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Formulation of Herbal Toothpaste Combination of Anna Apple Peel and Kaffir Lime Peel with Variation of Sodium Lauryl Sulfate Concentration

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ABSTRACT

Toothpaste is a preparation whose use aims to clean the mucous membranes of the mouth. Anna's apple is a fruit that contains malic acid which has the ability to whiten teeth. Kaffir lime contains essential oils that have effects as antibacterial, antifungal and refreshing. This study aims to formulate herbal toothpaste preparations a combination of Anna Apple Skin extract (Malus domestica) and Purut Orange Peel extract (Citrus hystrix) and determine the physical quality of the preparation made. This type of research is experimental research using maceration methods with physical quality stability testing, namely organoleptic observations, homogeneity, pH, foam height, viscosity, and dispersion. In this study, two herbal toothpaste formulations were made with variations in the concentration of Sodium Lauryl Sulfate as a foaming agent in toothpaste. From the results of the study, it was obtained that the combination of the two extracts can be formulated into herbal toothpaste preparations and based on the results of physical quality tests, both formulations with variations in the concentration of Sodium Lauryl Sulfate 1.5% and 2.5% meet the requirements of the established standards.

Keywords: anna apple peel, kaffir lime peel, sodium lauryl sulfate, toothpaste.

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INTRODUCTION

Oral and dental health is highly maintained because it can affect a person's standard of living, especially regarding self-confidence (Fellows et al., 2022). Besides that, the mouth is a place for food and drink to enter as well as a place for various kinds of diseases. The percentage of oral health problems in Indonesia is 14% in abscesses and swollen gums cases. Meanwhile, the most effective rate, namely 45.3%, had cavities or damaged teeth (Riskesdas, 2018).

Tooth discolouration is also a problem that can affect a person's self-confidence (Zou et al., 2020). Today, one's appearance is essential, especially in maintaining dental esthetics. Everyone wants to do various ways to increase self-confidence through body care. With the increasing development of dentistry, the need for dental aesthetics is also growing (Anggraeni & Aryanto, 2019).

Oral and dental health needs to be maintained by carrying out maintenance, namely brushing teeth using toothpaste (Carter et al., 2022). The side effects caused by the use of carbamide peroxide and hydrogen peroxide make researchers continue to try to find alternatives using natural ingredients that can restore white teeth with few side effects and affordable prices (Anggraeni & Aryanto, 2019).

Various kinds of plants can be found in Indonesia because the area is tropical, so it has natural ingredients for various health problems. Apart from being preferred because of their high nutritional value, apples are also used as a teeth-whitening agent because of their acidity. As much as 90% malic acid is the main content of apples. Anna apple is a type of apple with a slightly yellowish-red colour, thin skin, and more water content than other types of apples. According to research (Sa'adah & Estiasih, 2015), Anna apples have more acid content than other types of apples. Organic acids can whiten teeth.

Another natural ingredient that can be used to keep your teeth and mouth clean is kaffir lime. Generally, kaffir lime adds flavor to dishes where the taste comes from essential oils. Essential oils function as antimicrobials (Yunilawati et al., 2021). Based on research conducted (Etika, 2019) that the ability of essential oils in kaffir lime peels is antimicrobial, antifungal, and tonic. Streptococcus mutants are a bacterium whose growth can be inhibited by the content of citronellal compounds in essential oils. These bacteria can form plaque, the leading cause of dental caries (Yuliani et al., 2011).

According to research (Anggraeni & Aryanto, 2019), Anna apples can be a natural teeth-whitening agent. According to Annisa's research in 2019, kaffir lime peel extract effectively reduces plaque buildup at a concentration of 5%. This is due to the antibacterial and antiseptic properties of kaffir lime peels.

Based on this description, researchers developed a Formulation of Herbal Toothpaste Preparation Combination of Anna Apple Skin Extract (*Malus domestica*) and Purut Orange Peel (*Citrus hystrix*) with Variations in Lauryl Sulfate Sodium Concentration of 1.5% and 2.5%. Sodium lauryl sulfate in the formula acts as a surfactant with the ability to reduce surface tension and reduce food waste on the teeth. This study aims to formulate an Herbal Toothpaste Preparation Combination of Anna Apple Skin Extract (*Malus domestica*) and Purut Lime Fruit Peel (*Citrus hystrix*) with Variations in Sodium Lauryl Sulfate Concentration with physical quality stability testing, namely organoleptis observation, homogeneity, pH, foam height, viscosity and dispersion.

The purpose of the study was to formulate herbal toothpaste preparations from a combination of Anna Apple Skin Extract (*Malus domestica*) and Purut Orange Peel (*Citrus hystrix*) and to determine the physical quality of the toothpaste preparations made.

The benefit of research is to add insight into science in the pharmaceutical field, especially in the manufacture of toothpaste preparations with the use of natural ingredients and this research as reference material for further research.

METHODS

This research is experimental with the aim of formulating Herbal Toothpaste Preparations Combination of Anna Apple Skin Extract (*Malus domestica*) and Purut Orange Peel (*Citrus hystrix*) with Variations in Sodium Lauryl Sulfate Concentration with physical quality stability testing, namely organoleptis observation, homogeneity, pH, foam height, viscosity and dispersion. The population in the study is all types of plants that can be formulated in the dosage form of toothpaste. The equipment used is a maceration tool, knife, stirring rod, sieve, petri dish, gauze, glass funnel, glass beaker, erlenmeyer, mortar and stamfer, horn spoon, measuring cup, analytical balance, sudip, orek, drip pipette, pH meter, Rotary Evaporator, Waterbath, Incubator, refrigerator, and viscometer. The ingredients used are Anna Apple peel, Kaffir Orange peel, Tocopherol, Glycerol, Calcium Carbonate, Methyl Paraben, Sodium Lauryl Sulfate, Sorbitol, Ethanol, Oleum Menthae Piperitae, dyes and Aqua Destillata. The following is the design formula for this study:

Table 1. Herbal Toothpaste Formula Design Combination of Anna Apple Peel (*Malus Domestica*) and Kaffir lime (*Citrus Hystrix*) Peel

Material	Composition % Toothpaste Formulas		Reference
	Formula 1	Formula 2	
Anna Apple fruit skin extract	5	5	(Annisa, 2019)
Kaffir lime peel extract	5	5	(Annisa, 2019)
Calcium carbonate	30	30	(Arisanty, 2016)
Glycerin	5	5	≤ 30 (HPE Fifth Edition, 2006)
Sorbitol	20	20	20-60 (HPE Fifth Edition, 2006)

Material	Composition % Toothpaste Formulas		Reference
	Formula 1	Formula 2	
Sodium Lauryl Sulfate	1.5	2,5	0.5-2.5 (HPE Fifth Edition, 2006)
Methyl Paraben	0.1	0.1	0.015-0.2 (HPE Fifth Edition, 2006)
Tocopherol	0.05	0.05	(Nur Sa'adah, 2016)
Oleum Mentha Pip.	0.5	0.5	(Zulfa, 2012)
Dye	qs	qs	
Aqua Destillata	Ad 100	Ad 100	

The process of making toothpaste is made of two formulas. The first step is to crush Calcium Carbonate, sieved, and then weigh it. Then the extracts of Anna apple peel and Kaffir lime peel, Sodium Lauryl Sulfate, Glycerin, Sorbitol, Methyl Paraben, Tocopherol, and Oleum Menthae Pip were weighed. Moreover, measured Aqua Destillata. Next, heat Aquadest in a glass beaker on a hot plate. After it was hot, Methyl Paraben was added and stirred until it dissolved (mass 1). Add Sodium Lauryl Sulfate into the mortar and grind until smooth, then add Calcium Carbonate while grinding until uniform (mass 2). Next, the extract of Anna apple peel and kaffir lime peel was dissolved with some glycerin (mass 3). Put the rest of the glycerin into the mortar, grind it, and add part of the mass 2 bit by bit while grinding it until it is homogeneous and forms an emulsion. Then add the remaining mass two while grinding until homogeneous (mass 4). Sorbitol is added and then crushed until homogeneous. Then add tocopherol little by little and grind until homogeneous. Entered Oleum Menthae Pip. and crushed to form a paste. Added coloring and then crushed again. Then the paste is put into the container for further testing of the physical quality of the preparation.

Accelerated stability testing (*Cycling Test*) using the *Freeze-Thaw method* aims to determine the physical stability of the preparation. This test is based on the effect of changing the temperature of *the cycling test* at a temperature of 4oC, followed by a temperature of 40°C which is carried out in 6 cycles. One cycle lasts 24 hours (Suryani & Hernaman, 2017).

Evaluation of toothpaste preparations, namely:

Organoleptic Test

An organoleptic test is a test that looks at visual preparation. The preparations were observed for their shape, color, and aroma (Azkiya et al., 2017). According to SNI No. 12-3524-1995, the conditions for a good toothpaste preparation are soft and homogeneous, with no air bubbles, lumps, and separate parts.

Homogeneity Test

The preparation is taken and smeared on a petri dish, then observed. Good preparation standards based on SNI No. 12-3524-1995 that is homogeneous, with no air bubbles, lumps, and separate parts.

pH test

The tool in the form of a pH meter electrode is dipped in formulas one and two until an equivalent value appears on the pH screen (Lestari et al., 2020). Toothpaste is safe if it is within the range of 4.5 – 10.5, according to SNI 12-3524-1995.

Foam Height Test

Most toothpaste requires much foam to lift the remaining dirt on the teeth. This test method takes 1 gram of the preparation, puts it in a 50 ml measuring cup, and then dissolves it with 10 ml of Aqua Distillate. Shake five times and pay attention to the height of the foam (Daud et al., 2016). The maximum foam height requirement for toothpaste preparations is 15 mm (Achsia, 2020).

Viscosity Test

Viscosity measurement using a *Brookfield viscometer* on *the spindle* and the appropriate speed. Tests were carried out before and after *the cycling test* (Pratasik et al., 2019). Based on SNI 16-4399-1996, the viscosity standard for semisolid toothpaste preparations ranges from 2000 – 50000 cP.

Spreadability Test

Weigh 0.5 g of the preparation and store it on a 20x20 cm glass, then overlap it again using a glass and place a weight of 125 g on it. Then the diameter of the spreading power was measured after 1 minute (Nurjannah et al., 2018). Toothpaste requirements are in the range of 3 – 5 cm spreadability (Wahidin et al., 2021).

RESULTS AND DISCUSSION

Organoleptic Test

Table 2. Organoleptic test results for herbal toothpaste preparations combined with Anna Apple Peel (*Malus domestica*) and Kaffir lime (*Citrus hystrix*) Peel before and after storage using accelerated stability method with three replications

Formulas	Organoleptic					
	Before Accelerated Storage			After Expedited Storage		
	Form	Color	Smell	Form	Color	Smell
F1	Semisolid	Green	Mint	Semisolid	Green	Mint
F2	Semisolid	Green	Mint	Semisolid	Green	Mint

Homogeneity Test

Table 3. Results of homogeneity testing of herbal toothpaste preparations combined with extracts of Anna apple peel (*Malus domestica) and* kaffir lime peel (*Citrus hystrix*) before and after storage using the accelerated stability method with three replications

Formulas	Before Accelerated Storage	After Expedited Storage	Condition	Results
F1	Homogeneous	Homogeneous	There are no coarse details	Qualify
F2	Homogeneous	Homogeneous		Qualify

pH test

Table 4. Test results for the pH of herbal toothpaste preparations combined with Anna Apple Peel (*Malus domestica*) and Kaffir lime Peel (*Citrus hystrix*) extract before and after storage using the accelerated stability method with three replications

Formulas	Before Accelerated Storage		After Expedited Storage		Condition	Results
F1	I	8,22	I	7,79	4.5 - 10.5	Qualify
	II	8,18	II	7,67		
	III	8,14	III	7.59		
Average	8,18		7,68			
F2	I	8.40	I	7,84		Qualify
	II	8.35	II	7,82		
	III	8,31	III	7,78		
Average	8.35		7,81			

Foam Height Test

Table 5. The results of high foam testing of herbal toothpaste preparations combined with extracts of Anna apple peel (*Malus domestica*) and kaffir lime peel (*Citrus hystrix*) before and after storage using the accelerated stability method with three replications

Formulas	Before Accelerated Storage		After Expedited Storage		Condition	Results
F1	I	8mm	I	6mm	15mm	Qualify
	II	8mm	II	7mm		
	III	7mm	III	7mm		
Average	7.6mm		6.6mm			
F2	I	13mm	I	12mm		Qualify
	II	11mm	II	9mm		
	III	12mm	III	10mm		
Average	12mm		10.3mm			

Viscosity Test

Table 6. The results of viscosity testing of herbal toothpaste preparations combined with extracts of Anna apple peel (*Malus domestica*) and kaffir lime peel (*Citrus hystrix*) before and after storage using the accelerated stability method with three replications

Formulas	Before Accelerated Storage		After Expedited Storage		Condition	Results
F1	I	10100	I	9963	2000-50000	Qualify
	II	11297	II	10708		
	III	12053	III	11838		
Average	11150		10836			
F2	I	11752	I	10730		Qualify
	II	12107	II	11133		
	III	12141	III	11931		
Average	12000		11264			

Spreadability Test

Table 7. Test results for the spreadability of herbal toothpaste preparations combined with extracts of Anna apple peel (*Malus domestica) and* kaffir lime peel (*Citrus hystrix*) before and after storage using the accelerated stability method with three replications

No	Formulas	Before Accelerated Storage		After Expedited Storage		Condition	Results
1.	F1	I	3.3cm	I	3.5cm	3 - 5 cm	Qualify
		II	3.1cm	II	3.2cm		
		III	3.2cm	III	3.4cm		
	Average	3.2cm		3.36cm			
2.	F2	I	3.4cm	I	3.6cm		Qualify
		II	3.2cm	II	3.2cm		
		III	3.2cm	III	3.5cm		
	Average	3.26cm		3.43cm			

In this research, herbal toothpaste was made from natural ingredients with a combination of Anna apple peel extract (*Malus domestica*) and Jeruk Purut peel (*Citrus hystrix*) by varying Sodium Lauryl Sulfate 1.5% and 2.5% as a surfactant or detergent with its primary function is to form foam and has the cleaning power that can clean plaque and food residue easily.

The extraction technique used in this research is maceration. The advantage of this technique is that the active substance of the extract is not easily damaged, uses simple equipment, and is easy to work with. The submerged material releases secondary metabolites due to the breakdown of the cytoplasm from the breakdown of the cell wall and cell membrane caused by the pressure difference between inside and outside the cell. 216 g of Anna's apple skin and 215 g of Jeruk Purut peel which had been dried, then soaked in 96% ethanol for 15 days, stirring occasionally and changing the solvent three times. Furthermore, the resulting filtrate was evaporated using a Rotary Evaporator.

The ingredients used are Anna apple peel extract, Jeruk Purut peel extract, Tocopherol as an antioxidant, Glycerol as a moisturizer, Calcium Carbonate as an abrasive, Methyl Paraben as a preservative, Sodium Lauryl Sulfate as a foaming agent, Sorbitol as a sweetener, Oleum Menthae Piperitae as fragrances, dyes and Aqua Destillata. The finished toothpaste preparations were tested for physical quality stability by organoleptic tests, homogeneity, pH, foam height, viscosity, and spreadability tests.

Toothpaste organoleptic observation was done by looking at its texture, color, and aroma. The observations of the two formulations were the same, and the results obtained on the texture of the paste were semi-solid, green in color, and smelled of mint. Thus the varied concentration of Sodium Lauryl Sulfate had no effect on the organoleptic of the toothpaste prepared. The test results are in table II.

Homogeneity testing was done by smearing the preparation on a petri dish and then visually see the preparation. The observations showed no coarse grains, air bubbles, and separate parts when the preparation was smeared on the cup. This means that the ingredients in the preparation are uniform and evenly mixed and meet the requirements of SNI 12-3524-1995 (Warsy et al., 2016). The test results are shown in Table III.

The pH test is carried out using a pH meter. The pH test aims to see the degree of acid in the preparation so that it is comfortable to use and does not irritate the oral mucosa. The pH test for the two formulations with three replications showed that the toothpaste was still good because it was still in the 4.5 – 10.5 based on SNI 12-3524-1995. The test results used Two Way ANOVA $P = 0.553$ ($\alpha > 0.05$), meaning there was no significant difference in the pH of the preparation before and after storage. The changing pH indicates that the preparation during storage is less stable but still meets the pH range in the pH requirements of toothpaste preparations. The test results are shown in table IV.

The foam height test shows the ability of a preparation to produce foam, in which the foaming agent used is Sodium Lauryl Sulfate. The test was carried out by observing the height of the foam formed from the toothpaste preparation to measure the strength of the preparation in removing dirt and the ability to clean the mouth when brushing teeth. In the formula made, there are variations in the concentration of the foaming agent used. The test results show that when the concentration of Sodium Lauryl Sulfate is high, the foam produced also increases. The foam height test for both formulations with three replications showed that the results met the requirements. The test results using Two Way ANOVA $P = 0.495$ ($\alpha > 0.05$) proved no significant difference in the foam height before and after storage. The results of the foam height test are shown in table V.

Viscosity testing was conducted using a Brookfield viscometer measured with spindle number 4 at 30 rpm. Viscosity is a quantity of fluid viscosity that measures the size of the friction in the fluid. If the viscosity is large, the object is increasingly difficult to move in the fluid. Viscosity is closely related to toothpaste, so whether the preparation can stick well to the toothbrush (Adrianto, 2012). After the cycling test, there is a decrease in the viscosity value. The longer the storage time, the lower the viscosity value. This is also due to the less stable storage temperature (Widarsih et al., 2017). The test results using Two Way ANOVA $P = 0.181$ ($\alpha > 0.05$) proved that there was no significant difference in the viscosity of the preparation before and after storage. The results of the viscosity test are shown in table VI.

The spreadability test was carried out to know the mass of the toothpaste. The characteristics of quality toothpaste are that it is easily removed from the tube and can maintain its shape when applied to a toothbrush just before use (Lestari et al., 2020). The test results show that the diameter of F1 is 3.3 cm and F2 is 3.4 cm. This is due to the different concentrations of foaming agents for the two formulas. The results of the spreadability measurements showed that after the storage cycling test, the two formulas with three replications experienced an increase in spreadability. However, the spreading power diameter is still within the 3 – 5 cm standard range. Meanwhile, the test results using Two Way ANOVA P = 0.553 ($\alpha > 0.05$) proved that there was no significant difference in the spreadability of the preparations before and after storage. The results of the spreading power test are shown in table VII.

CONCLUSION

The study concluded that the combination of Anna apple (Malus domestica) and Jeruk Purut (Citrus hystrix) peel extracts could be formulated into herbal toothpaste preparations with varying concentrations of Sodium Lauryl Sulfate 1.5% and 2.5%. Based on the results of the physical quality test of toothpaste preparations, the two formulations of toothpaste combined with extracts from the skin of the Anna apple (Malus domestica) and the Peel of the Jeruk Purut (Citrus hystrix) with varying concentrations of 1.5% and 2.5% sodium lauryl sulfate meet the requirements. Stability of physical quality based on literature.

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