FORMULATION, EVALUATION, AND ANTIBACTERIAL TESTING OF *JATROPHA CURCAS L.* GUM TOOTHPASTE PREPARATIONS

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ABSTRACT

Dental caries remains a significant problem in Indonesia due to the activity of Streptococcus mutans, which damages tooth enamel. Prevention is done by brushing your teeth and using antibacterial toothpaste. Jatropha curcas L. sap has the potential to be a natural antibacterial agent because it contains flavonoids, tannins, saponins, and alkaloids. This study aims to determine the optimal formulation, evaluate toothpaste containing fence post gum as an antibacterial active ingredient, and assess its effectiveness against S. mutans. The research was conducted experimentally in a laboratory using a quantitative approach. Rubber samples were taken from Motinelo Village, Tabongo District, Gorontalo Regency. The toothpaste was formulated at 4%, 8%, and 16% castor oil extract (F1, F2, and F3) and tested for physical characteristics and antibacterial activity using the disk diffusion method. The results show that all formulas meet the physical quality standards outlined in SNI 12-3524-1995. Formula F3 (16%) had the largest inhibition zone and the most potent antibacterial activity, while F2 and F3 were not significantly different and were more effective than the positive control. Antibacterial activity is influenced by the flavonoid, saponin, tannin, and alkaloid content, which damage cell walls and inhibit bacterial metabolism. It is concluded that toothpaste containing fence post gum is effective at inhibiting Streptococcus mutans and has the potential to serve as a natural ingredient for maintaining dental and oral health.

Keywords: Jatropha curcas L., herbal toothpaste, Streptococcus mutans, antibacterial, formulation

INTRODUCTION

Dental health issues remain a major challenge in Indonesia and globally. According to the 2023 Basic Health Research (Riskesdas), approximately 56.9% of Indonesians experience dental and oral health problems, including caries, gum disease, and other oral infections. Dental caries is the most common problem resulting from suboptimal oral health.

Dental caries is a disease condition that occurs due to the activity of microorganisms on teeth that interact with carbohydrates. This disease is characterized by damage. localized inflammation of the teeth caused by acid organic results fermentation carbohydrates by bacteria *Streptococcus mutans* . In a review by [35] , it was stated that *S. mutans* plays an important role in the colonization of dental plaque, acid production, and biofilm formation, all of which contribute to the occurrence of carious lesions. *Streptococcus mutans* is able

Submit: Agust 25th, 2025 Accepted: Sept 14th, 2025 Published: Sept 24th, 2025
Journal of Health, Technology and Science (JHTS) — E-ISSN: 2746-167X

to survive in an acidic environment and produces glucans through the enzyme glucosyltransferase (GTF), which strengthens the structure of the biofilm. One alternative product that utilizes traditional medicinal plants for dental care and prevention of dental caries is the sap of the Jatropha curcas plant (*Jatropha curcas L.*) [20]

Jatropha curcas is a perennial species that produces resin, belonging to the *Euphorbiaceae family* . This plant is also known popularly as the medicinal bean, simple tree, or hardy tree. J. curcas is a tough plant with high edaphoclimatic adaptability and can thrive in soils with low fertility, high salt content, and drought conditions. [19]

Jatropha, which means healing plant, is a plant that is easily found in various places. There are several species of *Jatropha,* including *Jatropha curcas, Jatropha integerima, Jatropha gossypifolia,* and *Jatropha multifida* . In Indonesia, the most commonly found *Jatropha species is Jatropha curcas L.* The sap from this plant contains *flavonoids,* which have phenolic components that can inhibit the growth of *Streptococcus mutans bacteria.* [9]

Sap *Jatropha curcas L.* contain compound active such as saponins, flavonoids, alkaloids, and tannins which have anti-inflammatory properties antibacterial . Flavonoids have activity antioxidant and antibacterial with damage membrane cells , inhibit enzymes , as well as hinder growth *Streptococcus mutans* [12] . Saponin causes leakage content cells and lysis , effective to bacteria resistant such as MRSA and CRPA [21] . Alkaloids such as ambroxol and terbutaline interfere synthesis peptidoglycan in the wall cell bacteria [12] , whereas tannin hinder bacteria through protein precipitation and interference function enzyme [21] .

According to research [3] , *Jatropha curcas L.* latex was tested for its antibacterial activity using the disc method with concentrations of 4%, 8%, 16%, and 32%, which were selected based on the MIC results against *Porphyromonas gingivalis* and *Streptococcus mutans* . In the test against *S. mutans* , the inhibition zones produced were 7.50 mm; 8.22 mm; 9.47 mm; and 10.89 mm, respectively, while the positive control *chlorhexidine gluconate* reached 12.65 mm. The 32% concentration produced the greatest inhibition, namely 10.89 mm. The results are the same as [6] , stating that the higher the concentration of Jatropha curcas latex, the larger the inhibition zone formed.

Streptococcus mutans can create an organic acidic environment in the oral cavity triggered by the consumption of foods high in sugar. This condition causes a decrease in pH, the formation of plaque on the tooth surface, and ultimately causes hard tooth tissue known as dental caries. *Streptococcus mutans* can ferment sugar into lactic acid which is acidogenic and aciduric, thus playing a major role in the demineralization of enamel and dentin. Brushing your teeth twice a day and replacing your toothbrush

every three months helps maintain oral health. Antibacterial toothpaste is also recommended because it can inhibit caries-causing bacteria. [38]

Toothpaste contains various components, one of which is a binder that has an important role in maintaining the semisolid form of the preparation so that its stability is maintained well, toothpaste plays an important role in protecting the surface of the teeth that are damaged by the activity of pathogenic bacteria, especially *S. mutans* , which has become the main cause of caries. Regular use of toothpaste with antibacterial content can significantly reduce the number of *S. mutans colonies and increase protection against enamel demineralization* [29]

Active ingredients play an important role in toothpaste, especially those with antibacterial properties from natural sources to inhibit *S. mutans* . [15] reported that jatropha sap at a concentration of 100% produced an inhibition zone of 15.4 mm, which is included in the strong category, thanks to the flavonoid, tannin, and saponin content which damages the bacterial cell wall and inhibits its growth.

Dental caries remains a significant problem, with Streptococcus mutans as the primary cause. Prevention can be achieved through brushing and the use of antibacterial toothpaste. Therefore, researchers are interested in studying the "Formulation, Evaluation, and Antibacterial Testing of Jatropha Curcas (*Jatropha curcas L.*) Sap Toothpaste" to determine the potential of Jatropha curcas sap as a herbal caries prevention ingredient .

RESEARCH METHODS

This research approach uses a quantitative approach, this type of research uses a laboratory experimental research type.

The sampling location was Motinelo Village, Tabongo District, Gorontalo Regency, at 5:30 a.m. WITA (Central Indonesian Time). The formulation, evaluation, and antibacterial testing of the toothpaste were conducted at the Integrated Pharmacy Laboratory, Faculty of Sports and Health, Gorontalo State University.

RESEARCH RESULT

Table 4.1 Metabolite Compound Test Results Secondary

Compound	Reagent	Reaction Results	Note
Flavonoid	Mg + HCl	Brick red color	Positive
Saponin	HCl	Formation foam	Positive
Tannin	FeCl3 1%	Chocolate greenish	Positive
Alkaloid	*Dragendorff*	Sediment chocolate	Positive

(Primary Data Source 2025)

Table 4.2 Results of Metabolite Compound Testing Secondary IB.S.TP.2

Formula	Parameter	Before Cycling Test	After Cycling Test
F0	Color	White	White
	Smell	Odorless	Odorless
	Form	solid pasta	solid pasta
F1	Color	Chocolate young	Chocolate young

	Smell	Distinctive smell extract	Distinctive smell extract
	Form	solid pasta	solid pasta
F2	Color	Chocolate young	Chocolate young
	Smell	Distinctive smell extract	Distinctive smell extract
	Form	solid pasta	solid pasta
F3	Color	Chocolate young	Chocolate young
	Smell	Distinctive smell extract	Distinctive smell extract
	Form	Congested	Congested

(Primary Data Source 2025)

Information :
F0 = Not using extract
F1 = Extract sap distance fence 4%
F2 = Extract sap distance fence 8%
F3 = Extract sap distance fence 16%

Table 4.3 Results Homogeneity Test

Formula	Before Cycling Test	After Cycling Test	Parameters (SNI Number 12-3524-1995)
F0	Homogeneous	Homogeneous	Homogeneous
F1	Homogeneous	Homogeneous	
F2	Homogeneous	Homogeneous	
F3	Homogeneous	Homogeneous	

(Primary Data Source 2025)

Table 4.4 pH Test Results

Formula	Before Cycling Test	After Cycling Test	Parameters (SNI Number 12-3524-1995)
F0	5	5	pH of the preparation 4.5-10.5
F1	5	5	
F2	5	5	
F3	5	5	

(Primary Data Source 2025)

Table 4.5 Results of Spreadability Test

Formula	Before Cycling Test	After Cycling Test	Parameters (SNI Number 12-3524-1995)
F0	5.18 cm	5.28 cm	Standard diameter between 5-7 cm measurement distance vertically and horizontally
F1	5.18 cm	5.33 cm	
F2	5.32 cm	5.41 cm	
F3	5.33 cm	5.41 cm	

(Primary Data Source 2025)

Table 4.6 Adhesion Test Results

Formula	Before Cycling Test	After Cycling Test	Parameters (SNI Number 12-3524-1995)
F0	04.11 minutes	04.14 minutes	Range time standard between 1-5 minutes
F1	03.21 minutes	04.18 minutes	
F2	04.59 minutes	5.13 minutes	
F3	5.52 minutes	6.14 minutes	

(Primary Data Source 2025)

Table 4.7 Foam Height Test Results

Formula	Before	After	Parameters

	Cycling Test	Cycling Test	(SNI Number 12-3524-1995)
F0	5.56 cm	6.57 cm	Range tall foam between 3-10 cm
F1	5.73 cm	7.37 cm	
F2	6.90 cm	6.85 cm	
F3	6.92 cm	6.69 cm	

(Primary Data Source 2025)

Table 4.8 Viscosity Test Results

Formula	Before Cycling Test	After Cycling Test	Parameters (SNI Number 12-3524-1995)
F0	24586 cps	27426 cps	Toothpaste viscosity value range between 20,000-50,000 cps
F1	25440 cps	28088 cps	
F2	25740 cps	28426 cps	
F3	26746 cps	29446 cps	

(Primary Data Source 2025)

Table 4.9 Average Inhibitory Zone Jatropha Sap Toothpaste Preparation

Treatment	Inhibition Zone	
	Average Inhibition Zone	Category
Control Negative	0	Weak
F0	17,625	Strong
F1	18,7625	Strong
F2	19,875	Strong
F3	20,0875	Very strong
Control Positive	17,375	Strong

(Primary Data Source 2025)

Table 4.10 ANOVA Test Results

Inhibition Zone	Sum of Squares	df	Mean Square	F	sig
Between Groups	1194,759	5	238,952	6239,172	<,001
Within Groups	,689	18	,038		
Total	1195,447	23			

(Primary Data Source 2025)

Table 4.11 Duncan Test Results

		Subset for alpha = 0.05			
Treatment	**N**	**1**	**2**	**3**	**4**
Control -	4	,0000			
Control +	4		17,3750		
F0	4		17,6250		
F1	4			18,7625	
F2	4				19,8750
F3	4				20,0500
Sig		1,000	,088	1,000	,222

(Primary Data Source 2025)

DISCUSSION OF RESEARCH RESULTS

This research aims For know formulation and evaluation toothpaste preparations sap distance fence as well as its effectiveness to *Streptococcus mutans* at concentrations of 4%, 8%, and 16%. Sap samples distance fence obtained from Subdistrict Tabongo , Gorontalo Regency , because availability population abundant plants . Research results show that toothpaste preparation in formula F3 has activity very strong antibacterial , while F1 and F2 are classified as strong .

Preparation sample sap distance fence done with method cutting stem plant *Jatropha curcas L.* use knife until the sap out , then the sap obtained stored in a container colored dark For prevent exposure direct light that can change or damage content compound active in it . Latex distance hedge (*Jatropha curcas* L.) has trend experience change color become brownish due to the oxidation process when

exposed air . For prevent matter said , used ethyl alcohol in amount A little as material stabilizer . Addition ethyl alcohol in sap distance fence functioning prevent oxidation , maintaining color original , and maintain stability compound bioactive such as flavonoids, saponins, tannins , and alkaloids. Ethanol (C_2H_5OH) is polar, easily late in water, and is able to dissolve polar compounds and partly non-polar, so that Lots used as solvent in pharmaceuticals and extraction material nature . In addition , ethanol effective as antiseptic at a concentration of 60–95%, although its use must Be careful Because toxicity If exposed excessive . With thus , ethanol guard quality sap before used in study more carry on .

Screening phytochemicals done For identify compound metabolit secondary in plants . The results of this screening are then used For identification more continue . Metabolites secondary is compound chemicals produced plants and different between One species with species other . Screening phytochemicals show that sap distance hedge (*Jatropha curcas L.*) contains alkaloids, saponins, tannins , and flavonoids, which play a role in activity biological . Flavonoid test produces color red , saponin test produces foam stable , tannin test cause color chocolate greenish or blue blackish , and the alkaloid test produced sediment in accordance Dragendorff, Mayer, and Wagner reagents .

Combination fourth This compound supports potential sap distance fence as antibacterial and healing wound , according findings [17] to *Streptococcus mutans* . Evaporation is an evaporation process part solvent For get more solution concentrated with concentration high . This process is different from drying , because results end evaporation in the form of fluid thick , not solids . In general , evaporation aim For thicken solution containing solvent easy volatile and substances dissolved which is not easy evaporate (non-volatile) [11] . Evaporation process done with method heat sap distance fence results purification or filtration use evaporator at temperature controlled 40–60°C for solvents , such as ethyl alcohol , evaporates in a way slowly without damage compound bioactive properties thermolabile . Evaporation done up to the extract volume reduced and formed fluid thick with level minimal solvent .

Thick extract needed Because own content compound more active concentrated and stable , so that make it easier in testing activity biological , compared the sap that is still liquid and contains Lots solvent or impurities . In addition , the extract thick own Power save more Good Because level the water low , so that reduce risk degradation compounds and contamination microbes .

Study toothpaste formulation use sap distance hedge (*Jatropha curcas L.*) as material active antibacterial done with concentrations of 4%, 8%, and 16% for evaluate influence level to effectiveness and quality preparation , with addition other functional materials guard characteristic physical and stability product . Na-CMC

6% functioning as stabilizer viscosity and binder (binder). Na-CMC forms gel matrix that holds particle abrasives and materials bioactive in suspension , prevents separation phase and precipitation . With Thus Na-CMC helps to extract sap distance fence distributed evenly in pasta and not settle during storage . Study- formulation show that increase Na-CMC concentration in direct increase viscosity and stability homogeneity of toothpaste [34]

Sorbitol 30% as humectant play a role guard moisture of the paste so that No dry and maintain texture still gentle moment used . Sorbitol also helps guard texture especially in condition storage with humidity and temperature varies . In addition , sorbitol also has sweet function (*sweetener*) and add reception users without stimulate formation caries Because not easy sugar fermented by bacteria mouth [2]

SLS (*Sodium Lauryl Sulfate* e) 2% used as surfactants that help formation foam and reduce voltage surface between water, paste and surface plaque , so that material active more easy spread and contact with bacteria . Surfactants also help in dissolution and distribution material possible active rather difficult late or spread out . Combination surfactant with abrasive like calcium carbonate is also important for abrasive can clean in a way mechanical without damage tooth or make stock too abrasive . Calcium carbonate 40% as abrasive help clean plaque and stains through mechanism physique rubbing .

Sodium benzoate 0.5% as preservative prevent contamination microbes in toothpaste , especially because pasta contains water and ingredients organic like sap distance fence . Effectiveness preservative also depends on the pH and water activity of the formula , which is influenced by humectants and binders. If the humidity too tall or distribution material No evenly , bacteria or mold Can grow .

Sodium saccharin 0.12% and menthol 0.5% added For increase aspect sensory (taste & aroma). Acceptance of pleasant taste and aroma important For compliance users if toothpaste felt delicious , people will use it more regularly , which is important for activities antibacterial walk continuously . Menthol can also give sensation cold /fresh which adds experience brushing tooth .

Based on results observation before the stability test (*cycling test*) , the preparation F0 show color white and not smells , because No contain material active extract sap distance fences that have distinctive pigments and aromas . In contrast , in the F1, F2, and F3 formulas happen change color become chocolate young as well as appear smell typical extract , which is caused by increasing concentration extract sap distance fence containing flavonoid compounds , tannins , and saponins which provide color natural and distinctive herbal aroma in the preparation . The more tall concentration extract , intensity the color and aroma are also increasing strong

Because content metabolit secondary increased . Form physique preparations in all formulas (F0–F3) show consistency semi- solid , which indicates that paste bases such as Na-CMC and sorbitol work optimally in guard texture and viscosity . After done *cycling test* , no there is significant changes in color , odor , or form . F0 remains constant colored white without odor , while F1, F2, and F3 remain colored chocolate young and smelly typical extract . This shows that stock own stability good organoleptic , where the ingredients addition such as Na-CMC and sorbitol successfully maintain stability texture as well as prevent degradation substance active consequence fluctuations temperature during stability testing [23] . Differences color and aroma in toothpaste preparations especially influenced by the presence of extract sap distance fence and concentration , while similarities form show stability of the base and homogeneous formulation . Stability color , smell , and shape after *cycling test* signify that formulation made stable in a way organoleptic .

Test results can seen in Table 4.4 show that toothpaste with extract sap distance fence still homogeneous after through three cycle *cycling test* , namely the storage process alternating in temperature high 40 º C and low 4 º C for test stability physical.Constant homogeneity awake after *cycling test* caused by the role of Na-CMC as material binder and stabilizer viscosity capable form gel matrix , maintaining particle abrasives and materials bioactive to remain suspended and not precipitate . In addition , sorbitol as humectants also help maintain humidity system so that prevent occurrence separation phase during storage . Combination second This material makes the internal structure of the pasta remains stable although experience change temperature during testing . This is in line with research by [16] which shows that improvement Na-CMC levels in toothpaste formulation capable increase stability physical and maintaining homogeneity stock although pass *the cycling test* process repeated . This result has been in accordance with SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations must nature homogeneous . Based on results the toothpaste preparations sap distance fence stated fulfil homogeneity test requirements .

pH testing is an important parameter in evaluation quality toothpaste preparations because the pH is not in accordance can cause irritation mucosa and enamel damage . Test results can seen congested Table 4.5 show that toothpaste with extract sap distance fence has a stable pH in the range **5** , although has through three cycle *cycling test* at temperature low 4°C and high 40°C. This consistency indicates that formulation capable maintain stability chemistry material active and material addition although exposed fluctuations temperature . This result is in line with findings [32] , toothpaste preparation with pH value 5 is included category sour weak , but Still can accepted For use of herbal toothpaste ,

because No cause effect irritating and persistent support activity antibacterial from compound active such as alkaloids, flavonoids, saponins, and tannins. Based on the result is a toothpaste preparation sap distance fence stated fulfil SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations pH value ranges from 4.5 – 10.5.

Spread power describe ability toothpaste preparations For spread on the surface teeth , which are related with comfort usage and effectiveness distribution material active . Test results show that all formulas (F0–F3) are located in range standard (5–7 cm). This means that the toothpaste is formulated can with easy applied to surface tooth without need pressure excess . Average power value spread relatively stable before and after *cycling test* . Formulas F1 and F2 show A little improvement after stability test , while F0 and F3 tend to fluctuating . This shows that formulation material active No Lots influence ability spread . According to [30] , power spread close relation with viscosity : the more tall viscosity , the more low ability spread . Power test results spread that is not fully compared backwards with viscosity test results can explained by several influencing factors characteristics physique preparation . In theory , the more tall viscosity so ability spread will decrease Because stock become more thick and less easy spread . However , in the toothpaste formulation sap distance fence , this relationship is not always linear. This is can caused by the capable nature of Na-CMC forms an elastic and stable gel , so that although viscosity increased , flexible gel structure allows stock still easy spread [28] .

The *cycling test* process involves change temperature can cause reorganization structure Na-CMC polymer , which increases viscosity However still maintain plasticity stock [28] . With however , although happen improvement viscosity in some formulas, power spread still is at in range standard Because influence combination gel elasticity , moisture tall from humectants , and distribution homogeneous particles that maintain characteristic distribution stock remains optimal. Based on this result is a provision stated fulfil SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations mark Power spread that is standard diameter between 5-7 cm measurement distance vertically and horizontally.

Adhesive power show how long does toothpaste last? can stay on the surface teeth , which is important For extend contact material active with cavity mouth . Research results show variation between the F3 formulas have Power highest adhesion (more from 6 minutes), while F1 is the lowest (3–4 minutes). This difference is influenced by the concentration sap distance fence . Content flavonoid, saponin, and tannin compounds in sap own properties that can increase viscosity local , so that extend time adhesion. These results are in line with opinion [18] which states that concentration

substance active can modify interaction between molecule in the base, so that influence characteristic adhesion . Based on this result is a provision stated fulfil SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations mark Power sticky range time standard between 1-5 minutes .

The foam produced by toothpaste is aspect organoleptic that affects preference consumers . Although foam No always correlated direct with effectiveness cleaning , consumers often linking foam with impression clean . Data shows all formulas produce foam in range standard (3–10 cm). F1 produces the highest foam (up to 8.4 cm after cycle 2), while F0 is more low (about 7.2 cm). This difference is likely influenced by interactions material active with surfactant (SLS). According to [1] , interaction material active with surfactant can increase or lower stability foam depending on the structure molecules . Based on this result is a provision stated fulfil SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations mark range tall foam between 3-10 cm.

Very low viscosity value cause toothpaste runny and hard stick , while very high viscosity make it difficult issued from packaging . Research results show that all formulas are in range standard 20,000–50,000 cps. However , there are difference between formulas. F3 shows mark highest (34,693 cps in the 3rd cycle), while F0 was the lowest (24,586 cps). The increase viscosity in cycle storage possibility caused by changes bond molecule polymer consequence exposure temperature low and high. This is in line with opinion [28] which states that temperature can influence structure polymer such as CMC-Na, which is abundant used as thickener in toothpaste . Based on the result is a toothpaste preparation distance fence stated fulfil SNI Number 12-3524-1995 concerning toothpaste mature For toothpaste preparations mark viscosity of toothpaste range between 20000-50000 cps.

Preparation tested stability with three cycle *cycling test* at temperature low (4°C) and high (40°C) alternately for 24 hours every day cycle For evaluate resilience to change temperature extreme [5] . The results show organoleptic parameters , homogeneity , pH, height foam , power spread , and power sticky still stable , indicating stock own stability good physical condition and not happen degradation or interaction negative between material .

pH value of the preparation remains in the range of 5 , which is still in accordance with the safe pH limit of toothpaste (4.5–10.5) according to [7] . This pH resistance shows that compound active sap distance fence still stable during storage and not experience reaction significant acid-base parameters Power spread and power not sticky either show change meaningful , signifying consistency good texture and ability stock stick to the surface tooth in a long time [36].

However , the results evaluation show that viscosity stock increase after three cycle *cycling test* . Improvement This viscosity can caused by evaporation some water at room temperature tall during the *cycling test* process , so that concentration material thickener such as CMC-Na or glycerin increase relatively to the total stock volume [13] . In addition , at temperatures tall can happen change structure molecular material thickener that increases ability bond hydrogen between molecules , causing stock become more thick [25] . According to study [27] , fluctuations temperature during *cycling test* can influence reorientation chain polymers in materials thickener , which results in an increase viscosity even though other parameters remain the same stable .

Nutrient Agar (NA) media is used For grow *Streptococcus mutans* . Media created with dissolve NA in distilled water, heat , sterilize at 121°C, then poured to petri dish in aseptic . NA selected because it is rich in nutrients For growth gram- positive bacteria , so that influence clarity of inhibition zone and accuracy of antibacterial test [4]

Suspensi bacteria made with take colony pure *Streptococcus mutans* from culture stock on NA media, then suspended to in sterile 0.9% physiological NaCl solution until reach turbidity equivalent McFarland standard 0.5 (≈1.5 × 10^8 CFU/mL). Uniformity This turbidity aims to ensure that the amount bacteria used in each antibacterial test the same , so that inhibition zone results can compared to in a way objective [36] . Suspensi too much bacteria concentrated or too runny will produce an inhibition zone that is not consistent . With suspension uniform bacteria , ability antibacterial sap distance fence in hinder growth *S. mutans* can measured in a way accurate .

Potential antibacterial become the main parameter in this study . The results show all toothpaste formulas sap distance fence effective hinder *Streptococcus mutans* with an inhibition zone of 17–20 mm. Formulas F0–F2 incl category strong , while F3 is very strong and produces an inhibition zone more big compared to control positive , indicating sap distance fence potential as alternative or replacement material chemistry synthetic in toothpaste .

normality and homogeneity tests shows normal and homogeneous data , so that can analyzed parametric . The ANOVA test shows significance <0.01, indicating existence difference meaningful between concentration sap to Power resistor bacteria . Duncan's further tests showed that control negative No show activity antibacterial , whereas control positive and F0 is in One subset groups so that No different real . Formula F1 starts show improvement Power resistor compared to control positive and F0, however Still more low compared to F2 and F3. Inhibition zone the biggest obtained at F2 and F3 which are located in the same group as well as significant more tall compared to other formulas, so can concluded that improvement concentration sap in toothpaste preparations capable

increase activity antibacterial with the most optimal effectiveness is shown by F2 and F3.

The F0 toothpaste formulation is formulation without addition material active antibacterial that is sap distance fence . Although without addition material active , component toothpaste base such as Na-CMC, calcium carbonate , sorbitol, SLS, sodium benzoate , sodium saccharin , menthol, and distilled water still can hinder growth bacteria through mechanism physical and chemical . Na-CMC binds free water so that lower water activity and inhibits growth microbes [28] . Calcium carbonate maintain an alkaline pH that is not support bacteria acidogenic , while sorbitol is osmotic high and not fermented by bacteria [2] . SLS has effect antibacterial with damage membrane cells , sodium benzoate act as preservative antimicrobial [28] and sodium saccharin No support growth bacteria Because No source sugar.Menthol own characteristic antiseptic destructive nature membrane cell microbes , whereas distilled water sterile No provide nutrition for bacteria.Combination This material creates environment that is not ideal for microorganisms , so that toothpaste base still show activity antibacterial light .

In a way pharmacological activity antibacterial sap distance fence caused by the content of flavonoids, tannins , saponins, and alkaloids. These compounds Work with damage membrane cell bacteria , inhibit enzyme important , and prevent biofilm formation [33] . This is very relevant remember *Streptococcus mutans* is bacteria main reason caries tooth through formation plaque and production sour .

Flavonoids are antibacterial with damage membrane cells , increase permeability , disturbing metabolism , and inhibits *Streptococcus mutans* biofilms [22] [37] . Tannins are antibacterial and can kill *S. mutans* as well as *S. aureus* with damage wall cells , membranes , and enzymes microbes [10] [8]

Saponin own activity surfactants that reduce voltage surface membrane cell bacteria , increase permeability , and triggers cell lysis . This compound also forms complex with sterols on the membrane , which causes leakage cytoplasm and death cell [13] . According to study [26] , This effect explains the role of saponins as component supporters activity antibacterial in sap distance fence .

Alkaloid Work give disturbance in the wall bacterial cells and DNA . This compound can intercalated with DNA nitrogen bases , so that inhibit the replication and transcription processes . In addition , alkaloids are also capable of hinder Work enzymes that play a role in protein synthesis , causing disturbance metabolism and death cell [24] . Research latest by [31] state that alkaloids have ability damage integrity membrane cells and inhibit DNA gyrase activity , which results in the cessation of growth bacteria .

According to [14] , development modern herbal preparations require innovation formulation that is capable overcome various limitations physique

material nature in order to be able to produce stable , effective and fulfilling products standard pharmaceuticals . This view has close relationship with study about toothpaste formulation sap distance fence , which utilizes compound active *Jatropha curcas L.* as antibacterial experience For hinder *Streptococcus mutans* . Study the show that utilization plant drug traditional can developed become product health preventive if formulated with accurate and evaluated through adequate physical parameters . In line with that , research [14] about extract tablets sambiloto confirm that challenge main in herbal formulation is characteristic hygroscopic extract , difficult flowing , and not easy compressed . Through excipient co-processing technology based on MCC and HPMC, research the succeed improve flowability, compressibility, disintegration , and rate dissolution of sambiloto tablets , so that produce stable and suitable supplies For scale industry .

CONCLUSION

1. Formulation toothpaste preparations made from active sap distance fence (*Jatropha curcas)* L.) shows that all over results evaluation physique has fulfil requirements . These results prove that toothpaste preparations produced stable in a way physique .
2. Effectiveness antibacterial to *Streptococcus mutans* with variation concentration of 16% (F3) gives an inhibition zone the biggest with “very strong ” category , even more tall compared to control positive . The 4% (F1) and 8% (F2) formulas are fixed show “ strong ” activity , while the basic formula (F0) also has effect However more low . With Thus , concentration sap distance fence influential significant to effectiveness antibacterial toothpaste preparations .

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