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EFFECTIVENESS OF ROSELLA AS AN ANTIBACTERIAL

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ABSTRACT
The use of herbs for health maintenance and disease treatment is increasingly popular, particularly in developing countries. Rosella (*Hibiscus sabdariffa L.*) stands out as an herbal plant with significant health benefits. Its flower petals are rich in bioactive compounds, including flavonoids, saponins, tannins, anthocyanins, polyphenolic alkaloids, and terpenoids, which contribute to its antibacterial properties. The part of the rosella plant that is usually used is the petals. Rosella flower petals contain chemicals such as flavonoids, saponins, tannins, anthocyanins (red substances), polyphenolic alkaloids and terpenoids. The substances contained in the rosella plant have antibacterial activity. This paper discusses the antibacterial effect of the rosella plant. This study aimed to evaluate rosella's antibacterial effectiveness by reviewing 15 sources published between 2012 and 2022 from Google Scholar and PubMed in both English and Indonesian. The findings confirmed that rosella flower petal extract inhibits the growth of various bacteria due to its high concentrations of flavonoids and anthocyanins. These results highlight its potential as a natural antibacterial agent. Rosella extract offers promising antibacterial benefits, supporting its use in health care and as a natural alternative in managing bacterial infections. Further research could expand its applications in medical and pharmaceutical fields.

INTRODUCTION

The oral cavity is the most complex and easy place for microbes to colonize the human body. The teeth, gingiva, tongue and buccal mucosa have different surfaces for microbial colonization. The constant production of saliva, and the availability of sugars and amino acids from the food eaten provide nutrients for microbial growth. Bacteria are the most common microbes found in the human oral cavity. The human oral cavity is home to about 700 identified species of bacteria. Most of the bacteria that colonize the surface of these teeth are *Streptococcus* organisms. In addition, there are also *Lactobacillus* organisms that have an impact on the formation of caries (Unita & Singarimbun., 2018).

Infectious diseases are one of the health problems that continue to grow. Infections are caused by the invasion of microorganisms such as bacteria, viruses

and fungi into the body tissues which then multiply by themself. To overcome infectious diseases, therapy can be carried out using various antibiotics. Inappropriate use of antibiotics can cause problems with resistance and various reactions such as hypersensitivity, blood cell damage, drug poisoning, kidney damage (kidney failure) and damage to nerve cells (Putri et al., 2019).

Antibiotic resistance is an increasing global concern, prompting the need for alternative antimicrobial agents derived from natural sources. Rosella (Hibiscus sabdariffa), a widely known medicinal plant, has gained attention due to its potential antibacterial properties. Traditionally used in herbal medicine, Rosella contains bioactive compounds that may inhibit bacterial growth and provide a natural remedy against microbial infections. The use of natural plant extracts as antimicrobial agents is becoming more relevant in modern medical research, especially as the overuse and misuse of synthetic antibiotics contribute to resistance (Mohd Suhaili & Manshoor, 2022; Owoade et al., 2016).

Rosella has long been used in traditional medicine in various cultures, particularly in Africa, Asia, and the Middle East, for its broad-spectrum health benefits (Ali et al., 2005). So far, its chemical content, efficacy, and side effects have not been widely studied scientifically. One of the traditional medicines that is currently widely consumed by Indonesians is Rosella flowers (Hibiscus sabdariffa L.) (Febriyanto et al., 2018).

Rosella plant (*Hibiscus sabdariffa* L.) is a kind of shrub that is easy to grow. Rosella is a member of the family Malvaceae (Soo Ji & Dian Lestari dan Tristia Rinanda, 2012; Suniarti et al., 2022). Rosella plant is one of the natural products that has high potential as an herbal medicine and ornamental plant from a family of hibiscus types (Purba et al., 2020). This plant can live in tropical as well as subtropical regions and is known as herbal tea (Zulfikri & Putra., 2019). Every part of the rosella plant contains chemical compounds that are useful for treatment and as foodstuffs (Soo Ji & Dian Lestari dan Tristia Rinanda., 2012). Rosella flower contains polyphenol, several vitamins, minerals and 18 kinds of amino acids. Some studies show that polyphenols have antiviral, antioxidant and antibacterial activity. Rosella flowers can inhibit the development of Streptococcus sanguis bacteria which trigger the formation of dental plaque (Zulfikri & Putra., 2019). Rosella leaves contain major subclasses of flavonoids, such as rutin, quercetin, and kaempferol as well as their derivatives. In addition, rosella leaves (H. sabdariffa L.) are also known to contain neochlorogenic acid, chlorogenic acid, cryptochlorogenic acid, as well as protocatechuic acid, and sitosterol-β-D-galactoside. Rosella leaves contain higher concentrations of polyphenolic compounds, especially chlorogenic acid, quercetin, and kaempferol, contributing to antioxidant capacity and anti-inflammatory and antimicrobial activity (Komala et al., 2013).

It has shown that Rosella extracts exhibit significant antibacterial activity against various pathogenic microorganisms, including Streptococcus mutans and Porphyromonas gingivalis—two primary culprits in dental infections. The acidic and phenolic contents of Rosella interfere with bacterial cell walls, leading to disruption and inhibition of bacterial growth. Additionally, its antioxidant and anti-inflammatory properties contribute to oral health by reducing oxidative stress and inflammation in gum tissues. Moreover, the antimicrobial activity of Rosella is attributed to its high content of anthocyanins, which not only provide the characteristic red color but also possess antibacterial properties. Research suggests that anthocyanins can inhibit bacterial biofilm formation, an essential factor in the development of dental plaque. Since dental plaque plays a significant role in the onset of caries and gum disease, the ability of Rosella extracts to reduce plaque accumulation makes it a promising natural agent in dental care (Ismalayani & Sri Wahyuni., 2023).

One of the key advantages of Rosella extract lies in its anthocyanin content, which not only provides its characteristic red pigmentation but also plays a crucial role in inhibiting bacterial biofilm formation. Since biofilms are major contributors to dental plaque and subsequent oral infections, the

ability of Rosella to disrupt biofilm production enhances its applicability in dentistry (Zulfikri & Putra., 2019). Moreover, its anti-inflammatory and antioxidant properties further support oral health by reducing oxidative stress and inflammation in gum tissues, which are common precursors to periodontal disease (Komala et al., 2013).

In conclusion, Rosella demonstrates strong antibacterial properties that could revolutionize oral health care. Its effectiveness against key oral pathogens, combined with its biofilm inhibition, anti-inflammatory, and antioxidant properties, makes it a viable candidate for natural dental formulations. Future research should focus on optimizing Rosella-based dental products and conducting extensive clinical trials to validate its benefits in practical applications. If successfully integrated into mainstream dentistry, Rosella could offer a promising, natural solution to combat oral infections while addressing the global challenge of antibiotic resistance.

The main objective of this study is to evaluate the antibacterial efficacy of Rosella extract in the context of dentistry such as comparing the effectiveness of rosella extract with commonly used dental antibacterial agents (i.e. chlorhexidine and ethanol).

METHOD

This paper is prepared based on relevant references from various academic sources. The source include textbooks, scientific journals, articles and credible websites accessed through well-established and reputable databases such as PubMed, EBSCO and Google Scholar databases. The primary keywords used include “Rosella”, “*Hibiscus sabdariffa* L.”, “Effectiveness”, “Antibacterial”, “Bacterial”. The literature inclusion criteria for selecting the literature were quite specific: only publications from 2012-2022 were considered, and these had to be either in English or Indonesian, and the selected studies needed to be directly related to the theme of discussion, which is the effectiveness of rosella as an antibacterial. This approach ensured that the literature used was both current and aligned with the topic, providing a strong foundation for the analysis and conclusion in this paper.

RESULT AND DISCUSSION

Content of Result and Discussion

The results from the comprehensive literature search included total of 17 references. Subsequently, a detailed analysis was conducted using specific inclusion and exclusion criteria to ensure the relevance and quality of the sources. As a result of this thorough evaluation, 12 references were selected for further review, while 5 references did not meet the criteria and were therefore excluded from consideration. Additionally, another 5 references were removed from the list due to their publication dates; these references were either published more than 5 years ago in the case of journals or more than 10 years ago in the case of textbooks. This selection process was essential to ensure that only the most current and relevant literature was included in the study, thereby enhancing the credibility and accuracy of the research findings.

Table 1. Refrences Used

No	Reference	Reference Type	Rosella Extract	Topics Covered	Result
1	Unita & Singarimbun, 2018	Research	Aqueous extract of rosella 70 gr/100 ml diluted with concentrations of 10%, 30%, 50% and 70%	Number of colonies of *Streptococcus sp.* From several concentrations of ethanol extract of rosella petals that have antibacterial activity	A concentration of 5% indicates the value of the Minimum Inhibition Rate (MIR) while at a concentration of 10% indicates the value of the Minim

					um Kill Rate (MKR) of rosella flower petal extract against Streptococcus sp
2	Suniarti et al., 2022	Research	Water extract of rosella petals macerated with 70% ethanol in a ratio of 1:3	The potential of rosella flowers as antibacterial agents	The chemical compounds contained in rosella extract have the potential to be anti-inflammatory and antibacterial in dental disease
3	IG et al., 2016	Research	Rosella petal extract (concentration of 5%, 10%, 20%, 40%, 80%); positive control (Chlorhexidine 0.12%) and negative control (Aquades)	The effectiveness of the inhibitory power of rosella flower petal extract against the development of *Streptococcus mutans*	Rosella petal extract has potential as an antibacterial, especially *Streptococcus mutans* bacteria

					bacteria
4	Komala et al., 2013	Research	The mother solution of ethanol extract and rosella aqueous extract 70g/100 ml was diluted with concentrations of 10%, 30%, 50% and 70% for disc diffusion method with ampicillin positive control of 10 IU, and ethanol extract was diluted with concentrations of 0.1%, 0.25%, 0.5%, 1%, and 2% for dilution method against *S.pneumoniae*	Knowing the antibacterial effectiveness of ethanol extract and rosella petals water extract against *Streptococcus pneumoniae* bacteria	Ethanol extract and rosella water extract can inhibit the growth of *S. pneumoniae* bacteria. The minimum inhibitory concentration of the most effective rosella ethanol extract is a concentration of 1%
5	Nafisa et al., 2015	Research	Rosella petal extract (concentration 0.20 g/ml, 0.10 g/ml, 0.05 g/ml, 0.025 g/ml)	Antibacterial properties of rosella flower extract again	Rosella petal extract has antibacterial properties against the growth of *Strept*

			and control (Aquades) by diffusion method	st *Streptococcus sanguis*	*ococcus sanguis* bacteria with concentrations of 0.2 gr, 0.1 gr, 0.025 gr and 0.05 gr
6	Purba et al., 2020	Research	The infusion is obtained from rosella simplisia powder mixed with aquades up to 100 ml warmed while stirring to 90^{0}C, then let stand for 15 minutes and filtered with patchwork	Phytochemical screening and antimicrobial activity in rosella flowers.	Infusion of rosella flowers has antibacterial properties against bacteria *Escherichia coli* and *Staphylococcus aureus*.

Based on Table 1 above, it can be strongly suggest that Rosella (Hibiscus sabdariffa) possesses significant antibacterial properties, making it a promising natural alternative in dentistry. The bioactive compounds found in Rosella, including flavonoids, polyphenols, and organic acids, contribute to its effectiveness against common oral pathogens such as *Streptococcus mutans*, *Streptococcus sanguis*, and *Streptococcus pneumoniae*. Research has demonstrated that different concentrations of Rosella extract exhibit minimum inhibitory and bactericidal effects, comparable to conventional antimicrobial agents like chlorhexidine.

Moreover, Rosella's potential extends beyond antibacterial activity, as its anti-inflammatory and antioxidant properties may contribute to overall oral health by reducing oxidative stress and inflammation in gum tissues. The ability of Rosella extract to inhibit bacterial biofilm formation further enhances its relevance in preventing dental caries and periodontal diseases.

Given these promising findings, the integration of Rosella extract into dental care products such as mouthwashes and toothpaste could offer a natural, safe, and effective alternative to synthetic antimicrobial agents. However, further clinical studies and long-term assessments are necessary to fully validate its efficacy and ensure its safety for widespread dental applications. If successfully implemented, Rosella-based products could contribute to sustainable and innovative approaches in modern dentistry, reducing reliance on synthetic antibiotics and addressing concerns related to antibiotic resistance.

Ingredients of Rosella

Rosella plant (*Hibiscus sabdariffa* L.) is a kind of shrub that is easy to grow. Rosella is a member of the family Malvaceae (Suniarti et al., 2022). Rosella plant is one of the natural products that has high potential as an herbal medicine and ornamental plant from a family of hibiscus types. This plant can live in tropical as well as subtropical regions and is known as herbal tea (IG et al., 2016; Riwandy et al., 2014). The rosella plant (Hibiscus sabdariffa Linn) has a single ovoid leaf with rays, a blunt tip, edges, and a notched base. The leaf measures 6-15 cm in length and 5-8 cm in width. The rounded petiole is green and measures 4.7 cm in length. Rosella flowers (Hibiscus sabdariffa Linn) have brightly colored flowers, with dark red, bell-shaped, and not deciduous petals (Kusparmanto et al., 2024).

The phytochemicals which present in *H. sabdariffa* L have a lot of benefits in dentistry, some of which provide antibacterial activity where this activity is indispensable in the treatment of dental disease. Rosella (Hibiscus sabdariffa L.)

flower decoction contains polyphenols and flavonoids that can inhibit growth and reduce the number of bacterial colonies in the oral cavity. Besides, the hydroxyl group of flavonoids also can interact to bacterial wall proteins such as ATPase and cause inactivation of enzymes and transport proteins (Suniarti et al., 2022). Rosella leaves contain higher concentrations of polyphenolic compounds, especially chlorogenic acid, quercetin, and kaempferol, contributing to antioxidant capacity and anti-inflammatory activity. It also functions as an antimicrobial free radical and is potent against reactive oxygen species (Nafisa et al., 2015).

Rosella plant (Hibiscus sabdariffa L.) is used in treating many diseases and many folk remedies. The leaves are a good source of polyphenolic compounds. The main compounds identified include neochlorogenic acid, chlorogenic acid, cryptochlorogenic acid, shikimic caffeoyl acid, and flavonoid compounds such as quercetin, kaempferol, and derivatives. The flowers are rich in anthocyanins, as well as protocatechuic acid. Dried strands of petals contain the flavonoids gossypetin, hibiscetine, and sabdaretine. Roselle seeds are a source of fat-soluble antioxidants, especially gamma-tocopherol (Nafisa et al., 2015).

Alkaloids, saponins, tannins, flavonoids, phenols, and some other aromatics have the ability to resist microbial invasion. Flavonoids which are hydroxylated phenolic substances are produced by plants in response to microbial infections. Saponins have properties that can increase the permeability of bacterial cell membranes thereby facilitating the entry of antibiotics through the bacterial cell wall. Tannins bind to proteins, damage bacterial cell membranes, and inhibit microbial growth by precipitating microbial proteins making nutrient proteins unavailable. Thus, *Hibiscus sabdariffa* has been found to be a phytochemical reservoir and is able to exhibit antibacterial activity against a number of diseases (Nafisa et al., 2015; Suniarti et al., 2022).

Rosella Extract

In a study conducted by Rambe et al., 2022, *Hibiscus sabdariffa* L. leaves were collected from Tanjung Morawa, North Sumatra and validated by the University of North Sumatra, Indonesia. The leaves are dried by dryer at 40–50°C, and 500 g of simplisia powder is put in a container prepared for maceration. Next, 5000 ml of 96% ethanol is added to the container. The mixture is stirred for 6 hours, covered, and allowed to stand for 18 hours away from the lamp. Next, the mixture is filtered, where the precipitate is collected and soaked again in ethanol 3 times. Maceration is left for 24 hours to ensure complete extraction of all bioactive components. Finally, the mixture is evaporated using a rotary evaporator at 40–50°C until a thick extract is obtained (Komala et al., 2013).

Research conducted by Aydin & Zorlu., 2022 the manufacture of extracts prepared by the decoction method described by Rasheed *et al* with slight modifications. Rosella petals are ground using a blender and dispersed in distilled water (10% w/v). Rosella petals are boiled in hot water for 10 minutes and then allowed to stand at room temperature for 10 minutes. After the solution has cooled, it is filtered twice using standard medium pore filter paper to remove petal particles and kept at 4°C until use. Composite films were prepared with alginate and rosella (HE) extract at different concentrations (1%, 3%, and 5% w/v) through solvent casting techniques and analyzed physical, mechanical, and antibacterial properties. Incorporation of rosella extract into the alginate film results in rough and heterogeneous surface characteristics with increasing concentrations of rosella extract. The thickness and moisture permeability of the alginate-rosella extract composite film was significantly higher ($p < 0.05$) compared to the pure alginate film. The alginate-extract film of rosella showed good antibacterial activity against Gram-positive (*Staphylococcus aureus* and *Bacillus subtilis*) and Gram-negative (*Escherichia coli* and *Klebsiella pneumoniae*) bacteria. The antibacterial effect of the film, more pronounced against Gram-positive bacteria,

increases with a higher amount of rosella extract (Abdel-Shafi et al., 2019).

The preparation of rosella extract in research conducted by Komala et al., 2013 was made by maceration and infusion methods. The maceration method is by soaking 600 g of powder in 4500 ml of 70% ethanol for 3 days. Clear liquid is filtered, the pulp plus another 1500 ml of 70% ethanol is soaked for 2 days. The clear liquid is treated the same as first, then the two are put together. The liquid is dried with a vacuum rotavapor at a temperature of 50^0C. While the manufacture of infusion is carried out by dissolving 200 g of rosella flower petal pollen with 1800 ml of aquabidest. The mixture is heated at 90^0C for 15 minutes while stirring. After cooling, the liquid is filtered and thickened with a vacuum rotavapor. The extract obtained was further qualitatively tested for the content of flavonoid compounds, tannins and saponins (Purba et al., 2020).

Research conducted by W Estri & Anggarbeni., 2015 found that rosella extract (boiled rosella flower water) can inhibit the growth of E. coli bacteria because of the content of phenolic compounds consisting of flavonoids, tannins, anthocyanins and saponins. Flavonoid compounds are the largest phenol compounds contained in rosella flowers. These compounds produce red, purple, blue, and yellow natural plant dyes (Febriyanto et al., 2018).

Febriyanto et al., 2018 conducted a research who tested the antimicrobial ability of rosella flower petal extract (Hibiscus sabdariffa Linn) on the growth of Staphylococcus aureus. The sample used in that study was rosella flower petals (Hibiscus sabdariffa Linn) by paying attention to the physical condition of the flower petals which were good and still fresh. Based on the research conducted, the diameter of the inhibition zone of the extract of rosella flower petals (Hibiscus Sabdariffa L.) as an antibacterial for Staphylococcus aureus at a concentration that has the strongest inhibition power is at a concentration of 85% with an average zone diameter of 19.6 mm in the strong category. From the results of the research conducted by Febriyanto et al., 2018, it can be seen that the ethanol extract of rosella flower petals (Hibiscus Sabdariffa L.) can inhibit the growth of Staphylococcus aureus bacteria and the results of the inhibition zone obtained with a strong category for a concentration of 70%, strong for a concentration of 75%, strong for a concentration of 80% and strong for a concentration of 85%, based on the Davis Stout method. In that study shows that the greater the concentration of rosella flower petal extract, the greater the concentration of the inhibition zone formed in the growth of Staphylococcus aureus bacteria. The formation of a clear area or what is called an inhibition zone around the disc paper indicates the inhibition of bacterial colony growth due to the influence of compounds found in the ethanol extract of rosella flower petals (Hibiscus Sabdariffa L.). The content found in rosella flower petals is phenol or polyphenol compounds, saponins and tannins, which are included in the flavonoid group that are known to have antibacterial properties.

Antibacterial Activity on Rosella

The phytochemicals found in H. sabdariffa L have many benefits in dentistry (Purba et al., 2020). The ability of an antimicrobial material to inhibit the growth of microorganisms depends on the concentration of the antimicrobial. This means that the amount of antimicrobial material in a bacterial growth medium greatly determines the life of the exposed bacteria. In addition to the concentration factor, the type of antimicrobial material also determines the ability to inhibit bacterial growth (Febriyanto et al., 2018). Rosella flower petals are known to have antibacterial properties. The content found in rosella flower petals is phenol or polyphenol compounds, saponins and tannins, which are included in the flavonoid group (Febriyanto et al., 2018). Flavonoids can inhibit GTF enzymes produced by S. mutans and are known to act as virulence factors in the pathogenesis of dental caries (Suniarti et al., 2022). The hydroxyl group of flavonoids can also interact with bacterial wall proteins such as ATPase and cause inactivation of enzymes and transport proteins. Pentacyclic triterpenoids are reported to inhibit the formation of biofilms

S. mutans and Actinomyces viscosus. The glycoside group also has antimicrobial activity against some bacteria that cause dental caries, such as S. mutans, S. mitis, S. salivarius, S. aureus, and Lactobacillus acidophilus (Purba et al., 2020).

Polyphenols work by killing microorganisms by denaturing cell proteins. Hydrogen bonds formed between polyphenols and proteins cause the protein structure to be damaged. These hydrogen bonds will affect the permeability of cell walls and cytoplasmic membranes causing an imbalance of macromolecules and ions in cells, resulting in cell lysis (Mumpuni et al., 2021).

Saponins can exert antibacterial activity by causing penetration of proteins and enzymes in bacterial cells (Abass et al., 2022). Saponins are one of the secondary metabolite compounds contained in plants. This type of compound belongs to a group of organic components that have good steroid capacity. All plant organs such as fruit, flowers, leaves, stems and roots can be found with secondary metabolic compounds of saponins. The molecular structure of saponins consisting of a series of C and H atoms makes this compound have biological activity as an antibacterial. Saponin compounds are applied in pharmacy because they are known to have activities as antifungal, antibacterial, antitumor and antioxidant drugs (Kusparmanto et al., 2024). Saponins are also able to reduce surface tension, resulting in increased permeability or cell leakage and causing intracellular compounds to come out. Phenolic compounds have a working mechanism in inhibiting bacterial growth by inactivating proteins (enzymes) in the cell membrane, causing the protein structure to be damaged. Instability in the cell wall and cytoplasmic membrane of bacteria causes the selective permeability function, active transport function, and control of the protein composition of bacterial cells to be disrupted, which will result in the loss of macromolecules and ions from the cell, so that the bacterial cell loses its shape and becomes lysed (Febriyanto et al., 2018).

Tannin compounds in rosella extract have antibacterial properties that work by precipitating proteins. Tannins can inhibit reverse transcriptase enzymes and DNA topoisomerase so that bacterial cells cannot form. Tannins inactivate microbial cell adhesins, inactivate enzymes, and disrupt protein transport in the inner layer of cells. Tannins target cell wall polypeptides so that cell wall formation becomes less than perfect and lysis due to osmotic or physical pressure (Mumpuni et al., 2021). Tannins are a group of polyphenols that can increase platelet aggregation to form temporary platelet blockages in injured blood vessels by depositing blood proteins. Therefore, in dentistry, tannins play the role of astringent and gingival regenerating agents. Tannins are phenol compounds with high molecular weight that contain a hydroxy group as well as other related groups such as carboxyl, allowing them to form effective and strong complexes with proteins and macromolecules. Chemically, there are two types of tannins: condensed tannins and hydrolyzed tannins. Condensed tannins are formed by polymerization (condensation) reactions between flavonoids, whereas hydrolyzed tannins are formed by esterification reactions between phenolic acids and sugars (glucose). Tannins are easily oxidized, so the amount of time the substance is exposed to hot water or air determines how much tannic acid is produced. Tannic acid is an example of hydrolyzed tannins. Tannic acid is a polymer of gallic acid and glucose. Tannic acid is an amorphous, lustrous, yellow-white to light brown powder with a distinct odor. Tannic acid contains antibacterial, antienzymatic, antioxidant, and antimutagenic properties (Kusparmanto et al., 2024; Purba et al., 2020).

Discussion

The antibacterial effect in the decoction of rosella flowers is able to inhibit growth and reduce the number of bacterial colonies in the oral cavity, so that the bacteria are not able to ferment carbohydrates and sucrose into acid. Thus the pH of saliva will be neutral. The results of this study when viewed with statistical tests (paired t test). The significant number p value (0.00) < 0.05, it can be seen that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted,

meaning that there is a significant difference between salivary pH before and after gargling with rosella flower decoction in students of the Bukittinggi Dental Nursing Department (IG et al., 2016; Zulfikri & Putra, 2019).

The results of this study are in line with research conducted by Unita & Singarimbun., 2018 which showed bacteriostatic and bacteriocidal effects of various concentrations of rosella petals on the growth of bacterial colonies of *Streptococcus sp*. Research conducted by Febriyanto et al., 2018 showed that the greater the concentration of rosella petal extract, the greater the concentration of the inhibitory zone formed in the growth of *Staphylococcus aureus* bacteria (Zulfikri & Putra, 2019).

According to IG et al., 2016 this can happen because the polyphenol content of rosella flower decoction functions as an antibacterial by denaturing cell proteins and damaging bacterial plasma membranes. So that these bacteria cannot ferment carbohydrates into acids. Therefore, there will be an increase in salivary pH because bacteria that ferment carbohydrates into acids have been influenced by the polyphenol content contained in rosella flower decoction. The presence of active substances of secondary metabolites such as flavonoids, anthocyanins, tannins, phenols and saponins found in vitro to have antimicrobial properties in rosella flower extract is a factor that affects the ability of rosella extract to the growth of the number of colonies of *Streptococcus sp* bacteria (Unita & Singarimbun, 2018; Zulfikri & Putra, 2019). The content contained in rosella petals is phenola or polyphenol compounds, saponins and tannins, which belong to the flavonoid group.

Polyphenols have a mechanism of action against microorganisms as enzyme inhibitors by oxidized compounds. Phenol has a mechanism of action to inhibit bacterial growth by inactivating proteins (enzymes) on the cell membrane so that the protein structure becomes damaged Phenol denatures proteins and bacterial cell membranes. Saponins are able to reduce surface tension, resulting in increased permeability or cell leakage and resulting in intracellular compounds coming out. Flavonoids inhibit the function of bacterial cell membranes through complex bonds with soluble extracellular proteins that can disrupt the integrity of bacterial cell membranes. Instability in the cell wall and membrane of bacterial cytoplasm causes selective permeability function, active transport function, and disruption of the control of protein arrangement of bacterial cells which causes the loss of micro molecules and ions from the cell, so that bacterial cells lose shape and become lysis.

Research conducted by W Estri & Anggarbeni., 2015 found that rosella extract (boiled rosella flower water) can inhibit the growth of E. coli bacteria because of the content of phenolic compounds consisting of flavonoids, tannins, anthocyanins and saponins. This research is in line with research conducted by Febriyanto et al., 2018 that found a formation of a clear area or that is called an inhibition zone around the disc paper indicates the inhibition of bacterial colony growth due to the influence of compounds found in the ethanol extract of rosella flower petals (Hibiscus sabdariffa L.). The content found in rosella flower petals is phenol or polyphenol compounds, saponins and tannins, which are included in the flavonoid group that are known to have antibacterial properties. Rosella flower (Hibiscus sabdariffa L.) extract with ethanol solvent effectively inhibits the growth of E. coli and S. aureus bacteria starting from low concentrations. The more concentrated the extract used, the larger the bacterial inhibition zone formed (Febriyanto et al., 2018).

CONCLUSION

Rosella flower extract which has several antibacterial ingredients such as phenols, saponins, tannins and flavonoids that are effective in inhibiting the growth of bacterial colonies adjusted to the concentration of rosella extract used. The ability of antimicrobial ingredients to inhibit the growth of microorganisms depends on the concentration of antimicrobials. In addition to the concentration factor used, the type of antimicrobial material also

determines the ability to inhibit bacterial growth. The component that plays a role in rosella flower extract that has antibacterial activity is the flavonoid compound.

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