



## Toothpaste Formulation Combination of Andaliman Fruit and Kecombrang Flowers as a Cleaner and Antibacterial

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### Article Info

#### Article history:

Received 2 March 2024

Received in revised form 17 April 2024

Accepted 30 April 2024

#### Keywords:

Andaliman Fruit

Combrang Flower

Toothpaste

Streptococcus Mutants

Escherichia Coli

### Abstract

Currently on the market there are many circulating toothpastes for cleaning teeth and treatment, but they contain synthetic chemicals that can cause health problems, such as fluoride and sodium lauryl sulfate (SLS). This material can irritate the gums and mouth, gums feel burning, sensitive teeth and discomfort on the tongue. Traditionally, andaliman fruit has been used as a refreshing and deodorizing agent and prevents tooth decay by gargling for about 10 minutes. One natural ingredient that has been proven to have antibacterial activity and has often been used to eliminate bad breath and body odor is combrang flower (*Etilinger elatior Jack*). Therefore, the author utilizes the combination of andaliman fruit and combrang flowers in toothpaste formulations with the aim of obtaining a natural toothpaste that is relatively safe and economical. The formulation of toothpaste preparations uses a combination of andaliman fruit and combrang flowers concentrations of 2.5%, 5%, and 10% with a ratio (75:25); (50:50); and (25:75). Evaluation of the preparation includes tests of homogeneity, pH, stability, cleaning power, organoleptic with hedonic test, irritation test of volunteer skin, and antibacterial activity against mutant *Streptococcus* and *Escherichia coli*. Toothpaste preparations containing a combination of dry pollen of combrang flowers and andaliman fruit have good cleaning power, no irritation, and can eradicate *Streptococcus mutans* and *Escherichia coli* bacteria with strong categories. The best formula is with the content of combrang flowers and andaliman fruit 75:25, because although the cleaning power is smaller, it has the strongest antibacterial, so the resulting toothpaste provides benefits for cleaning and dental care, safe and economical.

## Introduction

Toothpaste is one of the commonly used oral health products to clean teeth and maintain oral health. In recent years, research has continued to develop new formulations for toothpastes with the addition of natural ingredients to increase their effectiveness. One interesting combination to consider is the use of andaliman fruit and combrang flowers as the main ingredients in toothpaste. Both ingredients have the potential to be effective cleansers and antibacterials, and have additional benefits for oral health (Lugo-Flores et al., 2021; Barnett, 2006).

Poor dental and oral hygiene leads to bad breath, tooth decay and gingivitis. Therefore maintaining dental hygiene and care is very important (Sokolov et al., 2023). A simple way to care for teeth is to brush your teeth using toothpaste containing ingredients that can clean and prevent infections of the mouth, gums and teeth. Bacteria found in the mouth causing cavities

and bad breath are *Streptococcus mutans*, and bacteria around the environment can also be in the mouth can infect the mouth and gums is *Escherichia coli* (Ganiswara, 1995; Rowińska et al., 2021).

The purpose of this study was to formulate a toothpaste that combines andaliman fruit and combrang flowers as the main ingredients, as well as to evaluate the toothpaste's potential as a cleanser and antibacterial for oral health. This study also aims to understand the mechanism of action of these two natural ingredients in the context of teeth cleaning and bacterial control (Braga et al., 2022).

The toothpaste formulation of the combination of andaliman fruit and combrang flower is an interesting innovation in the development of dental and oral care products. Andaliman fruit and combrang flower are two natural ingredients that have the potential to provide health benefits to the teeth and mouth, especially in terms of cleaning and antibacterial. In this context, toothpaste formulations that combine these two natural ingredients can provide an effective and natural solution in maintaining healthy teeth and mouth (Laleman & Teughels, 2020).

Currently on the market many circulating toothpastes to clean and prevent infections of the mouth, gums, cavities. However, it contains synthetic chemicals that can cause health problems, for example, fluoride can cause health problems, especially in children under 8 years, if ingested it can cause fluorosis, cancer and thyroid disease (Mridha et al., 2021; Onipe et al., 2020). and contains Sodium Lauryl Sulfate (SLS) as a foam producer, if used in the long term it can irritate the gums and mouth, feel like burning, sensitive teeth and discomfort on the tongue (Tranggono & Latifah, 2007).

Traditionally the people of North Sumatra have used andaliman fruit seeds (*Zanthoxylum acanthopodium* DC), to eliminate bad breath and prevent tooth decay by smoothing and squeezing, the juice is diluted and gargled for approximately 10 minutes. In addition, plants that have antibacterial activity and are often used to treat various infectious diseases, eliminate bad breath and body odor, are combrang flowers (*Etlinger elatior* Jack) (Sinaga & Bintarti, 2021; Anggraeni, 2023).

Andaliman is a fruit that comes from the genus *Zanthoxylum* which is found in many parts of Indonesia, especially in the North Sumatra area. This fruit has a unique and fresh taste and contains active compounds such as flavonoids, alkaloids, and tannins. These ingredients have antibacterial and anti-inflammatory properties that can help reduce bacterial growth in the mouth and relieve gum inflammation.

Andaliman fruit (*Zanthoxylum acanthopodium*) is known for its spicy taste and contains active compounds such as alkaloids, flavonoids, and saponins (Sibero et al., 2020; Syaputri et al., 2022). On the other hand, combrang flowers (*Etlingera elatior*) contain compounds such as flavonoids, tannins, and terpenoids that have antibacterial and anti-inflammatory properties. With the combination of both in toothpaste formulations, it is expected to produce products that are effective in cleaning teeth and fighting bacteria that cause oral disease.

Andaliman fruit seeds and combrang flowers contain various chemical compounds, especially polyphenols, flavonoids, tannins, saponins, and essential oils, potentially antibacterial and have a distinctive and sharp aroma, most likely to eliminate bad breath and prevent mouth and gum infections. Therefore it has the potential to be formulated into toothpaste for cleaning, preventing oral and gum infections, as well as oral and dental care.

Kecombrang flower, or also known as honje flower or kincung flower, is a flower that is often used in Indonesian cuisine as a spice or flavoring. However, in addition to culinary purposes, combrang flowers also have properties as a natural antiseptic. The content of phytochemical compounds in combrang flowers, such as flavonoids, terpenoids, and polyphenols, has the potential to kill bacteria and maintain oral hygiene (Syafriana, 2021).

By combining these two natural ingredients in toothpaste formulations, we can create products that have double benefits. First, this toothpaste can help clean teeth effectively with a gentle but effective abrasion content to remove plaque and stains on teeth. Second, the antibacterial content of andaliman fruit and combrang flowers can help reduce the number of bacteria in the mouth, so as to prevent plaque formation and tooth decay and maintain healthy gums.

In addition to the health benefits offered, the use of natural ingredients such as andaliman fruit and combrang flowers in toothpaste formulations also has advantages in terms of environmental sustainability. Both of these ingredients are easily found in Indonesian nature and have a low carbon footprint in the production process, so their use in personal care products can help support the principles of environmental sustainability (Vermeulen et al., 2019).

In the development of toothpaste formulations of a combination of andaliman fruit and combrang flowers, it is necessary to carry out several stages. First, is the identification of the optimal concentration of each active ingredient to obtain maximum cleaning and antibacterial effects while still being safe to use. Furthermore, it is necessary to conduct product stability and safety tests to ensure that this toothpaste can be maintained in quality throughout the shelf life and does not cause unwanted side effects for users (Petrović et al., 2023).

The development of a toothpaste formulation combining andaliman fruit and combrang flower also needs to be supported by strong scientific research to corroborate related health claims. Clinical studies can be conducted to evaluate the effectiveness of the product in cleaning teeth and maintaining overall oral health. In addition, laboratory research can be carried out to study the mechanism of action of the active ingredients of these two natural ingredients in inhibiting bacterial growth more deeply.

Thus, the toothpaste formulation of the combination of andaliman fruit and combrang flowers can be an attractive alternative in caring for dental and oral health naturally and sustainably. Support from strong scientific research and adequate regulation will help ensure that these products can provide optimal benefits to consumers, while also paying attention to environmental sustainability in the production process.

## Methods

This type of research is experimental. The study included variations in the concentration of andaliman seed juice and combrang flowers in toothpaste preparations as independent variables, and quality parameters of cleaning power tests, effectiveness of preparations as antibacterial as dependent variables. Antibacterial activity against *mutant Streptococcus* bacteria and *Escherichia coli* bacteria was carried out. In addition, physical tests (quality of preparations) are also carried out.

### How To Make Toothpaste

Andaliman fruit and combrang flowers that have been weighed according to the formula are mixed and mashed, extracted with 10 mL of aquade, squeezed, the pulp is extracted again with 5 mL of aquade, and repeated once again with 5 mL of aquade. The collection of juice is dried with the lowest possible heat until a thick juice of approximately 2 mL is obtained. Into the sterilized porcelain mortar is inserted calcium carbonate, sodium lauryl sulfate is added, crushed until homogeneous, set aside, mass I is obtained. Next, mixed mass I and mass II, crushed until homogeneous mass of paste is formed, added andaliman fruit juice and combrang flowers while stirring, toothpaste is obtained with a mixture of andaliman fruit juice and combrang flowers with various concentrations.

### Antibacterial Activity Testing

Antibacterial testing performed on combination toothpaste Andaliman juice and Combrang flower, by agar diffusion method using metal salvage. A total of 0.1 ml of bacterial inoculum

(bacterial concentration  $1 \times 10^6$  cfu/ml) mixed homogeneously with 20 ml of Mueller Hilton Agar (MHA) temperature media ( $450C \pm 10C$ ) Inside the Petri dish is sterile, then left until the substrate solidifies. The solid media is implanted with a metal spare ring that is spaced out, then in each spare plate is inserted toothpaste preparation which is formulated a combination of andaliman juice and combrang flowers of various concentrations, toothpaste preparations circulating in the market as a comparison, and toothpaste base as blank. Then incubated in an incubator at a temperature of  $36-37^{\circ}C$  for 18-24 hours. After 24 hours, the diameter of the inhibitory zone was measured which occurred around the metal backup ring using a caliper. Repeated 6 times.

The test results testing the effectiveness of preparations as antibacterial from fomula with various variations in the concentration of the combination of andaliman fruit juice and combrang flowers, concluded based on the wide diameter of bacterial growth inhibition, namely the larger the area of bacterial growth inhibition, the stronger the preparation as antibacterial.

### Total Plate Number Test (ALT)

Saliva specimens were taken from 6 volunteers who had been conditioned, each put into a petri dish and made a triple. Into a petri dish poured  $\pm 20$  ml of NA media (temperature  $450C \pm 10C$ ). The petri dish is rotated and shaken in such a way (the movement of writing the number 8), so that the sample is evenly distributed, and is carried out in the same way for the blank test. After the medium solidifies, the petri dish is incubated at  $350C \pm 20C$  for 24 hours in the reversed position. Furthermore, the number of bacteria growing on each petri dish was observed and calculated (Darmstadt, 1998).

Then in the same way was done on the same volunteers, saliva specimens were taken who had brushed their teeth using a formulated toothpaste preparation so that differences in the number of bacteria growing on the media before and after using toothpaste could be seen. In the total plate number test, the difference in the number of bacteria growing on the media before and after the use of toothpaste was evaluated, so that a reduction in the number of bacteria in the use of the preparation was known.

## Result and Discussion

### Net Power Test Results

Testing the cleaning power of toothpaste preparations made is carried out to determine the ability of the preparation to clean or remove stains / plaque. The test is carried out by preparing a piece of white granite, then stained with a paint, left to dry until a stain forms. Then three toothbrushes are prepared, each given 1 gram of paste preparation, then tied to the stained granite, by rubbing in the same direction, repeated until the stain is clean, and calculated the amount of rubbing until the stain is clean. Thus it is done with the triplo number for each formula. The results can be seen in the following table.

Table 1. Dosage Net Power Measurement Data

Formula	Number of rubbing stain loss (times)			
	I	II	III	Average
Toothpaste (BK:BA=75:25)	14	15	14	14
Toothpaste (BK:BA=50:50)	12	12	11	12
Toothpaste (BK:BA=25:75)	10	11	12	11

Description: BK = Combrang Flower

BA = Andaliman Fruit

Table 1 above shows that the higher the content of andaliman fruit in the formula, the less the amount of rubbing to remove stains, the higher the level of cleaning power of the preparation. So it can be concluded that andaliman fruit in toothpaste preparations acts as a cleaning agent.

### Test Results of Antibacterial Activity of Toothpaste Preparations

Antibacterial activity tests are carried out to determine the ability of the preparation as antibacterial in the mouth at the time of toothpaste use. Testing was carried out by agar diffusion method against *Streptococcus mutans* as Gram positive bacteria and *Escherichia coli* as Gram negative bacteria. Observation of the diameter of bacterial growth inhibition by preparations containing a combination of dry pollen of combrang flowers and andaliman fruit in various concentrations and as a control of commercial toothpaste preparations on the market as can be seen in the following table 2:

Table 2. The Results Of Measuring The Diameter Of Bacterial Growth Inhibition

Test materials	Bacterial Growth Inhibition Diameter (mm)	
	<i>Streptococcus mutanss</i>	<i>Escherichia coli</i>
Toothpaste (BK:BA=75:25)	16.50 ± 0.50	15.30 ± 0.29
Toothpaste (BK:BA=50:50)	13.50 ± 0.50	12.50 ± 0.50
Toothpaste (BK:BA=25:75)	11.30 ± 0.29	10.50 ± 0.50
Toothpastes on the market	17.30 ± 0.29	16.30 ± 0.29

Remarks : BK = Combrang Flower

BA = Andaliman Fruit

Based on the Indonesian Pharmacopoeia edition V (2014), an inhibitory area is effective if it produces an obstacle area boundary with a diameter of approximately 14 mm. The diameter of the inhibitory zone of 5 mm or less is categorized as weak, the inhibitory zone of 5-10 mm is categorized as medium, the inhibitory zone of 10-20 mm is categorized as strong and the zone of 20 mm or more is categorized as very strong.

Test results of antibacterial activity of toothpaste preparations containing a combination of dry pollen of combrang flowers and andaliman fruit in various variations of comparison to bacteria *Streptococcus mutanss* and *Escherichia coli*, showed the results that the higher the content of combrang flowers, it provides a stronger barrier, against the two bacteria, and looks stronger against the two bacteria *Streptococcus mutanss* with an effective category of about 16.50 mm, against *Escherichia coli* about 15.30 mm.

It can be seen that although the diameter of bacterial growth inhibition provided by toothpaste preparations formulated differently against *Streptococcus mutanss* and *Escherichia coli* bacteria, and smaller than the bacterial growth inhibition provided by preparations on the market, both are included in the strong category.

Growth inhibition produced by the preparation against bacterial bacteria *Eschericia coli* smaller than bacteria *Streptococcus mutanss*, this can be caused due to *Eschericia coli* Gram negative bacteria have thin (10–15 mm) and more complex cell walls with high lipid content so that the cell walls are more difficult to penetrate. While *Streptococcus mutanss* is a Gram positive bacterium that has a simple and thick (15–80 mm) single-layered cell wall, low lipid content (1–4%), membrane layer *Cytoplasm* composed of peptidoglycan and acid *teichoic* in the form of water-soluble polymers, so that Gram positive bacteria are more easily penetrated by polar substances derived from combrang flowers dissolved in preparations such as polyphenolic compounds, flavonoids, and tannins that have the potential to be antibacterial, so that the resulting diameter is larger.

## Test Results of Total Plate Number of Toothpaste Preparations

The total plate number test results from the volunteers' saliva specimens showed that there was a reduction in the number of bacteria from saliva specimens before and after the use of formulated toothpaste, and it was also seen that the higher the concentration of combrang flowers in the preparation, the greater the reduction in the number of bacteria. The results of observations and calculations can be seen in Table 3 as follows:

Table 3. Results of Observation of the Number of Bacteria Before and After the Use of Toothpaste

Volunteer salivary specimen samples	Number of bacterial colonies				
	Before the use of toothpaste	After the use of toothpaste			
		Formulated toothpaste preparations			Comparator (Toothpaste on the market)
		Toothpaste (BK:BA=75 :25)	Toothpaste (BK:BA=5 0:50)	Toothpaste (BK:BA=2 5:75)	
Specimen 1	240	Negative	60	90	Negative
Specimen 2	260	Negative	50	70	Negative
Specimen 3	270	4	50	70	Negative
Specimen 4	270	6	60	80	Negative
Specimen 5	240	Negative	70	90	Negative
Specimen 6	260	5	60	90	Negative

Description: BK = Combrang Flower

BA = Andaliman Fruit

The table above shows that, the higher the content of combrang flowers in the preparation, the higher the number of bacteria. This is very close to the presence of chemical compounds of flavonoids, tannins, essential oils, and saponins in combrang flowers. Compounds in the form of polyphenolic compounds are very potential as antibacterials.

### Suggestions/ Recommendations

Here are some suggestions based on the following discussion:

**Emphasis on Product Benefits:** More specifically, the explanation of the benefits and advantages of such products can be expanded. For example, in addition to mentioning that this toothpaste has cleansing and antibacterial potential, you can highlight additional benefits such as freshness of the mouth and protection of teeth from decay.

**The Importance of Understanding Health Problems:** In the discussion of oral and dental health problems, you can add some recent data or statistics to emphasize the importance of maintaining oral and dental hygiene and the adverse effects of lack of dental care.

**Comparison with Conventional Products:** To improve the relevance and competitiveness of the product, it could further consider providing a more detailed comparison between conventional toothpaste and the proposed new formulation in terms of effectiveness, safety, and potential side effects.

**Strengthening Scientific Research:** Underscoring the importance of strong scientific research to support product health claims. This could include further clinical research, product stability tests, and laboratory research to understand more deeply the mechanism of action of active ingredients.

**Environmental Sustainability Considerations:** Expand the discussion on environmental sustainability by providing concrete examples of how the use of local natural ingredients such as andaliman fruit and combrang flowers can help reduce negative impacts on the environment.

Discussion of Potential Side Effects: Do further research or provide advice to address or reduce possible side effects that may arise from the use of the product, especially if there are concerns about synthetic chemicals in conventional toothpaste.

Sustainable Product Development: Conveying discourse on sustainable product development, including environmentally friendly production processes, the use of recyclable materials, and efforts to minimize waste.

Taking these suggestions into account, the discussion in the introduction will be more complete and informative, providing a better understanding of the advantages, benefits, and challenges associated with the development of a combination toothpaste of andaliman fruit and combrang flower.

## Conclusion

The conclusion obtained in this study is that toothpaste preparations containing a combination of andaliman fruit and combrang flowers have good cleaning power and can remove stains with 10 to 14 brushing. Toothpaste preparations containing a combination of combrang flowers and dried banana peels have effective antibacterial activity against *Streptococcus mutans* and *Escherichia coli*, with resistance diameters above 14 mm.

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