

Potential of Natural Ingredients for Tooth Paste from Red Betel Leaf Extract (*Piper crocatum Ruiz & Pav.*) and Mint Leaf Extract (*Mentha piperita*) to Support the Availability of Drug Ingredients in Dental and Mouth Diseases

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Abstract:- Bacteria are the normal flora in the oral cavity, one of which is *Streptococcus mutans*, if there is an increase in the population of bacteria then cause the formation of dental caries. Dental caries is a chronic disease which lasts quite a long time, in the form of chronic loss of mineral ions and so on on the tooth enamel surface caused by bacteria and other products they produce. The damage is initially only visible microscopically, but over time it is visible on the enamel in the form of white spot lesions/melting of the cement on the roots of the teeth. Various ways are done to prevent the formation of dental caries by using effective toothpaste to inhibit the bacteria that cause dental caries. The purpose of this study was to make toothpaste with the active ingredient red betel leaf extract combined with mint leaf extract, and test the antibacterial activity of toothpaste preparations containing the efficacious ingredient of red betel leaf extract combined with mint leaf extract. The research samples were red betel leaf and mint leaf. obtained in Makassar City, the extract obtained by maceration method of extracting red betel leaves and mint leaves respectively using ethanol 70% v/v. The extracts obtained were then subjected to standardized extract tests, namely testing the chemical components using TLC, testing for heavy metal contamination and testing for water content and ash content. The extract obtained was made into toothpaste preparations using various concentrations of the active ingredients of red betel leaf extract and mint leaf extract in a ratio of 1:1, 2:1 and 1:2. Toothpaste that has been made is tested for physical quality, namely organoleptic test, pH test, viscosity, sag test, antibacterial activity test and hedonic test. It is hoped that the results of the research can be drawn conclusions regarding standardization of extracts, obtaining toothpaste preparations that meet the physical quality requirements of toothpaste preparations and their hedonic and antibacterial properties, so that the results of this study serve as a basis for developing products and ensuring the availability of raw materials from plants, especially paste preparation products teeth as a medium

in the treatment of teeth and mouth, especially dental caries.

Keywords:- Red Betel Leaf Extract, Mint Leaf Extract, Toothpaste, Diseases of the Teeth and Mouth.

I. INTRODUCTION

A. Background

Dental health problems are currently not the center of attention, even though dental health is something that needs more attention, because unhealthy teeth of a person will interfere with the digestive process. Teeth are hard body tissues, but damage can occur due to bacterial activity in the oral cavity. One of the many bacteria that exist in the oral cavity is *Streptococcus mutans*, this bacterium is a normal flora in the oral cavity, but if there is an increase in population it will cause dental caries to form.

Dental caries is a chronic disease where the process lasts quite a long time, in the form of chronic and continuous loss of mineral ions from the enamel surface on the tooth root surface caused by bacteria and other products they produce. This damage is initially visible only microscopically, but over time it will appear on the enamel in the form of white *spot* or softening of the cement on the roots of the teeth (Deynilisa, S, 2016).

The common factor that causes dental caries and periodontal disease is plaque. *Streptococcus mutans* is a gram-positive bacterium that plays a role in the formation and increase in plaque accumulation, as well as being the main organism that causes caries. The glucosyl transferase enzyme produced by *Streptococcus mutans* can facilitate the formation of glucan, thereby helping the attachment and aggregation of other bacteria to form plaque biofilms. Plaque that is not cleaned regularly will ripen. The pathogenicity produced by the bacterial complex can cause caries, gingivitis, and periodontitis. Therefore, plaque control is needed as an effort to maintain oral health (Gani BA, 2012).

Various ways are done to prevent the formation of dental caries is to use effective toothpaste to inhibit the growth of bacteria that cause dental caries. Toothpaste also functions as an active substance medium to remove bacteria from dental plaque to be applied to the tooth surface (Perry et al, 2007). To prevent tooth decay, an anti-plaque substance is needed in toothpaste which is currently closely related to fluoride content.

Toothpaste containing fluoride is not suitable for children under 4 years of age. This was confirmed by the existence of instructions from BPOM to withdraw all toothpaste products for children that still contain fluoride above 500 ppm (Harmely, F, 2011). Because the use of toothpaste containing fluoride has certain side effects, it is necessary to look for alternative toothpaste formulas made from natural ingredients. Based on the results of research conducted by the Belgian Ministry of Health, it shows that excessive use of fluoride can cause osteoporosis and damage to the nervous system (Sundus M, 2010)

Dental caries is by using herbal ingredients in the manufacture of toothpaste which is expected to inhibit the formation of dental caries and reduce the side effects caused by the use of the active ingredient fluoride in toothpaste. This can be seen from the results of previous studies showing that using herbal plants as active ingredients in the manufacture of toothpaste can inhibit the growth of bacteria that cause dental caries.

Among the many herbal plants that are used as active ingredients in the manufacture of toothpaste are red betel leaves and mint leaves. Red betel is widely used in *herbal center* as an ingredient or therapy for patients who cannot be cured with chemical drugs (Anonymous, 2009). The phytochemical compounds contained in red betel leaves are alkaloids, flavonoids, saponins, tannins and essential oils. According to Ivorra, MD in the book "*A review of natural products and plants as potential antidiabetic*" active compounds of flavonoids and alkaloids have hypoglycemic activity or lower blood glucose levels (Anonymous, 2007). Polyphenolic compounds (tannins) have antimicrobial activity. Polyphenols are one of the most common and widespread groups of substances in flowering plants, occurring in all vegetative organs, as well as flowers and fruits. Polyphenols are considered secondary metabolites involved in plant defense against chemical predators. The findings appear to suggest various potential mechanisms of action of polyphenols that can prevent disease, such as inhibition of bacterial replication enzymes. The antimicrobial effects of polyphenols have also been widely reported to have the ability to deactivate bacterial toxins. There is research by (Gianmaria F. Ferrazzano., *et al*) which stated that the glucosyltransferase enzymatic activity of *Streptococcus mutans* was inhibited by plant polyphenols (Ferrazzano, GF, et al. 2010).

Mint leaves are a plant that is widely used as an anti-bacterial in toothpaste and mouthwash preparations, because the substances contained in mint leaves are essential oils of

around 1 -2% and menthol (80-90%) (Widyaningrum, H., et al 2011).

According to Adi (2012), mint leaves contain 1-2% essential oil, 80-90% menthol, d-piperitine, hexanol phenylacetate, ethyl amilcarbinol, and neomentol. The content contained in mint leaves is essential oil 1-2% which can inhibit the growth of bacteria and menthol can be used as a fresh aroma addition in the manufacture of natural mouthwash. In Testiningsih's study, RF (2015) the highest antioxidant in the manufacture of tea infusion was 49.87%, namely tea infusion with the formulation of 2 g of avocado leaves, 0.4 g of mint leaves. Research was also conducted by Putpila, U, (2011), Comparison of Distillation Methods of essential oil (*Mentha piperita*) on antibacterial activity. The results showed that all essential oil distillation methods had antibacterial potential. Distillation steam showed the lowest MIC and MBC values for *E. coli*, *S. aureus* and *S. typhimurium*. Essential oil extraction, water and steam distillation found many bactericidal.

Based on the description above, research will be carried out to make toothpaste preparations using red betel leaf extract combined with mint leaf extract, and then an antibacterial test will be carried out against *Streptococcus mutans* that causes dental caries which is obtained by isolating bacteria from dental plaque. By carrying out a combination of these efficacious ingredients, it is expected to obtain a preparation that has a better effect (Potential) when used only in a single form.

II. METHOD

A. Research Variables and Research design

His research is included in the quasiexperimental research with a factorial design

- Independent variable. The independent variable in this study was the variation in the addition of red betel leaf extract and mint leaf extract with various concentration ratios of red betel leaf extract and mint leaf extract.
- Dependent variable. The dependent variable in this study was the physical quality of the toothpaste, namely organoleptic, homogeneity, pH, and viscosity profile periodically for 0 days, 6 days and 12 days.
- Controlled confounding variable. Controlled confounding variables in this study were storage time, nature of the storage container, storage temperature, light intensity, speed and duration of mixer stirring.
- Uncontrollable confounding variable. The uncontrollable confounding variables in this study were room temperature and humidity.

B. Operational Definitions

- 70% alcoholic extract of red betel leaf and mint leaf extract. Red betel leaf alcoholic extract and mint leaf extract are dry extracts in the form of fine powder, extracted with 70% alcohol solvent.
- Response. The response is the quantity with which the observed effect changes, the magnitude can be quantitated. The responses in this study were the physical quality of toothpaste, antibacterial properties, and hedonic tests.

e. Physical quality of toothpaste. are parameters to determine the physical quality of toothpaste, in this study are organoleptic, homogeneity, pH, viscosity 0 days, 6 days and 12 days after manufacture.

f. Antibacterial power test is a parameter testing the antibacterial effect of toothpaste preparations combining red betel leaf extract with mint leaf extract by measuring the inhibition zone/clear zone

g. The hedonic test is a test parameter to assess the level of preference for toothpaste preparations combining red betel leaf extract with mint leaves, while the assessment parameters are color, aroma, taste and texture

C. Research Procedures

➤ Preparation of red betel leaf extract and mint leaves

a. Red betel leaf extract using 70% v/v alcohol solvent. Red betel leaves are extracted by maceration, namely by soaking as much as 1000 grams of simplicia in 1000 ml of 70% v/v alcohol for 3-5x24 hours while stirring occasionally. After 3-5x24 hours, the extract is filtered using filter paper and the dregs are squeezed out. The dregs are added with enough solvent, stirred and then filtered so that 1500 ml of liquid extract is obtained. After that, the extract liquid was evaporated with a rotary vacuum evaporator until it was in the form of a thick liquid, then followed by using a water bath with a temperature between 50 - 60oC until a thick extract was obtained, and the results were weighed (Suwondo, 2007).

b. Mint extract. Using 70%v/v alcohol solvent. Mint leaves were extracted by maceration, namely by soaking 1000 grams of simplicia in 1500 ml of 70% v/v alcohol for 3-5x24 hours while stirring once in a while. After 3-5x24 hours, the extract is filtered using filter paper and the dregs are squeezed out. The dregs are added with enough solvent, stirred and then filtered so that 1500 ml of liquid extract is obtained. After that, the extract liquid was evaporated with a rotary vacuum evaporator until it was in the form of a viscous liquid, then followed by using a water bath with a temperature between 50 – 60oC until a thick extract was obtained, and the results were weighed.

c. Extract qualitative test

Testing the quality of the extract was carried out by testing the water content, total ash content and testing the acid insoluble ash content in accordance with the herbal Pharmacopoeia.

d. The viscous extract obtained was tested for heavy metal contamination, including Pb loam. Cu and others use the conventional method, namely the Gravimetric method

D. Toothpaste standard formula (Young, 1972)

Bahan pasta gigi	Satuan (g)
Kalsium karbonat	57
Natrium lauril sulfat	1
Gliserin	21
Tragakan	1,5
Pewarna	1 tetes
Natrium sakarin	1 tetes
Aquadest	19,5]
Natrium benzoat	1 mikroskopatuli

Table 1. Modified formula of red betel leaf and mint leaf extract toothpaste (100 g):

Ingredient	-				
	F1	F2	F3	F4	F5
Eks.Sirih Merah	20	-	10	15	5
Eks. Mint	-	20	10	5	15
CMC-Na	1.5	1.5	1.5	1.5	1.5
6*	40	40	40	40	40
Na. Lauril Sulfat	1	1	1	1	1
Gliserin	11	11	11	11	11
Metil Paraben	0,2	0,2	0,2	0,2	0,2
Natrium sakarin	0,25	0,25	0,25	0,25	0,25
Etanol	1	1	1	1	1
Aquadest ad.	100	100	100	100	100

E. Making toothpaste with red betel leaf alcohol extract and mint leaf extract

Toothpaste manufacture. CMC-Na was developed in 30 ml of distilled water for 24 hours. After that, add glycerin and stir using a mixer at speed number 2 for 10 minutes. On the other hand, N. Lauryl Sulphate was dissolved in hot water, methyl paraben was dissolved in 1 ml ethanol while sodium saccharin and alcoholic red betel leaf extract and mint leaf extract were each dissolved in the remaining aquadest. Methyl paraben solution using a mixer with rotational speed number 2 for 5 minutes. Then, add the sodium saccharin and calcium carbonate solution portion by portion and stir gently for 5 minutes to homogenize the mixture. At the final stage add a solution of red betel leaf alcohol extract, mint leaf extract and stir for 5 minutes until homogeneous.

a). Antibacterial Power Testing.

Equipment Preparation and Sterilization

- The tools and materials to be used in the antibacterial activity test are prepared and sterilized beforehand. Sterilization of tools and materials by wrapping them in paper. After everything is ready, the tools and materials are sterilized in an autoclave at 121oC for 15 minutes (Nurjannah et al., 2018).
- Preparation of Nutrien Agar (NA) Media
- Nutrient Agar (NA) media was prepared by dissolving 4 grams of Nutrien Agar (NA) media powder in 200 mL sterile aquadest. Then it is heated while stirring until all the ingredients are dissolved homogeneously. Then poured into 9 petri dishes aseptically 10 mL each. Finally,

all media were sterilized in an autoclave at 121oC for 15 minutes (Nurjannah et al., 2018).

- Rejuvenation of Streptococcus mutans Bacteria streptococcus mutans bacteria are rejuvenated in sterile Nutrient Agar (NA) media by taking bacteria in pure cultures and then putting them in Nutrien Agar (NA) media. Furthermore, the Nutrien Agar (NA) media containing bacteria was incubated for 24 hours in an incubator (Nurjannah et al., 2018).
- Paper disc Diffusion Test

There were 7 treatment groups in the antibacterial test, namely toothpaste preparations that did not contain red betel leaf extract and mint leaf extract as F1, herbal toothpaste as a positive control, and 5 formulas for toothpaste preparations red betel leaf extract and mint leaf extract as the test group. . Each paper disk was immersed in a toothpaste preparation that did not contain red betel leaf extract and mint leaf extract as a negative control, herbal toothpaste as a positive control, toothpaste preparations F2, F3, F4, F5 and F6 for ±25 minutes. The 7 paper disks were placed on agar media which had been inoculated with Streptococcus mutans according to the label on the petri dish. Each treatment was repeated 3 times. And then incubated in an incubator at 37°C for 24 hours. After 24 hours, the clear zone of inhibition around the paper disk area was observed. The diameter of the clear zone was measured using a caliper.

b). Hedonic Test

The hedonic test is a method used to measure the level of preference for a product using an assessment sheet. Toothpaste was measured for the preference level of aroma and color of the six Toothpaste formulas. The results obtained from 30 panelists were that the 4th formula was the most preferred formula both in terms of color and aroma

F. Data Analysis

The data collected is the antibacterial power test data where the data obtained from the measurement of the inhibition zone/clear zone of each formula and the hedonic test data for toothpaste preparations are obtained from the results of the preference test including color, aroma, taste and texture. Data analysis used the One Way ANOVA test at the 95% level of confidence. From the analysis results, the p-value (probability-value) is obtained, if the p-value <0.05 it can be concluded that each factor and its interaction has a significant effect on the response and for the hedonic test using bar chart analysis.

III. RESEARCH RESULTS AND DISCUSSION

A. Research results

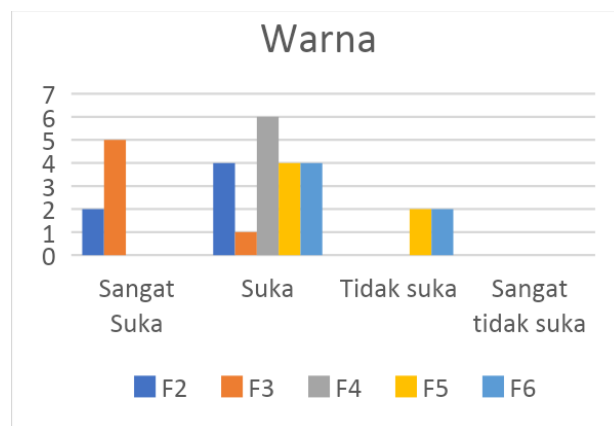
Observation results of anti-bacterial power test

F1	F2	F3	F4	F5	F6	K+
13,21	8,24	7,00	12,10	18,14	15,18	25,00
12,89	8,30	7,05	12,02	18,02	15,12	25,03
13,04	8,28	7,11	12,11	18,06	15,12	25,06

Information:

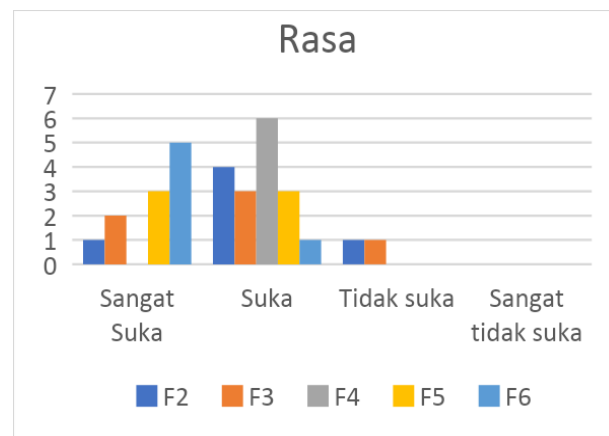
- F1 = Negative Control
- F2 = Toothpaste containing 20% red betel leaf extract
- F3 = Toothpaste containing 20% mint leaf extract
- F4 = Toothpaste containing 10% red betel leaf extract and mint leaf extract 10%
- F5 = Toothpaste containing 15% red betel leaf extract and mint leaf extract 5%
- F6 = Toothpaste containing 5% red betel leaf extract and mint leaf extract 15%

➤ Hedonic Test Results for Toothpaste Preparations



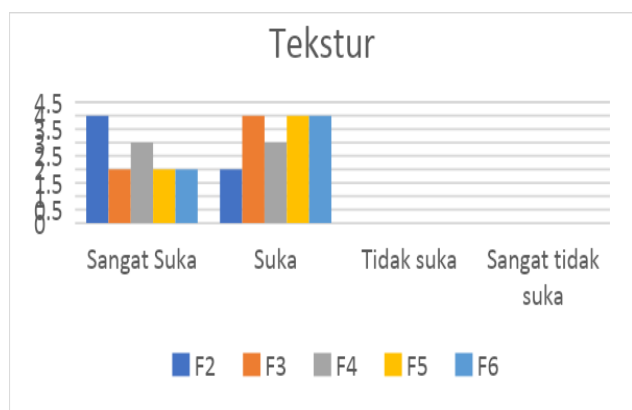
Picture 4.1 Hedonic Test Results for Color

Picture 4.1 shows that the highest percentage of respondents' preference for the color of the toothpaste preparation is that there is no formula that they strongly dislike, they do not like F5 and F6, they like F4 and F2, and they really like F3.



Picture 4.2 Hedonic Test Results for Aroma

Picture 4.2 shows that the highest percentage of respondents' preference for the aroma of toothpaste preparations was that there was no formula which they strongly disliked, did not like F4, preferred F2 F3 F5, and really liked F6

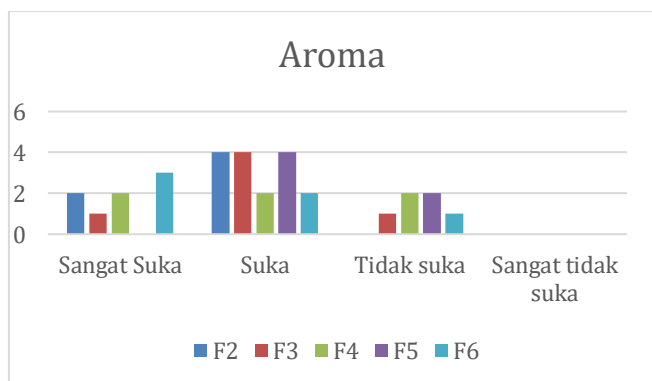


Picture 4.3 Hedonic Test Results for Taste

Picture 4.3 shows that the highest percentage of respondents' preference for the taste of toothpaste preparations is that there is no formula that they really don't like, they like F4 and F2, and they really like F6.

B. Discussion

Toothpaste formula is a preparation composed of a polishing agent, a moisturizing agent, a detergent and foaming agent, a binding agent, a sweetener, a flavour, and a preservative combined with an active ingredient from leaf extract. red betel which is combined with mint leaf extract which aims as an antimicrobial preparation that causes inflammation of the gums (gingivitis) and cavities (caries).



Picture 4.4 Hedonic Test Results for Texture

Picture 4.4 shows that the highest percentage of preference for the texture of toothpaste preparations is that there are no formulas that are very disliked and disliked, preferred in formula F3 F5 F6, and highly favored in formula F2.

The results of testing the inhibitory power of toothpaste preparations with various concentrations are in table 1.10, namely in F1 the average diameter of the obstacle is 13.04mm, in F2 the average diameter of the obstacle is 8.27mm, in F3 the average diameter of the obstacle is 7.05mm, in F4 the average diameter of the obstacle is 12.7mm, on F5 the average diameter of the obstacle is 18.7mm, on F6 the average diameter of the obstacle is 15.14mm, while on K+ the average diameter of the obstacle is 25.03mm. Of the three concentrations used by looking at the diameter of the inhibition zone, it shows an increase in the inhibition zone along with the increase in the concentration

used. This is due to the increasing active substance contained in red betel extract toothpaste preparations with a combination of mint leaf extract in inhibiting the growth of Streptococcus mutans and this is also due to the content of bioactive compounds which are derivatives of phenolic compounds which have the potential as anti-bacterial and metabolite compounds. other secondary triterpenoids, alkaloids, and flavonoids which are higher so that they are more able to inhibit Streptococcus mutans bacteria.

The mechanism of tannin compounds in red betel leaf extract is by means of bacterial walls that have been lysed due to saponins and flavonoids, causing tannin compounds to easily enter bacterial cells and coagulate protoplasm, as a result the cells cannot carry out living activities and their growth is stunted or even dies. . Tannins also inhibit antibacterial growth and are able to inactivate microbial cell adhesin as well as inactivate enzymes and interfere with protein transport in the inner layer of cells.

Flavonoids are the largest group of phenolic compounds. Flavonoids play an important role in the biochemistry and physiology of plants, among which they function as growth regulators, as well as antioxidants and antibacterials. This is because flavonoids have a broad spectrum of antibacterial activity by reducing immunity in target organisms. Cell membranes can be damaged by flavonoid compounds by inhibiting the synthesis of macromolecules. Flavonoids can also depolarize cell membranes and inhibit the synthesis of RNA, DNA and protein. In addition, the function of the cytoplasmic membrane and energy metabolism in bacteria can be inhibited by flavonoid compounds.

Mechanism Phenol is a secondary metabolite that acts as an antibacterial. The antibacterial mechanism of phenolic compounds is by denaturing bacterial cell proteins. Hydrogen bonds that occur between phenolic compounds and proteins in cells cause the protein structure to be damaged. This hydrogen bonding affects the permeability of the bacterial cell wall and cytoplasmic membrane, because both are composed of protein. Disruption of the permeability of the cell wall and cytoplasmic membrane will cause an imbalance of macromolecules and ions present in the bacterial cell, so that the cell becomes lysed. Flavonoids are the largest group of phenolic compounds. Flavonoids play an important role in the biochemistry and physiology of plants, among which they function as growth regulators, as well as antioxidants and antibacterials. This is because flavonoids have a broad spectrum of antibacterial activity by reducing immunity to the target organism. Antimicrobial activity in essential oils against gram-positive and negative bacteria through the mechanism of damaging the outer membrane of these bacteria. The hydrophobic nature of essential oils causes periton into the lipid of the bacterial cell membrane and then damages the bacterial cell structure and turns it into permeable, this cell membrane permeability results in damage to the cytoplasmic membrane.

The obtained inhibition test data were then statistically tested using the SPSS Version 23 application. To see normality values using the Shapiro-Wilk method, the results showed that the Significant values ($p > 0.05$) were normally distributed and could be continued with Homogeneity testing and One Way Testing, ANOVA. To see the value of homogeneity with the Test of Homogeneity of Variances method, the results show that the significance value ($p > 0.05$) of the data variable inhibition test is Homogeneous and can be continued with the One Way Anova Test. The results of the One Way Anova test obtained a significance value ($p < 0.05$) indicating a difference between each concentration, and then further testing, namely Post Hoc with the Benferroni method, obtained a significance value ($p < 0.05$) indicating a significant difference for each concentration.

The results of the hedonic/favorability test for toothpaste preparations obtained included the hedonic test for color based on Picture 4.1. The addition of extracts had a significant effect on the level of preference for the color of the red betel leaf extract toothpaste, a combination of mint leaf extract produced, so that the panelists liked it. The difference in color that is formed is a sign that the higher the concentration of the extract the darker the color, it can be seen in formula F4 that it has a darker color due to the high concentrations used for red betel leaf extract and mint leaf extract.

The results of the hedonic test/favorability of toothpaste preparations for aroma based on Picture 4.1 on the formula show that concentration has a significant effect on the aroma of red betel leaf extract toothpaste with a combination of mint leaf extract produced. The higher the concentration given, the panelist's preference for the aroma produced is higher.

In the hedonic test results / preference for toothpaste preparations for taste has the highest weight, because it is the main factor in choosing. Based on Picture 4.3 it shows that concentration has a significant effect on the resulting taste. Red betel leaf extract toothpaste combined with mint leaf extract has a distinctive taste in each extract due to the influence of the compounds contained in each extract.

On the results of the hedonic test / preference for toothpaste preparations for texture is one of the sensory factors or often referred to as the level of hardness, namely the property observed by mouth and touch, texture is also a benchmark for product quality that needs attention

In carrying out the research, there were several obstacles faced by researchers, namely limited references because it was very rare to do similar research using elephant ginger extract, and the COVID-19 pandemic caused several activities to not run smoothly, so the data obtained was very small due to the difficulty in finding respondents so that the activities research lasted quite a long time..

IV. CONCLUSION AND SUGGESTION

A. Conclusions

Based on the results of the research and discussion, it can be concluded as follows:

- a). Toothpaste preparations made with various concentration ratios namely F1, F2, F3, F4, F5, and F6 are physically stable.
- b). Toothpaste containing Red Betel leaf extract combined with Mint leaf extract is effective in preventing the growth of *Streptococcus mutans*.

B. Suggestion

Berdasarkan hasil penelitian dan discussion it is necessary to conduct further research on:

- a). Research on the spreadability of the prepared toothpaste preparations
- b). Research on the effect of storage temperature on the physical stability of toothpaste preparations
- c). In this study the effectiveness of red betel leaf extract toothpaste with a combination of mint leaf extract in preventing the growth of *Streptococcus mutans* bacteria still needs further research. Thus this product can be used widely by the public and has a more affordable economic value

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