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Antibacterial activity of coriander seeds extract (*Coriandrum sativum*) against the growth of *Streptococcus mutans*

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Abstract
Background: Streptococcus mutans is the main cause of dental caries, previously known as part of the normal flora in the oral cavity which plays a role in the process of fermenting carbohydrates to produce acid, and causes tooth demineralization. Chemical-based medicinal products such as toothpaste and mouthwash. Continuous use of chemicals can cause side effects for users such as hypersensitivity, therefore an alternative treatment from natural ingredients such as coriander seeds which can inhibit bacterial growth is needed. *Objective:* This research aims to determine the lowest concentration of coriander seed extract in 0,75%, 1.5%, 3% inhibiting the growth of *Streptococcus mutans*. *Methods:* This study was conducted by soaking the test discs in coriander seed extract concentrations of 0.75%, 1.5% and 3%. each disc was inserted into the bacterial culture to be cultured, incubated and seen whether there was a clear zone or not. *Result:* Test results showed a clear zone at a concentration 1.5% with an average diameter of 1.5 mm, at concentration of 3% an average diameter of 3.7 mm and at concentration of 0.75% did not show clear zone. *Conclusion:* Based on the results of the study, the lowest concentration of coriander seed extract was obtained which was able to inhibit the growth of Streptococcus mutans bacteria, is at concentration of 1.5%, the diameter of the inhibition zone of coriander seed extract had weak antibacterial activity.

Keywords
Coriander seed, Effectiveness test, Maceration, *Streptococcus mutans*.

1. Introduction

Dental *caries* comes from Latin which means tooth hole. Caries is a disease of the hard tissue of the teeth which is characterized by damage to the enamel layer, dentin, and in the process dental caries occurs. Dental caries affected all ages in the world with prevalence increasing rapidly in many countries so that it has become a common problem in society and needs serious attention (Bahar, 2015). According to the National Basic Health Research by the Indonesian Ministry of Health on 2018, the national prevalence of

dental and oral problems was found to be 57.6% of the Indonesian population admitting to dental and oral problems and only 10.2% received dental medical treatment. Ministry of health concluded that the province with the greatest dental health problems was Central Sulawesi, 75.3% and only 8.2% received services from medical dental personnel (Kemenkes RI, 2018).

The normal flora inhabiting the oral cavity consists of *Streptococcus mutans*, *Streptococcus salivarius*, *Streptococcus sanguinis*, *Streptococcus oralis* (Abranches et al., 2018). Even though they are found in the oral cavity as normal flora, under certain conditions these bacteria can become pathogenic due to predisposing factors, namely oral hygiene (Abranches et al., 2018). The dominant bacteria in plaque formation and the main cause of dental caries are Gram-positive cocci, one of which is *Streptococcus mutans* (Widiani & Pinatih, 2020).

Prevention of dental caries by removing plaque can be done by using mouthwash and toothpaste containing antibacterials. Brushing teeth with toothpaste is one of the most frequently used oral hygiene practices in the world and is an important measure for maintaining oral health. Through it, the biofilm can be removed mechanically and consequently reduce the number of microorganisms. However, this is not always done well. Therefore, the incorporation of antimicrobial agents into toothpaste is a very important prophylactic method to help control the number of microorganisms present in the oral cavity and thereby reduce the possibility of infection. They act by slowing down the multiplication of microorganisms, preventing bacterial aggregation and rupture of pathogenic cell walls. Antimicrobial agents such as sodium fluoride and triclosan have different mechanisms of action by inhibiting enzyme activity. In addition, herbal toothpaste contains phytochemicals, namely substances responsible for antimicrobial and anti-inflammatory effects (Marinho et al., 2022).

Coriander seeds (*Coriandrum sativum*) are one of the herbal plants that have antimicrobial effects. Coriander seed essential oil has antimicrobial activity against gram-positive and gram-negative bacteria with a mechanism of action that involves damaging bacterial cell membranes, causing bacterial death (Eliana et al., 2017). Previous research related to the benefits of coriander seed extract as an antibiotic was conducted by Eliana in 2017 that 4%, 8%, 12% and 16% ethyl acetate fraction of coriander seed extract could inhibit the formation of S. mutans bacterial biofilm mass. Apart from that, research conducted by

(Magani et al., 2020) shows that coriander has antibacterial activity. Therefore, it is necessary to look for alternative antibacterial drugs to prevent problems that occur in the mouth and teeth, one of which is by using coriander seeds.

2. Materials and Methods

2.1. Preparation and identification of coriander seed extract

The materials used in this research are sterile distilled water, alcohol, glacial acetic acid, anhydrous acetic acid, sulfuric acid, 70% alcohol, $Bi(NO_3)$, pure culture of *Streptococcus mutans*, mouthwash, $CHCl_3$ (Chloroform), coriander seed extract, 96% ethanol, NaOH (Sodium hydroxide), HCl (Chloric acid), HNO_3 (Nitric acid), $HgCl_2$ (mercury chloride), Nutrient Agar (NA) Media, NH_4OH (Ammonium hydroxide), lugol, crystal violet, safranin, and magnesium powder.

The procedural stages of this research include sterilization of glassware, extraction of coriander seeds, phytochemical identification for alkaloids, lipids, steroids and terpenoids, identification of flavonoids, saponins and tannins and antibacterial testing. Sterilization of glassware is carried out by washing all glassware until clean using soap, then drying it and wrapping it in newspaper. The wrapped equipment is sterilized using an oven at a temperature of 160^{O}C – 180^{O}C for 2 hours (Wulandari et al., 2022). Weigh 1.5 kg of dried coriander seeds, then grind them. Add 8L of ethanol to the coriander seeds, then macerate for 72 hours. After maceration is carried out, the solution is filtered using gauze, then the filtrate is concentrated using a rotary evaporator (Anggraeni et al., 2016).

Identification of the alkaloid group was carried out by measuring 0.5 g of extract plus 5 mL of 10% hydrochloric acid, shaking and adding 5 mL of 10% ammonia solution. The solution was extracted with 10 mL of chloroform and evaporated; the remaining evaporation residue was added with 1.5 mL of 2% hydrochloric acid in two tubes. The first tube was reacted with 3 drops of Mayer's reagent, a yellowish white precipitate was formed indicating the presence of alkaloids. The second tube was reacted with 3 drops of Dragendroff's reagent, a brick red precipitate was formed indicating the presence of alkaloids (Majid et al., 2022).

Identification of the Lipid, Steroid and Terpenoid groups was carried out by weighing 0.5 g of the extracted extract with 10 mL of Ether. The extract solution was then tested using

Lieberman Burchard's reagent. The formation of blue or green color indicates the presence of lipids and steroids, green or purple color indicates the presence of terpenoids (Nasrudin, wahyono, Mustofa, 2017).

Identification of Flavonoid, Saponin and Tannin groups was carried out by measuring 0.5 g of extract dissolved in 10 mL of water and placed on a handle, then the solution was divided into three tubes. Into the first tube, 100 mg of magnesium powder was added, then 1 mL of concentrated hydrochloric acid and 3 mL of amyl alcohol were added, shaken vigorously and allowed to separate, the red, yellow and orange colors in the amyl alcohol layer indicated the presence of flavonoids (Nikmah et al., 2022). The second tube is shaken vertically for 10 seconds, then stable foam will form. Left for 10 minutes, 1 drop of 1% hydrochloric acid was added. If the foam does not disappear, it indicates the presence of saponin. The third tube was reacted with several drops of 1% iron (III) chloride solution, forming a dark blue or blackish purple filtrate (Sukma et al., 2018).

2.2. Antibacterial assay

Antibacterial assay was carried out by inoculating the bacterial suspension into Nutrient Agar medium, then leaving it for 5 minutes to dry. Paper discs that had been soaked for 15 minutes in various stock concentrations of coriander seed extract-alcohol were placed on the surface of the medium with sterile tweezers. The medium that had been given the disks was incubated for 24 hours at 37^{o}C. After incubation, the diameter of the clear zone was measured using a caliper (Kodariah et al., 2022).

Data obtained from the results of research on the Minimum Inhibitory Concentration (MIC) of coriander seed extract on the growth of *Streptococcus mutans* in tabular form. In research conducted by (Pawar et al., 2014) it was found that coriander seed oil with a concentration of 0.5% functioned to prevent the development of gram-positive and gram-negative bacteria. On this basis, the researchers used variations in concentration which were increased from 0.5% and increased, namely 0.75%; 1.5%; 3%; with 5 repetitions.

3. Results and Discussion

3.1. Phytochemical Test Result

Phytochemical testing was carried out on coriander seed extract to determine the compounds contained in coriander seeds. The results of phytochemical testing can be seen

in Table 2. Test Results of Coriander Seed Extract on the Growth of *Streptococcus mutans*. According to Amayanja and Naranjo, (2014) the strength of microbial activity is based on the inhibitory diameter which is divided into 4 levels of strength, namely:

Table 1. Strength of Antimicrobial Activities

Barrier diameter (mm)	Strongest
20	Very strong
10-20	Strong
5-10	Medium
<5	Weak

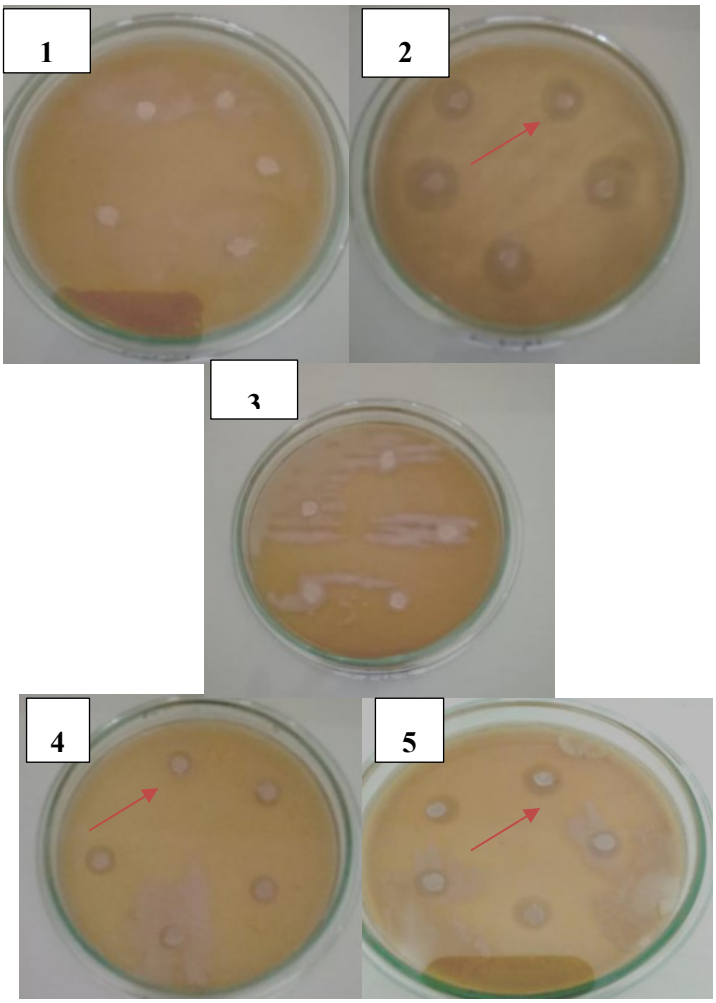

Figure 1. Antibacterial assay. (1) *Streptococcus mutans* control (-) inhibition zone o mm; (2) *Streptococcus mutans* control (+) inhibition zone 5.6 mm; (3) Coriander seed extract concentration 0.75% inhibition zone 0 mm; (4) Coriander seed extract concentration 1.5% inhibition zone 1.5 mm; (5) Coriander seed extract concentration 3% inhibition zone 3.7 mm. Red arrow: clear zone

Tabel 2. Phytochemical Test Result

Identified compound	Interpretation of result	Information
Saponin	Positive	There is foam that lasts for 1 minute
Lipid (terpenoid, steroid)	Positive	Only green in colour, positive terpenoids are thought to contain the pinen group alpha pinen, beta terpinene, etc.
Tanin	Negative	-
Flavonoid	Positive	Positive red colour is thought to contain flavans, flavonols, etc.
Alkaloid (Wagner method)	Positive	The reaction result is a precipitate. The type of alkaloid should be identified further to find out the compounds contained in the sample

The table above, it can be seen that the phytochemical test results of coriander seed extract contain saponins, lipids (terpenoids, steroids), flavonoids and alkaloids, which are thought to act as antibacterials.

In this study, we tested the effectiveness of coriander seed extract on the growth of *Streptococcus mutans* at concentrations of 0.75%; 1.5% and 3%. This concentration is a continuation of the concentration of coriander seed extract carried out by (Pawar et al., 2013), where a concentration of 0.5% coriander seed extract can act as an antibacterial and in this study the media used was MHA (Mueller Hilton Agar) media because the best media for examining sensibility using the Kirby Bauer method on aerobic and facultative anaerobic bacteria (Widiani & Pinatih, 2020). In accordance with research (Yeni Meryandini and Sunarti, 2016), the media in which bacteria were grown was incubated at 37 ^{o}C for 24 hours. The temperature for optimum bacterial growth is 37^{o}C-43^{o}C (Mutiasari, 2019) if the temperature reaches 45 ^{o}C-55 ^{o}C it will damage the survival of the bacteria and bacterial incubation is carried out for 24 hours because at that time the bacteria may have are in the logarithmic or exponential phase (Pakaya et al., 2022). In this phase the bacteria divide constantly and the number of cells increases. 24 hours is harvest time (Su'aidi, 2019), where this time is in the logarithmic or exponential phase where the number of cells is highest, reaching 10 to 15 billion bacteria per milliliter (Albar & Wibawa, 2017).

The results of the research test were the formation of a clear zone at a concentration of 3% with an average diameter of 3.7 mm and at a concentration of 1.5% a clear zone was formed with an average diameter of 1.5 mm, but at a concentration of 0.75% did not form

clear zone (Magani et al., 2020). The strength of the microbial activity based on the indicated inhibitory diameter is divided into four strength levels, namely the inhibitory diameter of 20 mm, the antimicrobial activity is very strong, the antimicrobial activity of 10-20 mm in diameter is strong, the antimicrobial activity of 5-10 mm in diameter is moderate and the diameter below 5 mm. the strength of the antimicrobial activity is weak.

Based on the results obtained and adjusted to the provisions of Davis and Stout, the diameter of the inhibition zone of coriander seed extract has weak antibacterial activity (Listyorini, 2019). The concentration decreases along with the smaller diameter of the inhibition zone which also results in a decrease in the inhibitory activity of coriander seed extract. The varying diameter of the inhibitory zone for each concentration proves that the higher the concentration, the more active substance it contains so that the diameter of the resulting inhibitory zone is larger. The results obtained were based on the average of the results and were repeated 5 times, repeated to minimize errors during research and the results obtained were more accurate.

4. Conclusions

Coriander seed extract (*Coriandrum sativum*) has antibacterial activity as indicated by the formation of an inhibitory zone against the growth of *Streptococcus mutans* bacteria. The average diameter of the clear zone produced is: a concentration of 0.75% does not form a clear zone, a concentration of 1.5% forms a clear zone with an average of 1.5 mm, and a concentration of 3% forms a clear zone with an average diameter of 3 .7mm. The lowest concentration of coriander seed extract that can be used to inhibit *Streptococcus mutans* is a concentration of 1.5%. For more optimal results from the use of coriander seeds, more in-depth research needs to be carried out, so that coriander seeds can be used or consumed by the public as antibiotics that can treat dental caries caused by the bacteria *Streptococcus mutans*.

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5. References

Abranches, J., Zeng, L., Kajfasz, J. K., Palmer, S. R., Chakraborty, B., Wen, Z. T., Richards, V. P., Brady, L. J., & Lemos, J. A. (2018). Biology of Oral Streptococci. Microbiology Spectrum, 6(5), 1–18. https://doi.org/10.1128/microbiolspec.gpp3-0042-2018

Albar, F., & Wibawa, A. S. (2017). Pengaruh Perbandingan Cmc-Na Sebagai Gelling Agent Pada Sediaan Gel Ekstrak Bawang Daun (Allium fistulosum L .) Terhadap Bakteri Staphylococcus Aureus The Effect Of Cmc-Na Comparison As Gelling Agent In Spring Onion (Allium fistulosum L .) Extract Again. Jurnal Ilmiah Farmasi, 1–9.

mayanja, A., & Naranjo, J. (2014). Uji Aktivitas Antibakteri Ekstrak Etanol Daun Sirsak (Annona muricata L.) Terhadap Shigella flexneri Secara In Vitro. Applied Microbiology and Biotechnology, 85(1), 2071–2079.

Anggraeni, T., Ridwan, A., Kodariah Kelompok Keilmuan Fisiologi, L., & Hewan dan Sains Biomedika Sekolah Ilmu dan Teknologi Hayati, P. (2016). Ekstrak Etanol Seledri (Apium graveolens) Sebagai Anti-Atherogenik Pada Tikus (Rattus norvegicus) Yang Diinduksi Hiperlipidemia. Prosiding Symbion (Symposium on Biology Education), Prodi Pendidikan Biologi, FKIP, Universitas Ahmad Dahlan, Ldl, 171–188.

Bahar, A. (2015). Paradigma baru pencegahan karies gigi dalam menunjang kemajuan ilmu kedokteran gigi pencegahan. UI-Press. https://lib.ui.ac.id

Eliana, S., Nur, A., & Rini Maya Puspita. (2017). Pengaruh Ekstrak Biji Ketumbar (Coriandrum Sativum) Fraksi Etil Asetat Terhadap Pembentukan Massa Biofilm Bakteri Streptococcus mutans (Kajian In Vitro). https://etd.repository.ugm.ac.id/penelitian/detail/116306

Kemenkes RI. (2018). Hasil Riset Kesehatan Dasar Tahun 2018. Kementrian Kesehatan RI, 53(9), 1689–1699.

Kodariah, L., Ghasani, F., & Murtafi'ah, N. (2022). Antibacterial effect of corarian seed (Coriandrum sativum L.) extract on Streptococcus mutans. Asian Journal of Health and Applied Sciences, 1(1), 7–14. https://doi.org/10.53402/ajhas.v1i1.7

Listyorini, D. (2019). Uji Daya Hambat Antibakteri Kombinasi Ekstrak Daun Sirih Merah (Piper crocatum) dan Daun Kelor (Moringa oleifera L.) Terhadap Bakteri Eschericia coli. Karya Tulis Ilmia Stikes Bhakti Husada Mulia Madiun.

Magani, A. K., Tallei, T. E., & Kolondam, B. J. (2020). Uji Antibakteri Nanopartikel Kitosan terhadap Pertumbuhan Bakteri Staphylococcus aureus dan Escherichia coli. Jurnal Bios Logos, 10(1), 7. https://doi.org/10.35799/jbl.10.1.2020.27978

Majid, N. (Nikmah), Majid, A. (Abdul), & Paulus, A. Y. (Aysanti). (2022). Identifikasi Golongan Senyawa Tanin, Flafonoid, Alkoloid dan Saponin sebagai Senyawa Antibakteri pada Ekstrak Daun Kelor (Moringa Oleifera L.) Asal Kota Kupang. CHMK Applied Scientific Journal, 5(1), 1–7. https://doi.org/10.37792/CASJ.V5I1.1133

Marinho, V. T., dos Reis, A. C., & da Costa Valente, M. L. (2022). Efficacy of Antimicrobial

Agents in Dentifrices: A Systematic Review. Antibiotics, 11(10). https://doi.org/10.3390/antibiotics11101413

Mutiasari, A. S. (2019). Uji Aktivitas Antibakteri Minyak Atsiri Biji Ketumbar (Coriandrum Sativum L.) dan Nanoemulsinya terhadap Staphylococcus epidermidis. https://repository.unej.ac.id/xmLui/handle/123456789/90980

Nasrudin, wahyono, Mustofa, R. A. (2017). Isolasi Senyawa Steroid Dari Kukit Akar Senggugu (Clerodendrum serratum L.Moon). Pharmacon :Journal Ilmiah Farmasi - Unsrat, 6(3).

Nikmah, Majid, A., & Paulus, A. Y. (2022). Identifikasi Golongan Senyawa Tanin, Flavonoid, Alkaloid dan Saponin Sebagai Senyawa Antibakteri Pada Ekstrak Daun Kelor (Moringa oleifera L.) Asal Kota Kupang. CHM-K Applied Scientific Journal, 5(1), 1–7.

Pakaya, M. S., Akuba, J., Papeo, D. R. P., Makkulawu, A., & Puspitadewi, A. A. (2022). Isolasi dan karakterisasi bakteri endofit dari akar pare (Momordica charantia L). Journal Syifa Sciences and Clinical Research, 4(1), 301–309.

Pawar, V. A., Bhagat, T. B., Toshniwal, M. R., Mokashi, N. D., & Khandelwal, K. R. (2014). Formulation and Evaluation of Dental Gel Containing Essential Oil of Coriander Against Oral Pathogens. International Research Journal of Pharmacy, 4(10), 48–54. https://doi.org/10.7897/2230-8407.041012

Su'aidi, M. N. (2019). Isolasi dan Identifikasi Bakteri Resisten Selenate (SeO4 2-) dari Sedimen Mangrove Pantai Banyuglugur Kabupaten Situbondo, Jawa Timur.

Sukma, D. R., Berawi, K. N., & Wahyudo, R. (2018). Pengaruh Pemberian Bawang Putih (Allium Sativum) terhadap Penyakit Dislipidemia. Jurnal Medula, 8(1), 49–53. https://juke.kedokteran.unila.ac.id/index.php/medula/article/view/2099

Widiani, P. I., & Pinatih, K. J. P. (2020). Uji Daya Hambat Ekstrak Etanol Daun Kelor (Moringa oleifera) Terhadap Pertumbuhan Bakteri Methicillin Resistant Staphylococcus aureus (MRSA). Medika Udayana, 9(3), 22–28. https://ojs.unud.ac.id/index.php/eum

Yeni Meryandini, A., & Sunarti, T. C. (2016). Penggunaan Substrat Whey Tahu Untuk Produksi Biomassa Oleh Pediococcus pentosaceus E.1222. Jurnal Teknologi Industri Pertanian, 26(3), 284–293.