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Antibacterial Potential of *Muntingia calabura* L. Ethanol Extract Against MDR *Escherichia coli*

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Abstract: Kersen leaves (*Muntingia calabura* L.) have long been utilized as a traditional medicinal plant used for headaches, antiseptics, antioxidants, antimicrobials, anti-inflammatories, anti-diabetics, and anti-tumors. This study aims to determine the antibacterial activity and the concentration at which kersen leaf extract can inhibit the growth of Multi Drug Resistant (MDR) *Escherichia coli* bacteria. The type of research conducted is a laboratory-scale experimental study. The kersen leaves were extracted using the maceration method with a 70% ethanol solvent. The antibacterial activity was tested using the agar diffusion method with sensitive and MDR *Escherichia coli* bacteria at varying concentrations of 1.25%, 2.5%, 5%, and 10%, conducted in three replicates and incubated for 24 hours. Subsequently, the inhibition zones were measured and the data were statistically processed. Based on the research results, at a concentration of 1.25%, an inhibition zone of 7.86 mm was obtained, at 2.5% concentration 9.65 mm, at 5% and 10% concentrations 11.93 mm and 13.98 mm on sensitive *Escherichia coli* bacteria, while on MDR *Escherichia coli* bacteria at a concentration of 1.25%, an inhibition zone of 6.51 mm was obtained, at 2.5% concentration 6.61 mm, at 5% and 10% concentrations 6.68 mm and 6.98 mm. These findings suggest that kersen leaf extract possesses moderate antibacterial activity against both sensitive and MDR *E. coli*, particularly at higher concentrations.

Keywords: Antibacterial activity; *Escherichia coli*; Multi drug resistant (MDR); *Muntingia calabura* L.

Introduction

According to the European Center for Disease Prevention (ECDC) and the Center for Disease Control and Prevention (CDC), multidrug resistance (MDR) is the insensitivity of a bacterium to at least one agent belonging to three or more antibiotic categories. In simpler terms, MDR means that bacteria are no longer sensitive to at least three types of antibiotics. The World Health Organization (WHO) states that several factors cause antibiotic resistance including excessive administration of antibiotics; patients do not use up their medication due to excessive antibiotic administration in livestock and fisheries; lack of supervision of antibiotic use in clinics and hospitals; poor and unhygienic sanitation; and the lack of discovery of new antibiotics (Ayuningrum et al., 2020).

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Multidrug-resistant (MDR) is a condition where bacteria are resistant to at least one type of antibiotic from ≥3 antibiotic groups. This MDR can be caused by several things, including using the wrong dose of antibiotics, incorrect diagnostics and inappropriate bacteria. Multidrug-resistant organisms (MDRO) are microorganisms, especially bacteria that experience MDR. Currently antibiotic resistance is a global problem, data in 2009, Indonesia was ranked 8th out of 27 countries with the highest multidrug resistant title in the world (Boni et al., 2024; Tadesse et al., 2023; Al-Tawfiq et al., 2022).

Antibiotic resistance occurs when bacteria do not respond to drugs to kill them. This is a complex problem for global public health because no simple method can prevent the emergence of infection-causing organisms that have become resistant to current antibiotics. The existence of antibiotic resistance causes a decrease in the ability of antibiotics to treat infections and diseases in humans, animals and plants. Furthermore, this causes problems such as: increased morbidity and mortality, increased costs and length of treatment, increased side effects from the use of multiple drugs and high doses. Based on the latest report from the World Health Organization (WHO) in Antimicrobial Resistance: Global Report on Surveillance, it shows that Southeast Asia has the highest number of cases of antibiotic resistance in the world, especially infections caused by *Staphylococcus aureus* and *Escherchia coli* which is resistant to Methicillin, resulting in a decrease in the function of these antibiotics (Yunita et al., 2021; Laxminarayan et al., 2024; Huang et al., 2023).

Resistance is an attitude that shows the ability to survive, try to resist, oppose, or any form of opposition. Before discussing antibiotic resistance, we should talk a little about antimicrobial resistance. Antimicrobial resistance is when a person suffers from an infection caused by an antimicrobial because the use of antimicrobial drugs (fungi, bacteria, parasites and viruses) at usual treatment doses is unable to treat it. From antimicrobial resistance, the term antibiotic resistance emerged (Muntasir et al., 2021).

One natural ingredient that has the potential to be developed as a hand antiseptic is kersen (*Muntingia calabura* L). Based on research results, kersen leaves contain various bioactive compounds, namely flavonoids, saponins, triterpenes, steroids and tannins. Where this bioactive compound is a compound that has the potential to act as an antibacterial. The kersen plant (*Muntingia calabura* L) is a type of plant that grows wild in various places in Indonesia. This plant is often ignored and only used as a shade tree because of its shady leaves. Even though this plant has many benefits for human health, including medicine for headaches, cough medicine, gout, antioxidant, anticancer, diabetes and others. These benefits are not yet widely known by the Indonesian people. People in Peru use kersen leaves as a traditional anti-inflammatory medicine and headache medicine (Mutammimah et al., 2022; Krumkamp et al., 2022; Boni et al., 2024; Tadesse et al., 2023; Al-Tawfiq et al., 2022).

The triterpenoid compounds isolated from kersen leaves are the main contributors to the plant's antibacterial activity, supporting the use of kersen as a natural source to combat pathogens (Han et al., 2020). In the results of the antibacterial effectiveness test, there is a clear zone which represents the ability to inhibit the growth of the tested bacteria by the gel. The average diameter of the kersen leaf extract hand antiseptic gel preparation at concentrations of 5%, 10% and 15% respectively is 10.00 mm, 11.66 mm and 12.00 mm so that the ability to inhibit the tested bacteria by the gel at all concentrations is categorized strong (Manarisip et al., 2019). Research has been conducted on the potential of Muntingia calabura L. leaf extract as a source of natural antibacterial agents, which was demonstrated by its rich phytochemical profile containing compounds with antibacterial properties (such as flavonoids and tannins) and its in vitro effectiveness against MRSA, one of the most difficult-to-treat multidrug-resistant bacteria, namely Methicillin-resistant *Staphylococcus aureus* (MRSA), which is a multidrug-resistant (MDR) bacterium (Kholis et al., 2024).

Based on the above problems, phytochemical screening and the potential of kersen leaves (*Muntingia calabura* L.) as a source of anti-Multiple Drug Resistance (anti-MDR) compounds against MDR *E. coli* bacteria have not been conducted. Therefore, this research can provide new information on the potential of kersen leaves (*Muntingia calabura* L.) as an anti-MDR agent.

Method

Chemicals

The tools used in this research include a set of maceration tools, incubator, autoclave, laminar air flow, oven, spirit lamp, tube, sterile swap, petri dish, caliper, micropipette, and analytical balance. The materials used in this research include kersen leaf extract (*Muntingia calabura* L.), 70% ethanol, Nutrient Agar (NA) medium, Mueller-Hinton Agar (MHA) medium, Dimethyl sulfoxide (DMSO), Paper disk, amoxycilin, ampicilin, levofloxacin, ceftriaxon, gentamicin, fosfomycin and tetracycline.

Sample Preparation

The collected kersen leaf samples (*Muntingia calabura* L.) were wet sorted to clean them of impurities and plant parts used. Then wash with running water until clean. Then the sample is chopped to facilitate the

drying process, then weighed and dried in a drying cupboard, after drying the sample is sorted dry to separate foreign objects such as parts of the desired plant and other impurities that are still present and left in the sample, after that the sample is weighed and pollinated (Nur et al., 2023).

Extraction Prosses

Making kersen leaf extract (*Muntingia calabura* L.) using the maceration method. 500 grams of simplicia powder was put into the maceration vessel, then 5000 ml of 70% ethanol solvent was added, the solvent was added little by little until the sample was all wetted. Then the sample was left for 3x24 hours, while occasionally stirring and protected from direct sunlight. The residue and filtrate are separated by filtering. The filtrate was collected and the residue was remacerated with 4500 ml of solvent and given the same treatment to obtain the filtrate. Then the filtrates are combined. Then, evaporation is carried out until a thick extract is obtained (Nur et al., 2022).

Qualitative Test of the Chemical Content of Kersen Leaf Extract

Alkaloids

The extract was weighed as much as 0.5 grams then put into a test tube, 5 ml of 2N HCL was added and heated in a water bath, after it cooled it was filtered and the filtrate was dripped with Dragendroft reagent (potassium iodide solution), the red to orange precipitate indicated that it positively contained alkaloid compounds, the precipitate yello wish white with Mayer's reagent and a brown precipitate in Wagner's reagent (Utami et al., 2023).

Saponin

The extract was weighed as much as 0.5 grams then put into a test tube then added with 10 ml of hot water, shaken vigorously for 10 seconds. If froth or foam forms for approximately 10 minutes as high as 1 cm to 10 cm, and when 1 drop of 2 N hydrochloric acid is added and the foam does not disappear, it means it is positive for containing saponin (Imrawati et al., 2023).

Tannin

Weigh 0.5 gram of the extract, put it in a test tube, then dissolve it in 10 ml of warm water, then filter it and add 2-3 drops of 1% FeCl3 to the filtrate. If dark blue or blackish green is formed, the extract shows a tannin group compound (Andhiarto et al., 2020).

Flavonoids

Weigh 0.5 gram of the extract and put into a test tube then added with 70% ethanol, then 0.5 mg of magnesium powder and 5-6 drops of concentrated HCl were added. If a red color is formed, it indicates flavonoid compounds, the dark red color indicates flavonol compounds. and flavonones, if an orange color is formed it indicates a flavone compound and if a green color is formed it indicates an aglycone or glycoside compound (Maryam et al., 2023).

Ethanol Free Testing

The extract was added with sulfuric acid (H_2SO_4) then added again with acetic acid (CH_3COOH) and covered with cotton, then heated until boiling after which the ester smell on the cotton was identified. The test result is negative if there is no typical ester odor (Utami et al., 2024).

Sterilization

Glassware is soaked in 1% Na_2CO_3 solution and boiled for several minutes, after it cools or warms the glassware is brushed until clean and then rinsed with water. The glassware is then soaked in 1% HCl solution, then washed again with water as clean as possible, and rinsed with distilled water. The glassware is dried and then sterilized in an autoclave at 1 atm pressure at 121°C for 15 – 20 minutes. Plastic tools, pipettes are boiled in 1% Na_2PO_4 solution for 10 minutes then washed with water until clean and rinsed with distilled water then dried after that, sterilized in an autoclave at 1 atm pressure at 121°C for 15 – 20 minutes. Metal tools such as hoses are sterilized using direct heating with an alcohol lamp until they glow (Utami et al., 2024).

Mueller Hinton Agar Media (MHA)

Mueller Hinton Agar (MHA) 38 g was weighed and put into an Erlenmeyer flask, dissolved in distilled water and heated until all the ingredients were dissolved. Next, the pH was measured at ± 7.4, then the volume was increased with distilled water to 1000 mL. Cover the Erlenmeyer with cotton wrapped in sterile gauze. The media was sterilized by autoclaving at 121°C for 15 minutes (Oxoid, 2017).

Making Kersen Leaf Extract Concentration

Kersen leaf extract (*Muntingia calabura* L.) is made in several concentrations of 1.25%, 2.5%, 5%, 10%. The preparation was made in 10 ml so that the kersen leaf extract was weighed 0.125 g, 0.25 g, 0.5 g, 1 g respectively and then dissolved in 10% DMSO to 10 ml.

Preparation of Test Bacteria

Creation of Slanted Agar

Sterile NA medium 5 ml was taken and poured into a sterile test tube and covered with aluminum foil, then left at room temperature for ± 30 minutes until the medium solidified at a slope of 30° (Utami et al., 2023).

Preparation of Test Bacterial Suspension

From the results of rejuvenation, sensitive *E. coli* and MDR *E. coli* bacteria were suspended in 0.9% NaCl solution and then homogenized. The adjusted inoculum of bacteria was equivalent to 0.5 MacFarland.

Testing of MDR Bacterial Isolates Against Several Antibiotics

Inoculate the *E. coli* MDR bacterial suspension on the surface of the MHA media with a sterile swab until the entire surface is in contact with the bacterial isolate, leave for ± 15 minutes until the surface of the media is dry. The Amoxycilin, Ampicilin, Levofloxacin, Ceftriaxon, Gentamicin and Fosfomycin disks were taken using sterile tweezers and then placed on the surface of the MHA media which contained bacterial isolates. Incubate at 37°C for 1x24 hours, observe and measure the resulting zone of inhibition (Utami et al., 2023).

Sensitive Escherichia coli Antibacterial Activity Testing

Testing the antibacterial activity of Kersen leaf extract (*Muntingia calabura* L.) was used using the agar diffusion method. Place the MHA medium in a petri dish, let it sit for ± 15 minutes until the surface of the media solidifies. Inoculate a suspension of sensitive E. coli bacteria on the surface of the MHA media with a sterile swab until the entire surface is in contact with the bacterial isolate. Drop approximately 20 µL of extract on a paper disk for concentrations of 1.25%, 2.5%, 5% and 10% (each performed 3 times for each concentration), leave it for 3-5 minutes so that the active substances contained in the extract diffuse into the paper disk, then place the paper disk on the surface. MHA media containing bacterial isolates, the positive control used was Tetracycline and the negative control was DMSO 10%. Incubated at 37°C for 1x24 hours. Observe and measure the inhibition zone formed with a caliper (Handoko, 2019).

Testing of Antibacterial Activity of MDR Escherichia coli

The process is the same as testing antibacterial activity on MDR *E. coli* bacteria, only the positive control used in testing MDR *E.coli* antibacterial is Fosfomycin.

Data Analysis

Quantitative data in the form of the diameter of the antibiotic inhibition zone was analyzed descriptively based on the standard inhibition zone breakpoint according to CLSI and EUCAST (Hendrarti et al., 2023).

Result and Discussion

Kersen leaf simplicia is extracted using the maceration method. Extraction is the process of extracting nutritious or active substances from parts of medicinal plants, animals or minerals. Extraction can be done using several methods, one of which is maceration. Maceration is carried out by soaking simplicia powder in a suitable filter fluid. The maceration method was chosen because it was considered to minimize the risk of losing active substances during the extraction process because the influence of heat does not exist in this method. Apart from that, the advantage of this method is that the procedures and equipment used are simple, the maceration method is not heated so the natural ingredients do not decompose (Maryam et al., 2023). Maceration is a simple filtering method, namely by soaking simplicia powder in filter liquid with several stirrings at room temperature. The filter fluid will penetrate the cell wall and enter the cell cavity which contains the active substance. The active substance will dissolve due to changes in concentration between the active substance solution inside the cell and outside the cell, so the most concentrated solution is forced out. This event repeats itself so that there is a concentration balance between the solution outside the cell and inside the cell (Depkes RI, 2008).

Table 1. Calculation Results of % Yield of Kersen Leaf

Sample	Simplicia weight (g)	Extract weight(g)	Yield (%)
Muntingia calabura L. leaf extract	500	102.46	20.49

Table 2. Results of Identification of Chemical Compounds in Kersen Leaf Extract

Compound	Reagents	Result	Description
	+ P.wagner	There is no brown precipitate	-
Alkaloids	+ P. Mayer	There is no white precipitate	-
	+ P. Dragendrof	There is no orange precipitate	-
Saponins	Sample + water warm + HCl	Brown solution and persistent foam	+
Flavonoids	Sample + Mg powder + HCl P	Red Solution	+
Tannin	Sample + water + $FeCl_3$	A blackish green solution is formed	+

Table 3. Ethanol Free Test Results in Kersen Leaf Extract

Testing	Result	Description
Ethanol free test	There is no typical ester smell	-

Table 4. Results of Bacterial Sensitivity Tests to Antibiotics

Antibiotic	Sensitivity category (mm) (Oxoid, 2017; EUCAST, 2014; NCCLS, 2001)	Inhibition zone diameter (mm)	Description
Amoxicillin (25 µg)	S = ≥ 18 I = 14 -17 R= ≤ 13	0	Resistant
Ampicillin (10 µg)	S = ≥ 14 I = 12 -13 R= ≤ 11	0	Resistant
Levofloxacin (5 µg)	S = ≥ 17 I = 14 -16 R= ≤ 13	7.1	Resistant
Ceftriaxon (30 µg)	S = ≥ 21 I = 14 -20 R= ≤ 13	6.8	Resistant
Gentamicin (10 µg)	S = ≥ 15 I = 13 -14 R= ≤ 12	16.4	Sensitive
Fosfomycin (50 µg)	S = ≥ 16 I = 13 -15 R= ≤ 12	33.5	Sensitive

Notes: S=Sensitive; Intermediate; Resistant; (S=≥18; I=13-17; R=≤12) *based on CLSI (NCCLS, 2001) and EUCAST (EUCAST, 2022).

This research aims to determine the antibacterial activity of ethanol extract of kersen leaves (*Muntingia calabura* L.) against sensitive *Escherichia coli* bacteria and *Escherichia coli* which are resistant to several types of antibiotics or what is commonly known as Multi Drug Resistant (MDR). The next stage is to identify chemical compounds. by determining the compound content in kersen leaf extract (*Muntingia calabura* L.) because it is known that kersen leaf extract contains several compounds. In addition, this test provides an initial picture of the composition of the ingredients in the extract (Depkes RI, 2000).

The results of phytochemical screening of kersen leaf extract only found flavonoids, tannins and saponins (table 2). This is different from the literature which states that kersen leaf extract contains alkaloids, flavonoids, tannins and saponins (Setyowati & Cahyanto, 2016). According Mukherjee et al. (2011) this difference in secondary metabolite content is thought to be influenced by differences in geographic conditions where the samples were grown. In the ethanol-free test, if there is a typical ester smell then the extract still contains ethanol, whereas if there is no typical ester smell then there is no ethanol in the extract (table 3).

Bacterial Sensitivity Test to Antibiotics

The sensitivity test against *E. coli* MDR used 6 antibiotic controls, namely amoxicillin, ampicillin, levofloxacin, ceftriaxon, gentamicin and fosfomycin. Sensitivity testing against MDR *E. coli* using six antibiotic controls was used to ensure that the bacteria used were MDR bacteria. It is known that amoxicillin, ampicillin and ceftriaxon can inhibit cell wall proteins in bacteria, levofloxacin can inhibit transcription and replication in bacteria, while gentamicin can inhibit protein synthesis in bacteria (Jawetz & Melnick, 2005).

Bacteria can be declared MDR if based on the inhibition zone they are resistant to more than two antibiotics (Estiningsih et al., 2016). The results of the resistance test against *E. coli* MDR showed that of the six antibiotics used as controls, only gentamicin and fosfomycin showed inhibition in the sensitive zone based on data (EUCAST, 2014; NCCLS, 2001; Oxoid, 2017). So based on the data obtained, it shows that *E. coli* is MDR.

Table 5. Data Measurement of the Inhibitory Power of Ethanol Extract of Kersen Leaves (*Muntingia calabura L.)* Against Sensitive *Escherichia coli* Bacteria

Replication	Inhibition Zone Diameter (mm) Group				Control	
	1.25%	2.5%	5%	10%	(+)	(-)
I	7.8	9.1	12.5	15.1	27.1	0
II	8.4	9.35	11.2	13.35	26.1	0
III	7.4	10.5	12.1	13.5	25.7	0
Average ± SD	7.86 ± 0.50	9.65 ± 0.74	11.93 ± 0.66	13.98 ± 0.96	26.3 ± 0.72	0 ± 0

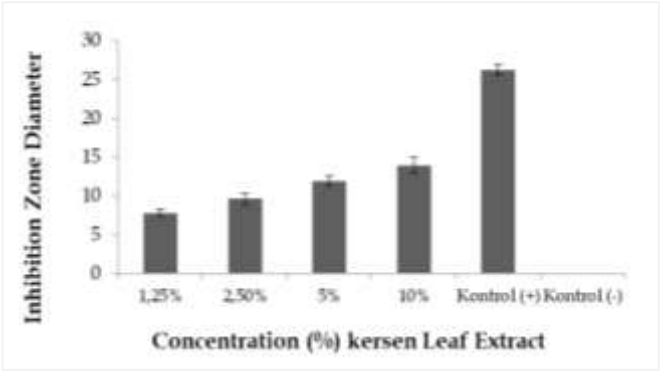

Figure 1. Graph of inhibition zone of ethanol extract of kersen leaves (*Muntingia calabura* L.) against sensitive *Escherichia coli* bacteria

Antibacterial Activity Testing

In testing the antibacterial activity of ethanol extract of kersen leaves (*Muntingia calabura* L.) against sensitive *E. coli* using the agar diffusion method with 4 concentrations, namely 1.25%; 2.5%; 5% and 10% using 10% DMSO as a solvent.

The results of measuring the inhibition zone of the antibacterial activity test of the ethanol extract of kersen leaves on the growth of sensitive *E. coli* showed that there was an increase in the diameter of the inhibition zone with each increase in extract concentration. This can be seen in the average diameter of the inhibition zone for each concentration, namely at a concentration of 1.25% the average diameter of the inhibition zone is 7.86 mm. A concentration of 2.5% has an average inhibitory zone diameter of 9.65 mm. The 5% concentration has an average inhibitory zone diameter of 11.93 mm and the 10% concentration has an average inhibitory zone diameter of 13.98 mm. 10% DMSO was used as a negative control because it is a solvent that can dissolve almost all compounds, both polar and non-polar and is not bactericidal, so it does not provide activity during testing (Hendrarti et al., 2023). The use of tetracycline as a positive control (+) is because tetracycline is an antibiotic that has a broad spectrum, which is capable of inhibiting the growth of bacteria, so this drug is chosen for many infections from various types of germs (Gunawan, 2007).

Next, activity testing was carried out against *E. coli* MDR to ensure the antibacterial activity of kersen leaves with varying concentrations, namely 1.25%; 2.5%; 5% and 10% using 10% DMSO as a solvent.

Based on the results of observations of *E. coli* MDR, it shows that each concentration has inhibitory power. This can be seen in the average diameter of the inhibition zone for each concentration, namely at a concentration of 1.25% the average diameter of the inhibition zone is 6.51 mm. A concentration of 2.5% has an average inhibition zone diameter of 6.61 mm. A 5% concentration has an average inhibitory zone diameter of 6.68 mm and a 10% concentration has an average inhibitory zone diameter of 6.98 mm. 10% DMSO was used as a negative control because it is a solvent that can dissolve almost all compounds, both polar and non-polar and is not bactericidal, so it does not provide activity during testing (Hendrarti et al., 2023). The use of fosfomycin as a positive control (+) is because fosfomycin is a local antiseptic for the acute urinary tract which is bacteriocidal for gram-negative bacteria with a mechanism of action that inhibits the early stages of bacterial cell wall synthesis (Gunawan, 2007).

The results of the antibacterial activity test showed that the ethanol extract of kersen leaves was more capable of inhibiting sensitive *Escherichia coli* bacteria than MDR *Escherichia coli* bacteria. This can be seen from the larger zone of inhibition in sensitive *Escherichia coli* bacteria compared to MDR Escherichia coli. The difference in results is caused by the different characteristics of each bacteria, namely sensitive and resistant.

The resistance properties of MDR *Escherichia coli* bacteria cause the inhibition zone to be smaller than that of sensitive bacteria. Resistance is a change in the ability of bacteria to become resistant to antibacterials. Resistance can occur due to changes in the nature of bacteria so that they can no longer be killed or killed. Changes in genetic characteristics occur because bacteria acquire genetic elements that carry resistance properties, this situation is known as acquired resistance. Resistance elements can also be obtained from outside and are called transferred resistance. Spontaneous genetic mutations or antimicrobial stimulation can also occur (Kurnianto & Syahbanu, 2023).

Table 6. Data Measuring the Inhibitory Power of Ethanol Extract of Kersen Leaves (*Muntingia calabura* L.) Against *Escherichia coli* MDR Bacteria

Replication	Inhibition Zone Diameter (mm)					
	Group				Control	
	1.25%	2.5%	5%	10%	(+)	(-)
I	6.6	6.55	6.5	7.3	31.9	0
II	6.4	6.8	6.75	6.95	31.45	0
III	6.55	6.5	6.8	6.7	31.2	0
Averag ± SD	6.51 ± 0.10	6.61± 0.16	6.68± 0.16	6.98 ± 0.30	31.51 ± 0.35	0 ± 0

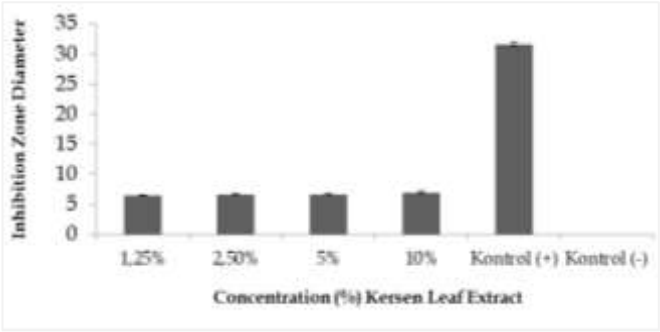

Figure 2. Graph of inhibition zone of ethanol extract of kersen leaves (*Muntingia calabura* L.) against *Escherichia coli* MDR

Even though *Escherichia coli* bacteria are MDR, the composition of their cell walls remains the same as other gram-negative bacteria, consisting of lipopolysaccharide (LPS), phospholipids and lipoproteins. Lipoproteins are proteins found in Gram-negative bacteria which function to prevent leakage of periplasmic proteins and protect cells from bile salts and enzymes from the external environment. In the outer membrane there are protein pores which are permeable for solutes that have a low molecular weight and are hydrophilic, whereas for substances that have a high molecular weight such as antibiotics they are relatively slow to penetrate (Jawetz et al., 2001).

The antibacterial activity of ethanol extract of kersen leaves against sensitive *E. coli* is due to the content of compounds that have the potential to be antibacterial, including flavonoids, tannins and saponin (Kholis et al., 2024). Flavonoid, tannin, and saponin compounds can disrupt the integrity of bacterial cell membranes, inhibit essential metabolism, and damage cell walls, supporting a synergistic mechanism that gives plant extracts antibacterial activity.

Conclusion

Based on the research results, it can be concluded that ethanol extract of kersen leaves (*Muntingia calabura* L.) contains flavonoids, saponins and tannins which have antibacterial activity against sensitive *Escherichia coli* and MDR *Escherichia coli*. Ethanol extract from kersen leaves (*Muntingia calabura* L.) can inhibit the growth of sensitive *Escherichia coli* and MDR *Escherichia coli* bacteria at a concentration of 1.25%.

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Author Contributions

The research team, depending on their scientific capabilities, contributes in the field of preparing natural materials or samples, starting from collecting raw materials, processing raw materials and extraction, namely myself as the first author. Other authors also contributed to the research, namely phytochemical screening, activity testing and data processing.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this paper.

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