



The Potential Of Cinnamon (*Cinnamomum Burmanni*) Toothpaste as a Resistance To The Growth of the *Streptococcus Mutans* Bacteria

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Abstract

Introduction: A microorganism that plays an important role in dental caries is *Streptococcus mutans*. Dental caries can be prevented by brushing your teeth. The addition of antibacterial to toothpaste can reduce the number of caries-causing bacteria. Some anti-bacterial ingredients commonly added to toothpaste include fluorine, triclosan, and sodium monophosphate.

Purpose: In this study, researchers wanted to develop an alternative toothpaste with cinnamon extract as an antibacterial ingredient. This research was conducted to formulate toothpaste with various concentrations of cinnamon extract 5%, 7.5%, and 10% and to determine the optimal concentration that can inhibit the growth of *Streptococcus mutans* bacteria.

Method: The type of research conducted is experimental laboratories with a research design *post-test only control group design*. The toothpaste formulation is made with the active ingredient cinnamon extract with a concentration of 5%, 7.5%, and 10%. Cinnamon toothpaste was then tested on agar media which already contained *Streptococcus mutans* cultures. In addition, there is siwak herbal toothpaste as a positive control. Bacterial inhibition was analyzed statistically using the method *one-way anova* at the 95% confidence level

Results: research shows that cinnamon extract toothpaste with a concentration of 5%, 7.5%, 10%, and control⁺ has an average resistance of 11.5mm, 12mm, 12.5mm and 13mm. The results of data analysis by *testanova* show that $p < 0.05$. This shows that there are significant differences in the concentrations of the three cinnamon extracts. After obtaining the results *One-Way Anova test* significantly continued with *the LSD test* The results showed that there was no significant difference between the positive control and cinnamon toothpaste with a concentration of 10%, $\rho = 0.153$. This shows that the inhibitory power of 10% cinnamon toothpaste is close to the positive control. This shows that the higher the concentration of cinnamon extract, the more antibacterial and bioactive content.

Keywords: toothpaste, cinnamon, *streptococcus mutans*, inhibition

Introduction

Dental and oral health problems that occur are generally caused by dental plaque. Dental plaque is a clear, thin film, consisting of mucus and a collection of bacteria that covers the surface of the teeth.¹. The most common types of bacteria/microorganisms are: *Streptococcus mutans*, *Streptococcus blood*, and *Streptococcus salivarius*. Plaque which is a collection of bacteria *streptococcus Mutans* causes the occurrence of caries. Caries

prevention can be done with plaque control efforts. The effort can be done by mechanical as well as chemical. Mechanical prevention can be done by brushing your teeth². Tools and materials used in brushing teeth include brushes and toothpaste. Toothpaste helps the toothbrush to clean the tooth surface mechanically and acts as a chemical antibacterial agent. Antibacterial substances in toothpaste, among others *triclosan* and *chlorhexidine* as an active ingredients that can provide a direct inhibitory effect on

plaque formation. Along with advances in science and technology, various toothpaste manufacturers make innovations to add other substances that are beneficial for dental health.³ Herbal ingredients considered to have small side effects compared to chemical-based antibacterial agents, and are easy to obtain. Herbal ingredients that have been widely used for antibacterial activity. Antibacterial compounds contained in herbal ingredients are secondary metabolites such as alkaloids, flavonoids, phenols, and tannins. Tannins and flavonoids are active ingredients that can inhibit bacterial metabolism, while saponins function to damage cell wall proteins bacteria⁴. Cinnamon is one of the herbal ingredients that can be used as a cooking spice and traditional medicine and is widely found. Cinnamon contains several active substances that are useful as antibacterials such as saponins, polyphenols, hydrocyanic acid, acetylcholine, tannins, riboflavin, phenol, and flavonoids. The production of antimicrobial compounds in cinnamon can kill or inhibit the development of bacteria⁵. From previous studies it was proven that cinnamon extract at a concentration of 5% functioned as disinfectant able to kill the growth of bacterial colonies on the oral apparatus diagnostics, this is due to the antibacterial content of the cinnamon⁶. This makes researchers interested in making cinnamon an alternative to herbal toothpaste, and knowing the potential of toothpaste from cinnamon extract (*Cinnamomum Burmans*) to inhibition *Streptococcus mutans*.

Methods

The type of research conducted is research *experimental Laboratories* with *plan control group design*. The object of this research is bacteria *streptococcus mutans* which is tested by using several concentrations, the cinnamon toothpaste concentrations used were 5%, 7.5%, and 10%. The concentration used refers to several journals that use an average concentration of 1.5%, 3%, and 4.5%⁷. The inhibition referred to in this study was to see how much the inhibitory ability of cinnamon extract in toothpaste had on bacterial growth *Streptococcus Mutans*. Inhibitory power was measured by the width of the clear zone formed on the growth medium. Test the normality distribution by test *kolmogorov. Kolmogorov-Smirnov test* for the normality test, *Levene test* for the homogeneity test, then followed by *One-Way Anova test* to see if there is a significant difference from the overall treatment. If there is a significant difference ($p < 0.05$) then continue *tests for* a look at the differences in each treatment group.

Results and Discussion

Manufacture of Cinnamon Extract

Cinnamon extract is made by maceration method, by means of 300 grams of dry cinnamon powder then put into the maceration vessel. Then poured with 2250 mL of 70% ethanol solvent into the maceration vessel. The vessel is closed, left in a cool place, protected from light. Left for five days. After five days, the dregs and filtrate were separated by filtering. Furthermore, evaporation was carried out using a rotary evaporator⁸. The viscous extract obtained was used for the manufacture of toothpaste with a concentration of 5%, 7.5%, and 10%.



Figure 1. Making Cinnamon Extract

Toothpaste Manufacturing

Prepare tools and materials. Made mucilage Na. CMC as a mixture 1. Preparation of mucilago Na. CMC: Weigh Na powder. CMC. Measured hot aqua 10 mL, then poured it into the mortar. Sprinkled with Na powder. CMC into a mortar that has been filled with hot aqua. Leave it for 15 to 20 minutes until it swells.

Measure 5 mL of cold aqua, add to the mortar and grind until homogeneous. Put calcium carbonate into the mortar containing mixture 1, grind until homogeneous. Add glycerin and then add cinnamon extract. Then put into the Na mortar. Lauryl sulfate and interspersed with grinding until homogeneous. Put in container.

Table 1 Preparation of cinnamon extract toothpaste

Composition	Concentration (%)			Function
	F1	F2	F3	
Cinnamon Extract	5%	7.5%	10%	Active Substance
CaCO ₃	13%	13%	13%	Na.Lauryl
Abrasive Sulfate	2%	2%	2%	Foaming
Glycerin	10%	10%	10%	Humectant
Na.CMC	3%	3%	3%	Viscosity
Ad15	Ad15	Aquadest	Ad15	Solvent

Culture Microorganism

Bacteria *Streptococcus mutans* 1 ose taken from a pure culture. Then grown or inoculated by streaking on Nutrient Agar (NA) medium incubated at 37C for 18-24 hours. Preparation of bacterial suspension

by letting the rejuvenated bacteria on slanted media be taken as much as 1 ose and put into a test tube containing 0.9% NaCl solution and then shaken until homogeneous to obtain a bacterial suspension



Figure 2 Preparation of Bacterial Suspension

Toothpaste Formula Inhibitory Test

Inhibition test of cinnamon extract toothpaste against bacteria *Streptococcus mutans* carried out by the agar diffusion method. Prepared cinnamon toothpaste with a concentration of 5%, 7.5%, 10%, and siwak herbal toothpaste as positive controls.

Then place each paper disk on the surface of the media II using tweezers. Adjust the distance between the paper disks so they don't overlap each other. After that, it was incubated for 1x24 hours at 37°C in an incubator.

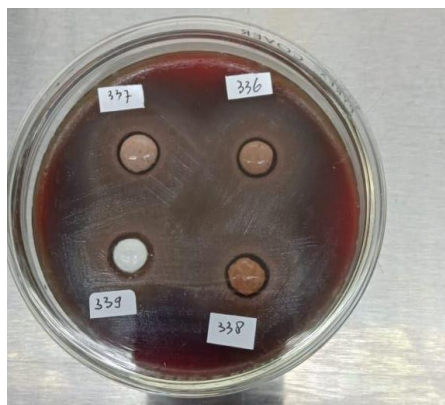


Figure 3 Inhibition Zone of Cinnamon Extract Toothpaste Against *Streptococcus mutans*

Test of Inhibitory Power of extract toothpaste on bacterial Cinnamon Extract Toothpaste against growth *Streptococcus mutans* can be seen in bacteria *Streptococcus mutans*. The results of measuring the inhibition zone of cinnamon table 3 below.

Table 2. Results of measuring the diameter of the toothpaste inhibition zone

Treatment	of Inhibitory Zone Diameter (mm) Against <i>Streptococcus Mutans</i> Bacteria					Total (mm)	Avera ge (mm)
	I (mm)	II (mm)	III (mm)	IV (mm)	V (mm)		
Formula I 5%	12.5	11.2	11.8	10.5	11.5	57.5	11.5
Formula II 7.5%	12.0	11.9	11.5	11.9	12.7	60	12
Formula III 10 %	12.5	11.9	12.5	12.9	12.7	62.5	12.5
Control (+)	13.4	12.3	13.0	13.5	12.8	65	13

In table 4.2, formula I have an average inhibition of 11.5 mm and shows a medium inhibition category, then formula II has an inhibition of 12 mm, and formula III has an

inhibition of 12.5 mm where these two formulas indicate a strong inhibition category. While the positive control has an inhibition of 13 mm and shows the

medium inhibition category. Based on the description above, it can be seen that toothpaste with a concentration of 10% has the greatest inhibition against the growth of *Streptococcus mutans* bacteria, while the lowest concentration is 5%.

Analysis of Research Results

Normality test results *Kolmogorov-Smirnov tests* show the results of the probability of each group is greater than 0.05 ($p > 0.05$). This means that all the data tested is normally distributed. Once the

data is known to be normal, its homogeneity is tested using *the Levene test*. The homogeneity test obtained a result of 0.567, which means that the data obtained is homogeneous. Once it is known that the data is normally distributed and the data is homogeneous, it is continued with the *One-Way Anova test*. This test was conducted to determine whether there was a significant difference between the entire study group

Table 3 Average inhibition zone of toothpaste against *Streptococcus mutans*

Mean	± SD	p-value
Formula 5%	11.5±0.7382	0.002
Formula 7.5%	12±0.4359	
Formula 10%	12.5±0.3742	
Control	13±0.4848	

Based on the table above it can be seen that the results of the test analysis *Way Anova* earned values of 0.002 which indicates that there is a significant difference in the inhibition of *S.mutans* with the four different toothpaste formulas because $p < 0.05$. After obtaining the results *One-Way Anova test* that there is

a significant difference between the four research groups above, it will be continued with *the LSD test*. *LSD test* This was done to find out whether there was a significant difference between the groups of toothpaste containing cinnamon extract concentrations of 5%, 7.5%, and 10%, and the positive control.

Table 4. Analysis results from test inhibition of cinnamon extract toothpaste on growth *streptococcus mutans*

Post Hoc	P
K + vs F 5%	0.000
K + vs F 7.5%	0.008
K + vs F 10%	0.153
F5% vs F 7.5%	0.153
F5% vs F 10%	0.008
F10% vs F 7.5%	0.153

Results *LSD test* above shows that between groups of 5% cinnamon extract toothpaste had a significant difference $p < 0.05$. The positive control with cinnamon extract toothpaste 7.5% and 10% showed no significant difference, but the toothpaste

DISCUSSION

with the 10% formula had a higher p-value, namely $p = 0.153$. This shows that the inhibitory power of 10% cinnamon toothpaste is almost close to the positive control in inhibiting growth *Streptococcus mutans*.

Based on the research results showed that the bacteria *Streptococcus mutans* which

causes dental caries⁹ can be prevented with cinnamon toothpaste. Proven by *testone way anova* earned *p value* <0.005 means there is a significant difference in the inhibition of *S.mutans* with four different toothpaste formulas. Cinnamon toothpaste with a concentration of 10% has the largest diameter of inhibition and is almost close to the positive control, namely siwak herbal toothpaste, this proves that the higher the concentration of the test substance, which means that the greater the amount of active substance contained in the extract, the greater the ability of the test material to inhibit bacterial growth. Cinnamon (*Cinnamomum Burmans*) can inhibit growth *Streptococcus mutans* because it has antibacterial power¹⁰. Cinnamon's antibacterial power is due to its presence of flavonoids, essential oils, eugenol, and tannins. The content of essential oils has active ingredients that are thought to have pharmacological effects. Tannins and flavonoids are active ingredients that have anti-inflammatory and antimicrobial effects, while essential oils have analgesic effects. As Antibacterial, flavonoids work by inhibiting the development of microorganisms because they can form complex compounds with proteins through hydrogen bonds 11.

Conclusions

Based on the results of this study, it can be seen the effect of toothpaste containing cinnamon which has antibacterial properties *Streptococcus mutans*, where toothpaste containing cinnamon at a concentration of 10% was more effective in inhibiting colony growth *Streptococcus mutans* compared to

This is supported by previous research on cinnamon extract as a disinfectant, showing that the number of bacterial colonies decreased after chemical sterilization using cinnamon this shows that the bioactive content of cinnamon can kill bacterial colonies, and the bioactive ingredients of cinnamon can denature protein molecules and nucleic acids. This will cause coagulation and protein coagulation, eventually, there will be metabolic disturbances and physiological functions of bacteria⁶. If the bacterial metabolism is disrupted, the energy requirement is not sufficient, resulting in permanent damage to the bacterial cell which ultimately causes the death of the bacteria¹². Herbal toothpaste has greater antibacterial power than non-herbal toothpaste, this is due to the addition of herbal elements as anti-bacterial additives¹³. The herbal content of cinnamon has been proven to increase anti-bacterial power besides herbal toothpaste which does not have side effects that harm the human body.¹⁴. The positive control was far more effective than cinnamon extract toothpaste because many other compositions had a role in inhibiting the growth of *Streptococcus mutans*.

the concentration of cinnamon extract 5% and 7.5%. The antibacterial inhibition zone of 10% cinnamon did not differ significantly from the positive control because the antibacterial content of cinnamon (especially flavonoids) at a concentration of 10% was almost as effective as the antibacterial content of the positive control siwak herbal toothpaste.

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