Optimization of Hand Sanitizer with Betel Leaf (*Piper Betle* L.) Extract and Cinnamon (*Cinnamomum burmanii*) Extract

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Abstract. The number of microorganisms will have a detrimental effect on health. The importance of cleaning hands before doing activities is a priority at this time. The use of hand sanitizer has become an option other than washing hands. Optimization of hand sanitizer formulations from natural ingredients with antibacterial effect is an alternative. Betel leaf and cinnamon bark are examples of ingredients. The combination of betel leaf extract and cinnamon bark extract will be used in optimizing the hand sanitizer preparation formula. This study aims to determine the optimal formula using a combination of extracts that can be used for hand sanitizer formulas. In this study, in vitro tests were conducted and the characteristics of hand sanitizer preparations containing extracts of betel leaf (Piper betle L.) and cinnamon bark (Cinnamomum burmanii) were tested using an experimental research design. The results of the test data in the form of an antibacterial activity inhibition zone, then analyzed using the One Way ANNOVA method and then continued with the Post Hoc LSD method with $p < 0.05$. The antibacterial test results showed that formulas A, B and C produced inhibition zone diameters of 9.3, 12.4 and 18.5 mm, respectively. Based on standard, the inhibitory power of bacteria is categorized into medium (A) and large (B & C). The statistical test showed that there was no significant difference in all samples ($p > 0.05$). The hand sanitizer formula using a combination of natural ingredient extracts will be an alternative for the manufacture of its products.

Keywords: Hand sanitizer · Betel leaf · Cinnamon · Combination extract

1 Introduction

Diarrhea is a disease that is often found in several areas in Indonesia. The clinical prevalence of diarrhea disease is 6.8% [1]. These data imply that the causes of diarrhea cannot be prevented evenly in all regions. The route of transmission of diarrhea through the fecal-oral route must be prevented by maintaining personal hygiene, namely cleaning hands from all kinds of dirt [2]. The most effective way is to wash your hands and/or use an antibacterial hand sanitizer.

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Betel leaf (*Piper betle* L) is one of the plants with antibacterial content in it. Betel leaf (*Piper bettle* L) has antibacterial compounds in its acetyl acetate extract due to the presence of phenolic compounds and their derivatives [3]. Betel leaf extract (*Piper Betle* L.) was also reported to have significant inhibition against Streptococcus pyogenes bacteria [4]. In addition to betel leaf (*Piper betle* L), cinnamon bark (*Cinnamomum burmani*i) also has antibacterial activity. This can be proven by the presence of cinnamaldehyde compounds, tannins, resins, calcium oxalate, flavonoids, triterpenoids, and saponins [5]. This content in cinnamon bark is reported to function as an antibacterial against E. coli and S. aureus [6].

Hand sanitizers can be found in various types of dosage forms, including liquid and gel forms. Hand sanitizer is used to kill hand germs with alcohol compounds in it [7]. In alcohol content 60–70% can provide better inhibition on gram-positive bacteria [8]. The addition of antibacterial compounds in hand sanitizer is believed to provide additional strength to inhibit or kill germs. This study aims to find the optimal formulation of hand sanitizer gel with the addition of a combination of betel leaf extract and cinnamon bark extract.

2 Materials and Method

2.1 Materials

Betel leaf (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*), 96% ethanol, TEA, Glycerin, Methyl paraben, Escherichia coli bacteria, nutrient agar, NaCl, hand sanitizer (Dettol®), Carbopol, and Aqua distillates.

2.2 Methods

2.2.1 Extraction Process

Betel leaf extract (*Piper betle* L.) and cinnamon bark extract (Cinnamomum burmanii) were made through a maceration process. The extraction process of betel leaf (Piper betle L.) and cinnamon bark (*Cinnamomum burmanii*) each used 500 g of material and 5 L of 96% ethanol. Then the re-maceration process was carried out by adding 2.5 L of 96% ethanol to each ingredient. The re-maceration process was continued with the filtration process and the thickening of the filtrate using a rotary evaporator.

2.2.2 Formulation of Hand Sanitizer Gel

The formulation of the Gel Hand Sanitizer was carried out using the number of ingredients in Table 1. The hand sanitizer gel was made by mixing all the ingredients according to the amount to form a gel preparation.

Table 1. Formula of hand sanitizers gel.

Ingredients	Competition		
	F1	F2	F3
Betel leaf extract (*Piper bettle* L.)	0.25 gr	0.50 gr	0.75 gr
Cinnamon bark extract (Cinnamomum burmanii)	0.25 gr	0.50 gr	0.75 gr
Carbopol 940	0.2 gr	0.2 gr	0.2 gr
Glycerin	0.5 mL	0.5 mL	0.5 mL
Methyl Paraben	0.1 gr	0.1 gr	0.1 gr
TEA	7 drops	7 drops	7 drops
Aquadest	qs.	qs.	qs.

Notes F1 (Formula 1); F2 (Formula 2); F3 (Formula 3)

2.2.3 Evaluation of Hand Sanitizer Gel

Homogeneity Test Hand sanitizer gel of betel leaf extract (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*) were placed on parchment paper and then rubbed. If there are no coarse grains, the preparation is considered homogeneous [9].

Organoleptic Test Organoleptic tests were carried out on hand sanitizer gel of betel leaf extract (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*) including observations of aroma, color and shape.

Adhesion Test Hand sanitizer gel of betel leaf extract (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*) weighed 0.25 g then placed on 2 glass objects measuring 2 × 2 cm. After that it was overwritten with a load of 1 kg for 5 min. The gel is removed with a load of 80 g. Record the release time from the object glass [10].

PH Test Hand sanitizer gel of betel leaf extract (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*) 1 g was taken and then dissolved in 10 mL of distilled water, the PH value was measured with a pH meter. The pH requirement for topical preparations is 4.5–7 [9].

Viscosity Test Viscosity test of hand sanitizer gel of betel leaf extract (*Piper betle* L) and cinnamon bark (*Cinnamomum burmanii*) was done using a Brookfield LV viscosimeter. Gel viscosity is declared good if the results are in the range of 6,000–50,000 cps because it meets Indonesian National Standards [11].

Antibacterial Test Preparation of Escherichia coli Bacterial Suspension

Preparation of suspension of E. coli bacteria was carried out by taking 1 ose of suspension of E. coli bacteria, dissolved in NaCl and diluted to a standard of 104 CFU/ml.

Well Diffusion Test

The well diffusion test was carried out by mixing 1 g of bacteria with Nutrient Agar, poured into a petri dish and waited for it to solidify. Then made a well with a perforator in a petri dish. After solidification, the petri dish was filled with 1 ml of hand sanitizer gel extract of betel leaf (*Piper bettle* L) and cinnamon bark (*Cinnamomum burmanii*) (F1, F2, and F3). The incubation process was carried out at a temperature of 37 °C with a time of 18–24 h.

2.2.4 Data Analysis

The Antibacterial test data analysis was carried out by measuring the area of the clear zone formed on the media. The results of the antibacterial inhibition zone test data were analyzed using the One Way ANNOVA method and followed by the Post Hoc LSD method with $p < 0.05$.

3 Result and Discussion

The hand sanitizer gel formulation process was carried out with variations in the levels of the combination of betel leaf extract (*Piper bettle* L) (A) and cinnamon bark (*Cinnamomum burmanii*) (B) as much as 0.25 g (A) + 0.25 g (B) (Formula 1); 0.50 g (A) + 0.50 g (B) (Formula 2); and 0.75 g (A) + 0.75 g (B) (Formula 3). This is as listed in Table 1. The results of the hand sanitizer gel preparation can be seen in Fig. 1.

The results of the homogeneity test of the hand sanitizer gel showed that Formula 1 and Formula 2 produced homogeneous preparations indicated by the absence of coarse grains. However, in Formula 3 there are coarse grains, which means the preparation is not homogeneous. The cause of this in-homogeneity is probably due to factors that affect the mixing process; including temperature, stress and duration of the stirring process [12]. The results of the organoleptic test showed that all preparations were greenish-brown in color with concentrations ranging from medium (F1), concentrated (F2) and very concentrated (F3). This shows that the higher the concentration of the extract combination, the more concentrated the resulting color. The aroma produced by

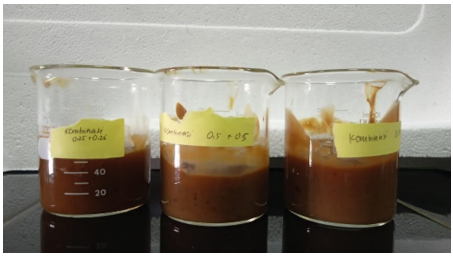

Fig. 1. Hand sanitizer gel formula results

Table 2. Results of adhesion test, PH test and viscosity test for gel hand sanitizer preparations.

Formula	Adhesive test (Seconds)	PH test	Viscosity (cps)
F1	0.51	5.47	12.630
F2	0.44	5.34	10.770
F3	0.37	5.57	6.480

this hand sanitizer gel gives a thin distinctive aroma a combination of betel leaf and cinnamon; but it can be said that the aroma of betel leaf still dominates. The texture of the three preparations showed that a semisolid gel texture was obtained.

The results of the evaluation test for hand sanitizer gel preparations in Table 2 in the form of a stickiness test, PH test and viscosity test showed that the increasing concentration showed a decrease in the adhesive power of the preparation, an increase in the PH value and a decrease in the viscosity of the preparation. The adhesion value did not meet the standard because the three formulas had adhesion <1 s. Meanwhile, the standard value for good adhesion of topical preparations is more than 1 s. This can occur due to the hydrogen bond between Carbopol and water when Carbopol is added to water, the Carbopol will be dispersed and partially decomposed to form bonds with water in the form of hydrogen bonds, then Carbopol which is completely decomposed must be added with TEA as neutralizing agent to form a gel mass. So, it can be concluded that too much water binds to Carbopol will cause the gel preparation to become less sticky when the adhesion test is carried out.

All preparations show a pH value that meets the requirements because it is in the range 4.5–7 which is a good pH requirement and criteria for topical preparations [13]. A good pH value is influenced by the presence of Carbopol and TEA materials. Carbopol has an acidic pH value so that its structure is flexible, not yet forming a gel characteristic. With the addition of TEA, the desired gel characteristics are formed due to the presence of ionic repulsion in the carboxylate and polymer groups [7].

The results of the viscosity test showed that all preparations met the requirements of Indonesian National Standard which ranged from 6,000 to 50,000 cps. The higher the concentration of the extract combination, the lower the viscosity according to the results of this test. This is influenced by the spindle rotation speed on the viscometer [14].

The effect of extract concentration can also be seen from the antibacterial test results for hand sanitizer gel preparations (Table 3). The higher the concentration, the larger the diameter of the inhibition zone. This means that the effect of antibacterial compounds on the combination of betel leaf extract (*Piper bettle* L) and cinnamon bark (*Cinnamomum burmanii*) is increasingly indicated by the high ability to inhibit bacterial growth. Antibacterial compounds have a mechanism of damaging cell walls and then changing cell membrane permeability, interfering with cell protein synthesis and inhibiting the

Table 3. Antibacterial test results for gel hand sanitizer preparations

Formula	Inhibition zone diameter (mm)
F1	9.3
F2	12.4
F3	18.5

work of enzymes in cells [15]. Betel leaf (*Piper bettle* L) with 0.1–1% phenol content showed bacteriostatic activity or inhibited bacterial growth. While phenol with a concentration of 1–2% has bactericidal activity or kills bacteria [16]. The ability of betel leaf is supported by the ability of cinnamaldehyde in cinnamon bark (*Cinnamomum burmanii*) with a concentration of 60–70%, because E. coli biogilm is sensitive to cinnamaldehyde [17]. Antibacterial work in hand sanitizer gel preparations is also influenced by several factors, including the concentration of antimicrobial compounds, the number of microorganisms, the temperature of the microorganism species and pH [15]. So that the results of the evaluation test in the hand sanitizer gel affect the antibacterial work in the preparation. Bacterial inhibitory power can be classified into medium (F1) and large (F2 & F3). Data analysis using the one-way ANNOVA method showed a significance value of $p > 0.05$, which means that the inhibition zone activity produced by the three formulas did not show a significant difference.

4 Conclusion

Formula 3 is a hand sanitizer gel with the highest bacterial inhibition. However, the combination of the three formulas is not significantly different. The antibacterial content of betel leaf (phenol) and cinnamon bark (cymene, pinen, eugenol, cinnamal acetate, caryophyllenes, benzyl benzoate, and cinnamaldehyde) can produce an antibacterial effect when processed into hand sanitizer products.

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