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Effectiveness Test of Curcuma Extract from Turmeric Rhizome *(Curcuma domestica val.)* Against the Growth of *Streptococcus viridans* In Vitro

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ABSTRACT
Background: *Streptococcus viridans is one of the normal flora found in the oral cavity. These bacteria can cause infection in dry socket and cause odontogenic infections in the oral cavity. Streptococcus viridans can cause the formation of dental plaque and caries. Steptococcus viridans can synthesize polysaccharides such as dextran from sucrose to form attachments with other bacteria so that they can colonize and form dental plaque which can cause dental caries.*
Method: *Data were analyzed by One Way Anova test and Post Hoc Test. The results of data analysis using ANOVA showed a p-value of 0.00 in inhibition, which means that curcuma extract from turmeric (Curcuma domestica val.) rhizome can inhibit the growth of Streptococcus viridans.*
Results: *The results of this study showed the effectiveness with a strong category of curcuma extract from turmeric (Curcuma domestica val.) at concentrations of 20% and 40%. The average inhibition zone produced was 9.83 mm at a concentration of 5%, 11.20 mm at a concentration of 10%, 11.93 mm at a concentration of 20% and 12.60 mm at a concentration of 40%. From this study it was concluded that curcuma extract from turmeric rhizome (Curcuma domestica val.) has an antibacterial effect against Streptococcus viridans.*
Keywords: *Streptococcus viridans, Turmeric Rhizome, Antibacterial.*

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I. INTRODUCTION

Streptococcus is a gram-positive bacterium that has microscopic round-shaped colonies arranged in chains. Streptococcus bacteria are pathogenic bacteria that can infect dental caries, plaque, and others. *Streptococcus viridans* include *streptococcus mitis, streptococcus mutans, streptococcus salivarius, streptococcus sanguis* (group H).[1]

According to Soedarto, *Streptococcus viridans* is a large group of commensal *Streptococcus* bacteria that cause α-hemolytic, producing a green color on blood agar plates (viridis: green color) or non-hemolytic. Negative catalase lives in facultative anaerobic conditions, colonies are round, arranged like chains and pathogenic bacteria. This bacterium is a member of the normal flora, is α-hemolytic, resistant to optochin, insoluble in bile and this bacterium does not have a capsule. *Streptococcus viridans* can cause various oral diseases, such as dry socket, dental plaque and caries, odontogenic infections and endodontic infections.[1,2]

Turmeric is a spice plant that functions as an anti-bacterial, both gram-positive and gram-negative bacteria. Turmeric contains various compounds such as alkaloids, flavoids, *curcumin*, essential oils, saponins, tannins and terpenoids. Ramadhani Erly and Asterina stated that *curcuminoids* are a group of phenolic compounds that function as antibacterials that can inhibit bacterial metabolism by damaging the cytoplasmic membrane and denaturing cell proteins which cause nutrient leakage from cells so that bacterial cells die or inhibit their growth.[3]

II. RESEARCH METHODS

The type of research used in this research is laboratory experimental. With a post-test only control group research design that aims to see the inhibition of curcuma extract from turmeric *(Curcuma domestica val.)* rhizome with concentrations of 5%, 10%, 20%, and 40% against *Streptococcus viridans* for 24 hours. Then measured the inhibition using a paper disc. This research was conducted in vitro using the Disk Diffusion method (*Kirby-Bauer test*) with *Mueller hinton* agar media. The Disk Diffusion method *(Kirby-Bauer test*) is carried out by placing a disc *(blanc disc)* that has been filled with an antimicrobial substance on agar media that has been planted with microorganisms. If a clear area is formed, it indicates an inhibition of the growth of microorganisms by antimicrobial agents. This study used six treatment groups, namely concentrations of 5%, 10%, 20%, 40%,

positive control (*clindamycin*) and negative control (DMSO). The sample calculation in this study used the federer formula with the results of four repetitions.

This research is a categorical-numerical variable, namely a variable consisting of 2 unpaired groups, so the *One Way* Anova test is carried out. However, if the data distribution is not normal, a non-parametric test is used, namely the *Kruskall-Wallis* test.

III. RESEARCH RESULT

From the research data, the extraction of Turmeric Rhizome *(Curcuma domestica val.)* was carried out by the maceration method with 96% ethanol diluted using DMSO and obtained extracts with concentrations of 5%, 10%, 20% and 40% respectively and the positive control was *clindamycin* and DMSO negative control. As well as three repetitions and data collection by measuring the diameter of the inhibition zone using a digital caliper. The inhibition zone formed around the bacterial colonies indicates inhibition which is expressed in millimeters (mm). The wider the inhibition zone, the higher the inhibition of Turmeric Rhizome extract *(Curcuma domestica val.)* against *Streptococcus viridans.*

In table 1 the results of this study show that Turmeric Rhizome extract *(Curcuma domestica val.)* with concentrations of 5%, 10%, 20% and 40% and the positive control clindamycin found a clear zone around the blank disc indicating inhibition of *Streptococcus viridans* with a diameter different inhibition. While the negative control DMSO did not find the clear zone so that it was stated that there was no antibacterial activity against *Streptococcus viridans.*

Table 1. Descriptive Analysis Results

Treatment	Concentration	Replication					
		1	2	3	4	Mean	SD
Turmeric Rhizome Extract (Curcuma domestica val.)	5%	9,6	10,0	9,9	9,6	10,15	0,6557
	10%	11,3	11,2	11,1	11,1	11,575	0,4113
	20%	11,8	11,9	12,1	11,9	12,20	0,4546
	40%	12,3	12,8	12,7	12,8	14,80	2,0347
positive control (Clindamycin)		25,6	25,3	25,7	25,7	25,70	0,3742
negative control (DMSO)		0	0	0	0	0	0

From the results of the normality test with the Shapiro-Wilk method in table 2, it shows that the data is normally distributed, so it can be continued using the One-way Anova statistical test.

Table 2. Normality Test using the Shapiro-Wilk Test

Perlakuan	Shapiro-Wilk		
	Statistik	Df	Sig
5%	0,851	4	0,228
10%	0,925	4	0,564
20%	0,916	4	0,517
40%	0,975	4	0,871
K+	0,961	4	0,783

One way ANOVA test was used to see the antibacterial effect of curcuma extract from Turmeric Rhizomes *(Curcuma domestica val.)* with concentrations of 5%, 10%, 20% and 40%, positive control (Clindamycin) and negative control (DMSO) on the growth of *Streptococcus viridans* bacteria. Oneway ANOVA static test results for the antibacterial effect of curcuma extract from Turmeric Rhizomes *(Curcuma domestica val.)* with concentrations of 5%, 10%, 20% and 40%, positive control (Clindamycin) and negative control (DMSO) on the growth of *Streptococcus viridans* bacteria have a value significant p=0.000 (p<0.50). This value indicates that curcuma extract from Turmeric Rhizome *(Curcuma domestica val.)* has an antibacterial effect on the growth of *Streptococcus viridans* bacteria. Table 3 shows the results of the one-way ANOVA test showing p <0.50, which means that the inhibition of *Streptococcus viridans* in the control group and the treatment group has a significant difference.

Table 3. Oneway Anova test results

Treatment	Mean	SD	P value
5%	10,15	0,65	
10%	11,575	0,41	
20%	12,20	0,45	
40%	14,80	2,03	0,000

Positive control (clindamycin)	25,70	0,37
Negative control (DMSO)	0	0

Then proceed with the Least Significant Difference LSD posthoc statistical test to find out which treatment group has a significant difference with a degree of significance p = 0.50. In table 4, there was a significant difference between the inhibition diameter and the treatment group which had a p value <0.05, which included the curcuma rhizome extract group *(Curcuma domestica val.)* 5% with a positive control with a value of p = 0.000 and a negative control with p = 0.000. = 0.000, between the curcuma rhizome extract group *(Curcuma domestica val.)* 10% and the positive control which had a value of p = 0.000 and the negative control p = 0.000, between the curcuma rhizome extract group turmeric *(Curcuma domestica val.)* 20% and the positive control which p = 0.000 and the negative control is p = 0.000, between the curcuma rhizome extract and *turmeric (Curcuma domestica val.)* 40% group with the positive control p = 0.000 and the negative control p = 0.000, between the positive and negative control groups with p = 0.000 0.000. However, there was no significant difference between the 5% curcuma rhizome extract of turmeric *(Curcuma domestica val.)* and the 10% curcuma rhizome extract *(Curcuma domestica val.)* with p=0.000 and between the curcuma rhizome extract group (Curcuma domestica val.). p=0.000 which means the value of p>0.05.

Table 4. Least Significant Difference (LSD) post hoc statistical test

Group		Mean Difference	P
Turmeric Rhizomes 5%	Turmeric Rhizomes 10%	-1,4250	0,042
	Turmeric Rhizomes 20%	-2,0500	0,006
	Turmeric Rhizomes 40%	-4,6500	0,000
	Positive Control	-15,5500	0,000
	Negative Control	10,150	0,000
Turmeric Rhizomes 10%	Turmeric Rhizomes 20%	-0,6250	0,350
	Turmeric Rhizomes 40%	-3,2250	0,000
	Positive Control	-14,1250	0,000
	Negative Control	11,5750	0,000
Turmeric Rhizomes 20%	Turmeric Rhizomes 40%	-2,6000	0,001
	Positive Control	-13,5000	0,000
	Negative Control	12,2000	0,000
Turmeric Rhizomes 40%	Positive Control	-10,9000	0,000
	Negative Control	14,8000	0,000
Positive Control	Negative Control	25,7000	0,000

IV. DISCUSSION

From Mariam Ulfah's research, curcuma extract from turmeric *(Curcuma domestica val.)* contains curcumin which is a phenolic compound which has antibacterial, antioxidant and anti-inflammatory properties. Curcuma extract from turmeric rhizome (Curcuma domestica val.) is able to inhibit the growth of *Streptococcus viridans* bacteria. *Curcuma* extract from turmeric rhizome *(Curcuma domestica val.)* was able to inhibit the growth of *Streptococcus viridans* bacteria in the medium category at a concentration of 40% with an inhibitory power (14.8 mm). This study proves that *curcuma* extract from turmeric rhizome (Curcuma domestica val.) has an antibacterial effect on the growth of Streptococcus viridans bacteria in the oral cavity in vitro. This is proven by the existence of an inhibition zone (clear zone) around the paper disc. This result is the first step in the possibility of using turmeric as an alternative antibacterial agent in dentistry.[4]

Streptococcus viridans is one of the most common normal flora in the mouth. *S. viridans* is a microorganism that hemolyzes blood on blood agar culture. 50% is found in the tongue and saliva and 30% is found in dental plaque in the oral cavity. S. viridans synthesizes polysaccharides such as dextran from sucrose to form a colony for other bacteria to form plaque on teeth. *S. viridans* is also the most common bacteria in the oral cavity that causes pulp and root canal infections, reaching 63%. *Streptococcus viridans* can be found in the oral cavity, oropharynx, gastrointestinal tract and genitourinary. Then in group H on *Streptococcus viridans* there is Streptococcus sanguinis. Anaerobic bacteria are bacteria that grow in an atmosphere with little or no oxygen.[5,6,7]

In this study, the bacteria used were facultative anaerobic bacteria. Facultative anaerobes can grow both oxidatively and anaerobically. In facultative anaerobic bacteria there are storage and maintenance techniques for the bacteria. The technique used in this research is periodic rejuvenation technique. Periodic rejuvenation is rejuvenation by moving or renewing old cultures to new growth media on a regular basis, for example once a month or two months. This is the most traditional method used by researchers to maintain collections of microbial isolates in the laboratory.[7,8,9]

Turmeric *(Curcuma domestica val.)* is a spice and medicinal plant originating from Southeast Asia. Turmeric *(Curcuma domestica val.)* can grow from lowland areas with a minimum altitude of 240 meters above sea level to highland areas with a maximum altitude of 2000 meters above sea level, with the best growth achieved in areas with optimal temperatures of 20-30° C and rainfall of 2000- 4000mm/year. Turmeric is efficacious as a

medicine because it contains essential oils (ar-tumeron, α and β-tumeron, tumerol, α-atlanton, β-karyophyllene, linalol, 1,8 cineol), curcumin, resin, oleoresin, desmethoxycurcumin, bidesmetoxicurcumin, in vegetation.[10,11,12]

Zorofchian Moghdamataousi stated that turmeric rhizome water extract has antibacterial activity with MIC *(Minimum Inhibitory Concentration)* values ranging from 4 to 16 g/L and MBC (Minimum bactericidal concentration) values ranging from 4 to 16 g/L. Turmeric rhizome contains curcumin, phenylpropanoid and tannins. Curcuminoids are a group of phenolic compounds that function as antibacterials. Mohanty and Sahoo mentioned that entering the proliferative phase, curcumin again increased PDGF secretion. TGF beta, FGF, EGF, and Vascular endothelial growth factor (VEGF) by macrophages and endothelial cells. Growth factors exhibit early reepithelialization, increased angiogenesis, granulation tissue formation, and increased migration of various cell types, including fibroblasts, keratinocytes, macrophages, and collagen.[10,11]

Turmeric is a therapeutic ingredient that can be used for *Streptococcus viridans* bacteria. This is because plant extracts have the potential as natural medicines in treating diseases to maintain microbiological safety of human health as well as antibiotics used to prevent and treat *Streptococcus viridans* infections. It is hoped that the effect of this turmeric rhizome can be antibacterial against *S. viridans* which can be an alternative to antibiotic therapy such as clindamycin.[13]

V. CONCLUSION

Based on the results of the research conducted, it can be concluded that:

1. Curcuma extract from turmeric rhizome *(Curcuma domestica val.)* with a concentration of 5%, 10%, 20% and 40% can inhibit the growth of *Streptococcus viridans.*
2. At a concentration of 5%, the average value of the inhibition zone was found to be 10.15 mm, at a concentration of 10%, the average value of the inhibition zone was found to be 11.57 mm. At a concentration of 20%, the average inhibition zone value was 12.2 mm and for the highest concentration, 40%, the inhibition zone average was 14.8 mm.
3. At a concentration of 40% curcuma extract from turmeric *(Curcuma domestica val.)* rhizome has the largest inhibition zone in inhibiting the growth of Streptococus viridans in vitro with an average inhibition diameter of 14.8 mm.

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