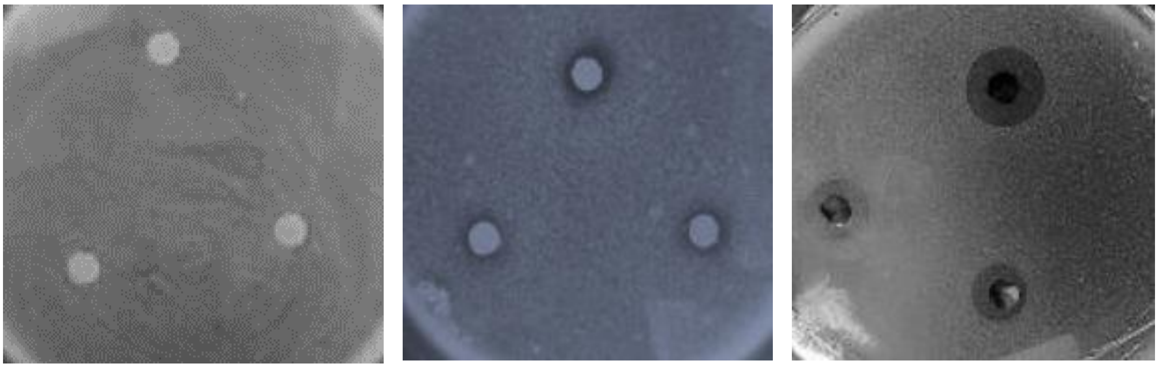

Figure 2. *Sansevieria trifasciata* concentrations: 5%, 10%, and 40% and their inhibition on the growth of *Eschercia coli*

It is well known that plants generate a variety of chemical compounds with a variety of biological activities against a variety of microorganisms It is well known that plants generate a variety of chemical compounds with a variety of biological activities against a variety of microorganisms [25]. At concentrations of 5%, 10%, and 40%, the *Sansevieria trifasciata* extract's inhibition zone demonstrated potent antibacterial action. Research using other plants can also inhibit the growth of bacteria, this was disclosed by [18], who stated that the antibacterial activity of *Sansevieria cylindrica* showed an inhibition zone of 17.8 mm against *P. aeruginosa*.

The findings of this study differ at the category level from previous study which states that *Sansevieria trifasciata* was discovered to have extremely potent antibacterial activity, with an 18 mm inhibition zone reported that the diameter of the inhibition zone of the ethanol extract of *Sansevieria* leaves was 13 mm. this is much different from the findings of researchers who stated that the average antibacterial activity of *Sansevieria trifasciata* was 6.55. This could be due to the different growth conditions of *Sansevieria trifasciata* in geographic conditions. It is also acknowledged that various geographical regions, where soil minerals and environmental factors have a significant impact on plants' phytochemical contents, result in varying antibacterial activities in plants. In response to important environmental stresses like sun exposure, temperature, groundwater, soil fertility, and salinity, different biochemical processes generate secondary metabolites like phenolics, flavonoids, terpenoids, and alkaloids. The same plant's extracts obtained from various locations will yield various active compounds [26]–[28].

The potential of bioactive secondary compounds and the potential antimicrobial activity of Sansevieria roxburghiana leaf extract were reported by [23] in 2015. antibacterial screening revealed significant antibacterial activity against *Proteus vulgaris*, *Salmonella typhi*, *Pseudomonas aeruginosa, Klebsiella pneumoniae, and Escherichia coli* [23]. These authors' qualitative analysis supported the existence of a variety of primary and secondary plant metabolites in specific Sansevieria roxburghiana sections, including terpenoids, saponins, flavonoids, alkaloids, phenols, steroids, quinine and tannins. In 2013, According to Sethi's study [29], an ethanol extract of the Sansevieria roxburghiana plant's rhizome was exceptionally effective at killing pathogenic bacteria like *Salmonella typhi, Pseudomonas fluorescens*, *Pseudomonas aeruginosa, and Escherichia coli*. *Pseudomonas fluorescens* had the highest level of activity, with an inhibition zone diameter of 32 millimeters (300 g/ml). according to research conducted by Sethi poonam [29] The minimum inhibitory concentration study revealed that the value for the S. Typhi and *Escherichia coli* as 80 and 60 µg/ml for *Pseudomonas fluorescens* and *Pseudomonas aeruginosa*.

Antibacterial elements' effects on bacterium cells have the potential to harm the cells. Bacteriostatic or bactericidal effects are possible with these antimicrobial components. The composition of different cell wall structures, such as peptidoglycan, lipids, and crosslinks, which can significantly affect the penetration, binding, and action of antimicrobial agents, is what makes gram-negative bacteria susceptible to antibacterial agents. Gram-negative *Pseudomonas aeruginosa* bacteria have a significant fat content in their cell walls (11-22%). In addition, there are three layers in the cell wall: lipoproteins, phospholipids (exterior membrane), and lipopolysaccharides. A phospholipid outer layer can limit how deeply antibacterial substances can enter cells [30].

Ethanol is the solvent used during the layered maceration procedure. This multilevel extraction method has the benefit of producing a lot of different polarity compounds. An effective organic fluid for extracting plant bioactive components is ethanol. Since ethanol is flammable, polar substances like the flavonoid aglycones can dissolve in it. Both non-toxic and non-hygroscopic describe this liquid. The *Sansevieria trifasciata* extract's antibacterial activity suggests the existence of bioactive substances. Alkaloids, saponins, terpenoids, steroids, glycosides, tannins, acidic compounds, fats, and oils are believed to be responsible for the composition's antibacterial activity [14], [31]. One class of glycosides that can be found in plants are saponins. Saponins have the ability to produce froth [32]. Phenols are substances that have a fragrant ring and a -OH group joined together. The biggest class of phenolic compounds found in nature are flavonoid compounds. Phenol compounds are widely distributed in nature and are used as industrial intermediates for a variety of products, including adhesives and antiseptics. The antiseptic, anti-inflammatory, and anti-cancer properties of these substances are well recognized [33]. The term "plant secondary metabolites" refers to substances found in flavonoids and other phenolic chemicals that have an aromatic ring with at least one hydroxyl group. It has been noted that plants naturally contain more than 8,000 phenolic compounds [34], [35]. In addition to being a natural antibacterial and antiseptic, *Sansevieria trifasciata's* ethanolic extract includes a number of bioactive compounds that prevent bacterial development [18], [36]. Finding the plant compounds that actively hinder the *Escherichia coli* germs will require more investigation.

4. CONCLUSION

The average diameter of the inhibition zone for the *Sansevieria trifasciata* ethanol extract at concentrations of 5%, 10%, and 40% was 6.63 mm, 5.42 mm, and 6.55 mm, respectively, to *Escherichia coli* bacteria on the control variable + using the prior ciprofloxacin, which was 20.4 mm, 20.8 mm, and 20.4 mm. Zones of inhibition that have developed on the agar media are evidence of growth inhibition. Because *Sansevieria trifasciata* contains dicarboxylic acids, fatty acids, phenols, flavonoids, steroid saponins, and coumarins that can directly damage the flagella of *Escherichia coli* bacteria, it has good inhibitory properties against the growth of *Escherichia coli* bacteria at low and high concentrations. The use of the microdilution method to determine the potential inhibition of *Sansevieria trifasciata* against *Escherichia coli* bacteria should be considered for the future because it is more effective and accurate. This is a research limitation that will be carried out in further research by researchers in 2024 in the next scheme.

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Rusmiati was born in the city of Jakarta, DKI Jakarta on February 12, 1963. After graduating from the Surabaya Sanitation Technology Health Assessment Academy, he was appointed as a civil servant as a lecturer at the Madiun Environmental Health Academy. Then get the opportunity to develop Undergraduate Education at the Faculty of Public Health, Universitas Airlangga in 1994 with an SKM degree to support learning at the AKL campus. In 2004, he had the opportunity to return to carry out Post-Graduate Education in the Environmental Science Study Program of Sebelas Maret University surakarta with an MSi degree. Then returned to teaching at the beloved campus of AKL Surabaya, as a permanent lecturer. In 2010 participated in the Environmental Health Risk Analysis Training at Bapelkes Cikarang. Teaching and Learning Activities, Research and Community Service are carried out with Lecturers and students of the Department of Environmental Health Surabaya Health Polytechnic Surabaya. She can be contacted at email: rustig63@gmail.com.