

Antibacterial Effect of Coriarian Seed (*Coriandrum sativum* L.) Extract on *Streptococcus mutans*

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ABSTRACT

Dental plaque plays an important role in causing dental caries. In plaque formation, gram-positive coccus bacteria are found, one of which is *Streptococcus mutans* which can secrete toxins so that tooth cells are damaged. Dental plaque or dental caries can be controlled in number by controlling plaque with antimicrobial agents such as mouthwash. However, the continuous use of antimicrobials can cause side effects for users, including hypersensitivity reactions and resistance, so it is necessary to use natural ingredients as antibacterial alternatives. Therefore, this study used coriander seeds as an alternative to inhibit the growth of *Streptococcus mutans* bacteria. The purpose of this study was to determine the effectiveness of coriander seed extract (*Coriandrum sativum* L.) with varying concentrations on the growth of *Streptococcus mutans* bacteria. This study used the diffusion method as a bacterial test method for coriander seed extract. The concentrations tested in this study were 3%, 6% and 9%. Based on the results of the study showed that there was an inhibition zone in the test of coriander seed extract against *Streptococcus mutans*. At a concentration of 3% the average inhibition zone was 3.7 mm, the concentration of 6% was 4.7 mm and concentration of 9% by 6.06 mm. The results of this study concluded that coriander seed extract (*Coriandrum sativum* L.) was effective in inhibiting the growth of *Streptococcus mutans* bacteria.

KEYWORDS

Dental; Plaque; Coriander;
Streptococcus mutans;
Coriandrum sativum

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Introduction

Bacteria in the mouth that infect teeth are one of the causes of complications. Based on the Basic Health Research (RISKESDAS) in 2013 showed the prevalence of dental disease sufferers in Indonesia increased from 2008 by 2.5% to 25.9% (Health Research and Development Agency, 2013). Lack of public awareness of dental and oral hygiene, can cause dental and oral diseases. The tooth surface is the part of the oral cavity that does not undergo metabolic changes. This causes the teeth to experience various infections due to certain factors that support microbial growth. One of the infections in the teeth is dental caries. Based on the results of the 2018 Basic Health Research (Risksedas) the value of DMF-T (Decay, Missing, Filling - Teeth) or dental caries index, for adults is in the very worrying category. The dental caries index of Indonesians from one adult with 32 teeth, on average there are 7 damaged teeth (Health Research and Development Agency, 2018). Caries is an infection of the hard tissues of the teeth that causes demineralization of enamel and dentin ((Pawar et al., 2013). The etiologic factor of dental caries is cariogenic bacteria or biofilm ((Alfath et al., 2013).

Dental plaque plays an important role in causing dental caries. Plaque is a soft layer consisting of a collection of microorganisms that proliferate on a matrix formed and adheres tightly to the surface of the tooth that is not cleaned. At the beginning of plaque formation, gram-positive cocci were the most common types, such as *Streptococcus mutans*, *Streptococcus sanguis*, *Streptococcus mitis* and *Streptococcus salivarius* and *Lactobacillus* in dental plaque (Pawar et al., 2013). *Streptococcus mutans* is a gram-positive bacterium of the *Streptococcus viridans* group that can secrete toxins so that dental cells are damaged and are aerobic and are relatively often found in the oral cavity, namely on the tooth surface (Shetty et al., 2010).

Gram positive globular characteristically forming pairs or chains with a diameter of 0.5 - 0.7 microns, immobile and devoid of spores. *Streptococcus mutans* can live in sucrose-rich areas and produce an acidic surface by lowering the pH in the oral cavity to 5.5 or lower which makes the enamel easy to dissolve, then bacteria buildup occurs and interferes with the work of saliva to clean the bacteria, so that the hard tissues of the teeth are damaged and cause dental caries (Alfath et al., 2013).

The amount of dental plaque or dental caries can be controlled by means of plaque control, namely the removal and prevention of plaque accumulation on the tooth surface and surrounding tissues. Plaque control can be

done mechanically by brushing and cleaning the interdental teeth and chemically with antimicrobial agents such as mouthwash (Newman et al., 2019)

Antimicrobial is a substance produced by a microorganism (bacteria), which has the ability to inhibit the growth or kill other microorganisms. One of the plants that has an antimicrobial effect is coriander seeds (Triatmoko et al., 2018)

Coriander (*Coriandrum sativum L.*) is a spice plant that is popular in Indonesia. The benefits taken from coriander are the leaves, seeds and fruit. Of all the contents there are vitamins, minerals and iron in the leaves, while the seeds contain essential oils such as linalool 70%.

In addition, according to (Moradian et al., 2013) there are monoterpenes, phenolic acids, steroids and flavonoids. Based on research by (Arianto, 2017), essential oil from coriander seeds effectively inhibits the growth of gram-positive and gram-negative bacteria with a concentration series of 0.2 - 0.8%. Coriander has antibacterial properties against *Pseudomonas spp.*, *Escherichia coli*, *Shigella dysenteriae*, *Salmonella typhi* and *S. mutans*. The same thing was also proven in *Staphylococcus epidermidis* bacteria (Triatmoko et al., 2018)

The use of mouthwash containing 3% coriander seed extract also has an effect on reducing plaque accumulation (Martina, 2015). Coriander seed oil with a concentration of 0.5% serves to prevent the development of gram-positive and gram-negative bacteria (Pawar et al., 2013). So based on the background that has been explained, the researchers wanted to know the Effectiveness of Coriander Seed Extract with Variations in Concentration on the Growth of *Streptococcus mutans*.

Literature review

Coriander chemical content

Coriander contains active components, namely vitamins, peptides, minerals, fatty acids, polyunsaturated fatty acids, antioxidants and enzymes (Handayani & Juniarti, 2012). Coriander has a distinctive aroma, the aroma is caused by the chemical components contained in the essential oil (Triatmoko et al., 2018). The largest chemical content of coriander is 1.8% essential oil. Refined oils contain 65-70% of linalool (coriandrol), which depends on the source. Other constituents are monoterpene hydrocarbons -pinene, -pinene, limonene, -terpinene, -lymene, borneol, citron wllol, Xmphoe, Geraniol and Geranylacetate; x pyridine, thiazole, furan, tetrahydrofuran derivatives; Isocoumarin (coriandrin), coriandrones AE, glazonoids; Z-digustilide; sterols, and flavonoids (Moradian et al., 2013). Gram positive globular characteristically forming pairs or chains with a diameter of 0.5 - 0.7 microns, immobile and devoid of spores. *Streptococcus mutans* can live in sucrose-rich areas and produce an acidic surface by lowering the pH in the oral cavity to 5.5 or lower which makes the enamel easy to dissolve, then bacteria buildup occurs and interferes with the work of saliva to clean the bacteria, so that the hard tissues of the teeth are damaged and cause dental caries (Alfath et al., 2013). The amount of dental plaque or dental caries can be controlled by means of plaque control, namely the removal and prevention of plaque accumulation on the tooth surface and surrounding tissues. Plaque control can be done mechanically by brushing and cleaning the interdental teeth and chemically with antimicrobial agents such as mouthwash. Antimicrobial is a substance produced by a microorganism (bacteria), which has the ability to inhibit the growth or kill other microorganisms. One of the plants that has an antimicrobial effect is coriander seeds (Moradian et al., 2013).

Streptococcus mutans

Streptococcus mutans belongs to the Streptococcaceae family and is a cariogenic bacterium which is the main cause of dental caries. The oral cavity is the main habitat capable of causing bacterial colonization on the tooth surface. *Streptococcus mutans* is able to metabolize carbohydrates to become acidic so that the pH of saliva and plaque pH decreases to below the critical point which can eventually lead to the dissolution of enamel. In addition, *Streptococcus mutans* is able to synthesize glucan from sucrose and the glucan formed is a sticky, concentrated and insoluble mass and plays a role in attachment to the tooth surface (R. & R., 2008).

Streptococcus mutans It has a capsule composition consisting of polysaccharides with a glucose (dextran) structural subunit. *Streptococcus mutans* bacteria are gram-positive, non-motile, and are bacteria facultative anaerobes. *Streptococcus mutans* is typically spherical in shape which can form pairs or chains during its growth period with a diameter of 0.5-0.7. *Streptococcus mutans* bacteria have a tendency to form cocci with long chain formation when grown on enriched media such as Brain Heart Infusion (BHI) Broth, whereas when grown in agar medium, they show short chains with irregular cell shapes.

Streptococcus mutans usually found in the human oral cavity, and is a major contributor to tooth decay (Wibowo, 2014). The results of putrefaction can greatly affect an individual's overall health. *Streptococcus mutans* can grow at temperatures between 18-40°C which is also called mesophilic (Indrawati et al., 2014). *Streptococcus mutans* bacteria have been isolated from the oral cavity and experimental animals including rats and human oral cavity.

Dental Plaque

Definition of Dental Plaque

Dental plaque is a soft deposit consisting of a collection of bacteria that proliferate in the lining of an intracellular matrix. This layer is formed and adheres tightly to the surface of the teeth when a person neglects the hygiene of his teeth and mouth. Small amounts of plaque cannot be seen unless it has been stained with disclosing solution or has been discolored by pigments in the oral cavity. If the plaque has accumulated, the plaque will appear

gray, yellowish and yellow in color. Plaque usually forms on one third of the gingival surface and on the surface of the teeth that are deformed and rough

Mechanism of dental plaque formation

Plaque consists of microorganisms that proliferate in an intercellular matrix in the form of sticky bacteria and bacterial products. The mechanism of plaque formation is the formation of an acquired pellicle on the surface of the tooth which is transparent in color, then bacteria will stick to and proliferate so that the color will turn yellowish. The pellicle consisting of glycoproteins is deposited by saliva after brushing the teeth. The proliferation of bacteria makes the plaque layer thicker. This is due to the metabolism and adhesion of bacteria to the outer surface of the plaque

The Role of Streptococcus mutans in the Dental Caries Process

The disease caused by *Streptococcus mutans* bacteria is dental caries. Several things that cause dental caries to get worse are sucrose intake, host resistance (tooth) and saliva. After consuming a sucrose-containing food or a few minutes after brushing your teeth, the attached glycoproteins (a combination of protein and carbohydrate molecules) will remain on the teeth to start forming plaque on the tooth enamel surface. At the same time the bacteria *S. mutans* in very large numbers are also contained in glycoproteins. Although many other types of bacteria are attached, only *Streptococcus mutans* can cause dental caries (Indrawati *et al.*, 2014)

In a more advanced stage, *Streptococcus mutans* bacteria use fructose and sucrose as an energy source for glycolysis metabolism. In the process of glycolysis metabolism, an enzyme is needed, namely the glucosyltransferase enzyme which can cause glucose polymerization in sucrose with the release of fructose. Glucosyltransferase enzymes can also increase the number of glucose molecules in forming dextran which has a structure similar to amylose. Dextran together with bacteria will be firmly attached to the surface of tooth enamel which causes the formation of plaque on the teeth

Methods

The method used in this research is experimental research. Experimental research is a research method used to find the effect of certain treatments on others under controlled conditions. This study aims to determine the minimum inhibitory concentration (MIC) of coriander seed extract (*Coriandrum sativum* L.) on the growth of *Streptococcus mutans*. Data collection is done by collecting primary data, namely data obtained or collected directly in the field by the person conducting the research or the person concerned who needs it. The primary data was obtained by giving direct treatment to disc paper that had been soaked in coriander seed extract which was then placed on the surface of NA (Nutrient Agar) media which had been planted with *Streptococcus mutans* bacteria. Then the data obtained were recorded and presented in tabular form.

Glassware Sterilization

Prepare all tools to be sterilized, wash thoroughly with soap then dry and wrap with newspaper. Sterilized by using an oven at a temperature of 160° - 180°C for 2 hours.

Making Coriander Seed Extract

The dried coriander seeds were weighed as much as 1.5 kg, then crushed and dissolve in 96% ethanol 8 L. The solution is macerated for 72 hours, the solution is filtered using gauze and the filtrate is concentrated with a rotary evaporator.

Phytochemical Identification

A total of 0.5 g of extract was added with 5 mL of 10% hydrochloric acid, shaken and added 5 mL of 10% ammonia solution. Extracted with 10 mL of chloroform and evaporated. The remaining evaporation residue was added with 1.5 mL of 2% hydrochloric acid, divided into two tubes. The first tube was added with 3 drops of Mayer's reagent, the formation of a yellowish white precipitate indicated the presence of alkaloids. In the second tube added with three drops reactor Dragendorff, The formation of a brick red precipitate indicates the presence of alkaloids.

Identification of lipids, steroids and terpenoids

A total of 0.5 g of extract was extracted with 10 mL of ether. A total of 0.5 mL of the solution was tested with Lieberman Burchard reagent. Formation of blue or green color indicates the presence of lipids, steroids and green or purple color indicates the presence of terpenoids.

Identification of flavonoids, saponins, tannins

A total of 0.5 g of extract was dissolved in 10 mL of water and placed on a water bath, then the solution was divided into three tubes. The first tube, 100 mg of magnesium powder was added and then 1 mL of concentrated hydrochloric acid and 3 mL of amyl alcohol were added, shaken vigorously and allowed to separate, the red, yellow, orange colors on the amyl alcohol layer indicated the presence of flavonoids. The second tube is shaken vertically for

10 seconds, it will form a stable foam, left for 10 minutes, added 1 drop of 1% hydrochloric acid. If the foam does not disappear, it indicates the presence of saponins. The third tube added a few drops of 1% iron (III) chloride solution, the formation of a dark blue or purple-black filtrate.

How to Make NA Media (Nutrient Agar)

Weigh 2.8 grams of powdered NA media, put it in an erlenmeyer. Dissolve into 100 mL of distilled water, stir using a stir bar, but pour in a little at a time, not all at once. Heat while stirring until it boils. Remove medium when it boils. Closed part mouth erlenmeyer with plug cotton and aluminum foil. Label the erlenmeyer containing the media with the name of the media and the date of creation of the media. Sterilize the media in an autoclave at 121°C for 15 minutes. Pour the NA medium into a sterile, aseptic petri dish as much as 15-20 mL.

How to make NB Media (Nutrien Broth)

Weigh 1.6 grams of powdered NB media, put it in an erlenmeyer. Dissolve into 200 mL of distilled water, stir using a stir rod, but pour in a little at a time, not all at once. Heat while stirring until it boils. Remove medium when it boils. Cover the mouth of the Erlenmeyer with a cotton plug and aluminum foil. Label the erlenmeyer containing the media with the name of the media and the date of creation of the media. Sterilize the media in an autoclave at 121°C for 15 minutes. Pour the NB media into a sterile, aseptic petri dish as much as 15-20 mL.

Method of Preparation of 0.5 M Mc Farland Standard Solution

Prepare tools and materials to be used. Add BaCl₂ . solution 2 1% 0.05 mL in a test tube. Add H₂SO₄ solution 9,95 mL 1% 2SO₄ in the tube, reaction that already contains a solution of BaCl₂ 1%. Then wrap over the tube. And homogenize until the two solutions are mixed.

Preparation of MHA (Mueller Hilton Agar) Medium

38 g of Mueller Hilton Agar dissolved in 1000 mL aquadest. Heat and stir until dissolved. The media was sterilized in an autoclave for 15 minutes at 121°C with a pressure of 15 Psi. Let stand until medium warm. Poured into a petri dish.

Gram stain

Put a drop of aquadest on the cleaned glass object. Take one loop of bacterial culture (do it aseptically). Apply homogeneously on the glass object evenly. Cool the glass object in the air. Fixation on fire using spirit. Drops of Ammonium Crystal Violet, let stand 2 minutes. Rinse using aquadest. Drop Lugol, let stand for 1 minute. Rinse with aquadest. Dry in the air, suck the excess water with a tissue. Observe cell morphology and color under a microscope. Bacteria are classified as Gram positive if the cells are stained purple, and Gram negative if the cells are stained red

Antibacterial Test

Prepare tools and materials. Dipped sterile swab into bacterial suspension. Inoculated into the MHA media by scraping the swab onto the surface of the MHA media evenly. The media that has been inoculated with the suspension is left to stand dry for five minutes. Put the paper disc that has been soaked in coriander seed extract dissolved in 96% ethanol onto the surface of the medium with sterile tweezers for 15 minutes. Include a positive control listerine (gargle) and a negative control aquades and keep the disc in the middle of the cup. Incubate all cultures for 24 hours at 37°C. After incubation, measure the diameter of each clear zone area using a caliper.

Results

This research was carried out in the Microbiology laboratory of the Rajawali Health Institute, Bandung in July - August 2020. The research was carried out by making coriander seed extract (*Coriandrum sativum* L), identification of *Streptococcus mutans* bacteria and testing of coriander seed extract against *Streptococcus mutans* bacteria. The results show that coriander seeds contain a class of compounds of saponins, lipids (terpenoids, steroids) and alkaloids.

Identification of Streptococcus mutans

Identification is done to ensure that *Streptococcus mutans* will be used as the object of research. Identification was carried out by means of morphological identification by means of macroscopic observations of colonies and microscopic observations. Macroscopic observations are carried out by observing microorganisms in visible parts that can be seen with the naked eye, while microscopic observations are carried out by gram staining which is then viewed under a microscope at a certain magnification to determine the shape, color, composition and properties of these microorganisms.

Table 1. Colony Macroscopic Observation

Observed aspects	Media Isolation (Blood Agar)
Colony Form	Round, Fine
Colony Color	Ash – translucent gray to white
Colony Diameter	0.5-1mm
Elevation	Convex

Table 4.1 shows the results of macroscopic identification with round and smooth colonies, translucent gray to white colonies, 0.5-1 mm in diameter and convex elevation. Furthermore, the colonies obtained were isolated on Nutrient Agar slanted agar media and preparations were made for microscopic examination using gram staining.

Table 2. Microscopic Observations

Observed aspects	Media Isolation (Nutrient Agar)
Shape	Round
Color	Purple
arrangement	Chain two or more
Nature	gram Positive

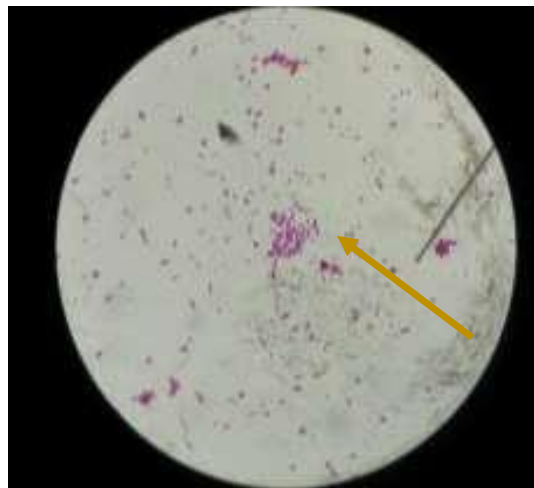


Figure 1. *Streptococcus mutans* bacteria on gram stain with 100X . magnification (yellow arrows indicate the presence of gram-positive bacteria that are stained purple in the form of coccus with short chains or two pairs and are gram-positive bacteria.)

Table 4.2 shows the results of microscopic identification with round colonies (coccus), purple colony color, two or more chains of colonies arranged and gram positive. In the research test used concentration variations of 3%, 6%, and 9% with five repetitions. This test was carried out using the diffusion method or the disc method, namely by soaking the discs in 3%, 6% and 9% coriander seed extract for 15 minutes, then stored in MHA medium which had previously been planted with *Streptococcus mutans* strains. The test sample was incubated at 37°C for 24 hours. The results of the research test are presented in tabular form as follows:

Table 3. Research Results of Coriander Seed Extract Intolerance

No	Result	Average		Description
		Concentration	Inhibition zone diameter (mm)	
1		Positive control, using mouthwash	5,5	Medium Inhibitory Strength

2		Negative control, using aquadest	0	No inhibition zone
3		Coriander seed extract 3%	3,7	Weak Inhibitory Strength
4		Coriander seed extract 6%	4,7	Weak Inhibitory Strength
5		Coriander seed extract 9%	6,06	Weak Inhibition Strength

Discussion

In this study, the test material used was coriander seeds (*Coriandrum sativum* L.) whose seeds were round and brownish yellow. Coriander seeds are extracted to produce metabolites so that identification can be carried out. During the extraction process, the active ingredient will be dissolved by a filter substance that matches its polarity. In this study, the extraction was carried out by the maceration method. The maceration method can avoid the destruction of thermolabile compounds. In the results of the study, it was found that the weight of the thick extract was 30 grams from the weight of the coriander seed sample as much as 1.5 kg. The results of the coriander seed extract were then diluted with distilled water to obtain the required concentrations of 3%, 6% and 9%. The discs were then immersed in the solution for 15 minutes. The negative control used in this study was using distilled water, distilled water was chosen because it did not have antibacterial substances. The negative control function is to ensure that the distilled water used as a diluent for coriander seed extract does not contain antimicrobial substances. The positive control in this study used mouthwash with the brand Listerine. Listerine is an essential oil-based mouthwash that usually contains alcohol and has a distinctive aroma, this mouthwash works by damaging the cell walls of bacteria so that no further development occurs and reduces plaque formation. The purpose of making controls in this study was to determine the existence of factors that affect the diameter of the inhibition zone such as the quality of the media used and the occurrence of contamination.

According to (S. et al., 2014), the main components of the essential oil in coriander seeds include Linalool (67.7%), -pinene (10.5%), -terpenoids (9.0%), geranylacetate (4.0%), camphor (3.0%), geraniol (1.9%) and less than 2% of components other than essential oils. Coriander seed extract components also contain protein compounds, carbohydrates, phenolic compounds, tannins, and flavonoids. To determine the chemical content of coriander seeds used for testing, a phytochemical test was carried out.

Phytochemical tests are used to detect plant compounds based on their groups as initial information in knowing the class of chemical compounds that have biological activity from a plant. From the results of phytochemical screening, it is known that the content of saponins, lipids (steroid terpenoids) and alkaloids in coriander seeds were used for testing. This is in accordance with research conducted by (S. et al., 2014) which states the presence of terpenoids in coriander seed essential oil. Secondary metabolites such as flavonoids, saponins, tannins and terpenoids or steroids are chemical compounds that have potential as antibacterial and antiviral. Alkaloids also have potential as antibacterial compounds, namely with an inhibitory mechanism by interfering with the peptidoglycan constituent components in bacterial cells, so that the cell wall layer is not fully formed and causes the death of the cell (Cheng & Hu, 2014). Saponins are found in all plants with high concentrations in certain parts. Saponins are very effective as antimicrobial agents against bacteria, viruses, fungi, and yeasts. Steroids or terpenoids have potential as antibacterial compounds, namely by inhibiting protein synthesis.

In this study, the effectiveness of coriander seed extract was tested against *Streptococcus mutans* bacteria with varying concentrations of 3%, 6% and 9%. *Streptococcus mutans* bacteria were isolated on blood agar plate (BAP) media. Blood Agar media is a bacterial growth medium that can distinguish pathogenic bacteria based on the effect of bacterial hemolytic exotoxins on red blood cells. Based on the results of the isolation of *Streptococcus mutans* bacteria, it shows that *Streptococcus mutans* is a hemolytic bacterium or partial lysis of red blood cells which is indicated by the color of the colonies that are translucent gray to white. There are three types of hemolysis, namely beta hemolysis, alpha hemolysis, and gamma hemolysis. Beta hemolysis is the complete lysis of red blood cells and hemoglobin. alpha hemolysis refers to partial lysis or partial lysis of red blood cells, gamma hemolysis, i.e. there is no hemolysis where there is no color change in the medium. Then the isolates of *Streptococcus mutans* were grown in Nutrient Agar (NA) medium. NA is one of the commonly used media in bacteriological procedures for the growth of samples in bacterial tests and isolating organisms in pure culture. Then gram staining was performed to determine the morphology of *Streptococcus mutans* bacteria. The results of the Gram staining showed that the colonies were purplish, coccus-shaped with short chains or two pairs and were gram-positive bacteria. Then the isolates of *Streptococcus mutans* were grown in Nutrient Agar (NA) medium. NA is one of the commonly used media in bacteriological procedures for the growth of samples in bacterial tests and isolating organisms in pure culture. Then gram staining was performed to determine the morphology of *Streptococcus mutans* bacteria. The results of the Gram staining showed that the colonies were purplish, coccus-shaped with short chains or two pairs and were gram-positive bacteria. Then the isolates of *Streptococcus mutans* were grown in Nutrient Agar (NA) medium. NA is one of the commonly used media in bacteriological procedures for the growth of samples in bacterial tests and isolating organisms in pure culture. Then gram staining was performed to determine the morphology of *Streptococcus mutans* bacteria. The results of the Gram staining showed that the colonies were purplish, coccus-shaped with short chains or two pairs and were gram-positive bacteria.

The effectiveness test of coriander seed extract was carried out using the paper disc diffusion method. Observations were made after the bacteria were inoculated, the growth of bacteria was observed to see the clear zone around the disc. The disc paper used is 0.5 cm in diameter. After incubation for 24 hours, a clear zone was found. At a concentration of 3%, the average clear zone formed after five repetitions was 3.7 mm. At a concentration of 6% the average clear zone formed after five repetitions was 4.7 mm and at a concentration of 9% the average clear zone formed after five repetitions was 6.06 mm. According to Davis and Stout (1971) antimicrobial power based on the diameter of the inhibitor is divided into four levels, namely the diameter of inhibition below 5 mm including weak, 5-10 mm including medium, 10 - 20 mm is considered strong and 20 mm is considered very strong. Based on the results obtained and adjusted to the provisions of Davis and Stout, the results of the effectiveness test of coriander seeds with a concentration of 3% with an average clear zone of 3.7mm including a weak inhibitory power, for a concentration of 6% with an average clear zone of 4.7 mm is included in the category of weak inhibitory power and for a concentration of 9% with an average clear zone of 6.06 mm is included in the category of moderate inhibitory strength. Zone differences occur because of the different levels of the active substance from each concentration which is influenced by the dilution series. The more active substances dissolved, the larger the diameter of the inhibition zone

formed, this is also due to the presence of saponin active substances, According to (Rahmawati et al., 2014), several factors that can affect the work of antimicrobial materials are: concentration or intensity of antimicrobial substances, the higher the concentration of antimicrobial substances, the higher the inhibitory or killing power (to a certain extent), the number, type, age and condition of microorganisms, pH or acidity because microorganisms present in acidic materials can be eradicated at lower temperatures in a shorter time than the same microorganisms in an alkaline environment, an increase in temperature can increase the effectiveness of an antimicrobial agent. Every 10°C increase can cause a doubling of the mortality rate, besides that microorganisms that are long enough in anti-microbial materials can be stunted or can die.

The results of this study concluded that along with the increasing diameter of the inhibition zone which also resulted in an increase in the inhibitory power of the coriander seed extract. For more optimal results from the use of coriander seeds, it is necessary to carry out various more in-depth studies, so that coriander seeds can be used as an antimicrobial alternative for *Streptococcus mutans* and to treat dental caries.

Conclusion

The conclusion on this research is coriander seed extract (*Coriandrum sativum* L.) has antibacterial activity as indicated by the formation of an inhibition zone against the growth of *Streptococcus mutans*. At a concentration of 3%, 6% and 9% a clear zone was formed with an average diameter of the clear zone formed at a concentration of 3% which was 3.7 mm, the the average diameter of the clear zone formed at a concentration of 6% concentration is 4.7 mm and the average diameter of the clear zone formed at a concentration of 9% is 6.06 mm. The concentration of coriander seed extract (*Coriandrum sativum* L.) was obtained which was able to inhibit the growth of *Streptococcus mutans* bacteria, namely at a concentration of 3% with a weak inhibitory power.

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