

Original Article

Formulation and Physical Evaluation of Hand Sanitizer Gel with Various Concentration Ambon Banana Peel Extract (*Musa paradisiaca* Var. *sapientum* (L))

Ginanjari Putri Nastiti*, Mayu Rahmayanti, and Dimas Febrin Rezky

Department of Pharmacy, Faculty of Medical and Health Science, Maulana Malik Ibrahim State Islamic University, Malang, East Java, Indonesia

*Corresponding author: Ginanjari Putri Nastiti | Email: ginaputri@farmasi.uin-malang.ac.id

Received: 17 December 2023; Revised: 03 June 2024; Accepted: 11 July 2024; Published: 23 August 2024

Abstract: Hand washing is an activity that can reduce microorganism contamination, but some people whose work environment is far from hand washing facilities will experience difficulties. This gave rise to the innovation of practical hand washing without water, commonly called a hand sanitizer. Currently, the innovation of materials for making hand sanitizers uses natural ingredients, one of which can be Ambon banana peels, where the use of banana peels can also increase their economic value. The purpose of this study was to evaluate the physical preparation of hand sanitizer gel from Ambon banana peel extract at various concentrations. This study used Ambon banana peels extracted by the UAE method. Next, three hand sanitizer gel formulations were made with the active ingredient, a dry extract of Ambon banana peel. Formulation 1 (F1) uses 7% extract, Formulation 2 (F2) uses 10% extract, and Formulation 3 (F3) uses 13% extract. Each formulation was subjected to physical evaluation, including organoleptic tests, homogeneity, pH, spreadability, and adhesion, for three replications. The results showed that the three formulations had almost the same organoleptic visuals, namely a brown color, a soft texture, and the typical smell of Ambon bananas. Each formulation also fulfills the requirement of being homogeneous, and the pH is within the pH range of the skin. Spreadability and adhesion to the three formulas also meet the requirements for topical preparations. It can be concluded that the three formulations of Ambon banana peel hand sanitizer gel fulfill the requirements as topical preparations based on their physical evaluation. The three formulas did not show significant differences, so the concentration of the active ingredients in this study had no significant effect on the physical state of the preparations.

Keywords: Peel of Ambon banana; Gel hand sanitizer; Physical test; Formulation

1. INTRODUCTION

Humans have organs that are interconnected with one another to support the whole body. The skin is one of the largest organs of the body and is located on the entire surface of the human body, covering bones, flesh, and the blood stream [1,2]. The skin functions as a shock barrier from outside the body so that the organs in the body do not become inflamed or damaged. Hands are parts of the body that often make physical contact, so they are easily exposed to microorganisms, both normal and pathogenic flora, and actions such as hand washing are needed to clean microorganisms attached to the palms of the hands [2].

Along with the rise in activity among Indonesians, particularly in metropolitan areas, and the proliferation of instant product. Then a innovative hand wash solution without the use of water but with an antiseptic was created and called a hand sanitizer [3]. Hand sanitizer is a product that contains an antiseptic substance in which there is alcohol with a concentration of 60–95% [4]. The

alcohol in hand sanitizers has effective bactericidal and antibacterial activity against gram-negative and gram-positive bacteria that can develop on the palms of the hands, including *Escherichia coli* and *Staphylococcus aureus*. However, alcohol has the weakness that its effectiveness for removing bacteria is only short-term because it is volatile and dries quickly. Besides that, excessive use of alcohol will cause skin irritation and even a burning effect [5]. It is necessary to have an alternative to replace the use of alcohol with natural ingredients that are relatively safer for the skin.

Bananas are one of the commodities that come from the fruit group, which is quite well known among Indonesians. There are more than 200 types of bananas in Indonesia that have the opportunity to be used [6]. Ambon banana is a type of banana that is widely consumed by Indonesians. These bananas are widely sold in traditional and modern markets and are spread across almost all of the Indonesian islands [7]. Banana (*Musa paradisiaca*) of the Ambon variety has many health benefits. One of them is useful for digestion because it has a high fiber content. Apart from that, it is not only useful in its fruit, but the sap of the Ambon banana plant is also useful as an antiseptic because it has a chemical content in the form of tannins [8]. Banana sap is usually found in the midrib and banana skin. Banana peels, often discarded as waste, actually offer numerous benefits that most people may not realize. Therefore, we should optimize the use of banana peels to enhance their selling value. Ambon banana peel has compounds that act as antimicrobial agents, including flavonoids, saponins, steroids, glycosides, and tannins [9,10].

Several studies using banana peels as wound antiseptics have shown effective results [10]. Other research also shows that banana peel is useful as an antibacterial and produces a good inhibition zone (> 5mm) against *Escherichia coli* and *Staphylococcus aureus* [9,11]. The use of banana peels as an antiseptic or antibacterial needs to be developed with formulations that are more diverse and functional according to the needs of the community so that the value of the benefits will be more optimal. Based on the description above, the researcher is interested in conducting research related to the formulation of hand sanitizer gel preparations from various concentrations of thick extract of Ambon banana peel by paying attention to the physical properties of the preparations.

2. MATERIALS AND METHODS

2.1. Materials

The materials used are Ambon banana skin from the dampit plantation in Malang, distilled water, hydroxypropyl methyl cellulose (HPMC) (Merck), carbopol 940 (Merck), Triethanolamine (TEA) (Merck), glycerin (Merck), methyl paraben (Merck), Ambon banana essences (Red bell), and 96% ethanol (Merck).

The tools used include analytical scales, a mortar, chamber, stamper, glassware (Iwaki), a waterbath, an oven (Menmert), a rotary evaporator (RE100-Pro), a set of power spreaders, a set of adhesion tools, a glass plate, and a pH meter.

2.2. Ambon Banana Peel Extraction

Extraction using the ultrasound-assisted Extraction (UAE) method with 96% ethanol (1:10). 545 g of Ambon banana peel powder were dissolved and extracted for 3 x 5 minutes. The ethanol extract obtained was then concentrated using a rotary evaporator until thick. Then dried using an oven to remove any residual ethanol that is still left behind. The yield of dry banana peel extract was calculated.

2.3. Manufacture of Ambon banana peel hand sanitizer gel

Weigh each material to be used. Mixed carbopol 940 gel base and HPMC into the mortar, then stirred until a swelled base formed, and TEA was added to the base, then homogenized. Dissolve methyl paraben in hot distilled water and then add it to the base mixture. Furthermore, dry banana peel extract was dissolved in glycerin, sprinkled into the base mixture little by little, and stirred until homogeneous. The last step is adding one drop of Ambon banana essence as a fragrance and homogenizing. In this study, three hand sanitizer gel formulas were prepared with different concentrations dry banana peel extract. The formula's gel hand sanitizer is shown in Table 1.

Table 1. Formula of Ambon's banana peel hand sanitizer gel

Material	Function	Concentration		
		F1	F2	F3
Ambon Banana's Peel Dry Extract	active substance	7% w/v	10% w/v	13% w/v
HPMC	Base	0.5%	0.5%	0.5%
Carbopol 940	Base	0.25%	0.25%	0.25%
TEA	<i>alkalizing agent</i>	2%	2%	2%
Gliceryn	Humectant	15%	15%	15%
Methyl Paraben	Preservative	0.075%	0.075%	0.075%
Escence of Banana's Ambon	Fragrance	1 drop	1 drop	1 drop
Aquades	Solvent	Ad 30 ml	Ad 30 ml	Ad 30 ml

2.4. Physical Evaluation

2.4.1. Organoleptic Test

Visually observe the hand sanitizer gel preparations, including color, smell, and texture.

2.4.2. Homogeneity Test

The hand sanitizer gel is applied on a piece of transparent glass, sealed up, and checked for a harmonious arrangement and the absence of coarse grains.

2.4.3. pH Test

The pH value was determined by dissolving up to 1 g of Ambon banana peel hand sanitizer gel formulation in 10 ml of water, stirring until homogenous, and the value was measured using a pH meter.

2.4.4. Spreadability Test

On transparent glass that has been covered with mica paper, 1 g of the hand sanitizer gel preparation is applied, and after being loaded with 500 g, its dispersion is measured.

2.4.5. Adhesion Test

1g of hand sanitizer gel is applied to a set of adhesive tools that are equipped with a transparent glass plate, covered on the side of the glass plate with another glass plate, and then given a weight weighing 500 g. The weight is then allowed to stand for 2 minutes, the weight is transferred, the weight is removed, and the time is calculated required for the two glass plates to separate.

3. RESULTS AND DISCUSSION

Bananas are a plant that is in great demand by the public because every part of the plant can be used for their daily needs. The benefits of this banana plant can also be found in the skin of the

fruit. Not many people use banana peels, so this research is expected to help increase the value of the benefits of banana peels in the community.

This study used three formulations of ambon banana skin extract sanitizer gel preparations, each of which was replicated three times. Each formulation uses a different extract concentration. One of the reasons for choosing this concentration is based on research results showing that 10% banana peel extract can provide an optimal inhibition zone [9]. In this study, we selected three concentrations: below 10% (7%), 10%, and above 10% (13%). In addition, the formulation incorporates additional fragrance to enhance the banana aroma, signifying that the hand sanitizer originates from banana peel extract.

The first physical evaluation carried out on hand sanitizer gel is an organoleptic observation. Organoleptic testing, or sensory testing, is a test method using the human senses as the main tool for measuring product acceptance [12]. The organoleptic tests carried out included observing texture, smell, color, and taste. The observation results are shown in Figure 1 and Table 2.

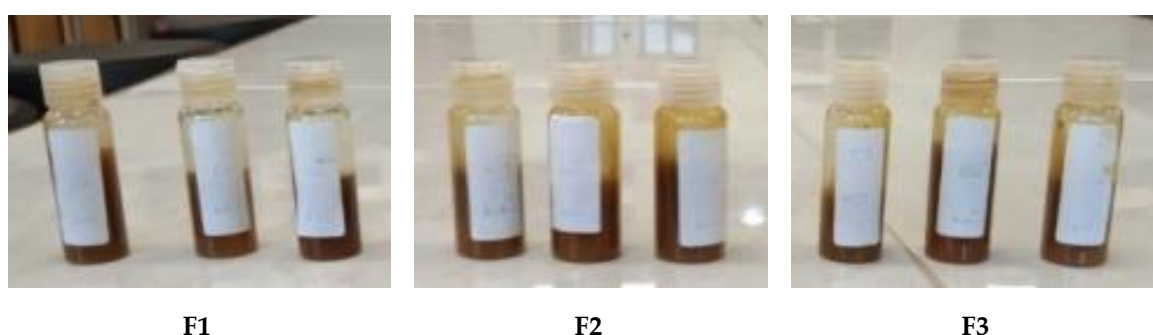


Figure 1. Visual organoleptic hand sanitizer gel Ambon banana peel extract

Table 2. The result of organoleptic test for Ambon banana peel extract hand sanitizer gel

No	Formulation	Texture	Smell	Color	Teste
1	F1 Replicate 1	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F1 Replicate 2	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F1 Replicate 3	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
2	F2 Replicate 1	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F2 Replicate 2	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F2 Replicate 3	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
3	F3 Replicate 1	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F3 Replicate 2	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour
	F3 Replicate 3	Gentle	Typical smell of Ambon banana	Brown	Bitter, slightly sour

The organoleptic test aims to determine the visual quality of the hand sanitizer gel preparation of Ambon banana peel extract. The dosage forms of the three formulas show that all the dosage forms are viscous. Ambon banana peel extract has a distinctive aroma of Ambon bananas that is not too strong, so it is given an Ambon banana fragrance. Based on observations, almost the same results were obtained, namely brown gel, soft texture, bitter taste, and typical Ambon banana smell. In terms of visual color, there is only a slight difference because the higher the concentration of the extract, the darker the color of the hand sanitizer gel preparation. This is in accordance with a study which states that the addition of active substances can affect the color and smell of the formulation [12].

The second physical evaluation is in the form of observing the pH of the preparation, where this pH has an important role in hand sanitizer gel preparations. The pH test aims to determine the safety of the hand sanitizer gel, which is formulated so as not to irritate the skin when applied. According to the Indonesian National Standard (SNI), the pH value of topical preparations is 4.5–8 [13]. The results of observing the pH of the preparation can be seen in Table 3.

Table 3. The result of pH test for Ambon banana peel extract hand sanitizer gel

No	Formulation	pH	Mean	Standard Deviation
1	F1 Replicate 1	6.21	6.26	0.049329
	F1 Replicate 2	6.30		
	F1 Replicate 3	6.29		
2	F2 Replicate 1	6.29	6.28	0.005774
	F2 Replicate 2	6.28		
	F2 Replicate 3	6.29		
3	F3 Replicate 1	6.14	6.13	0.005774
	F3 Replicate 2	6.13		
	F3 Replicate 3	6.13		

The pH value is very important for topical preparations because it can affect the safety and comfort of using the product. Based on the observed data, it was determined that the gel preparations had a pH in the range of 6.1–6.3. These results met the requirements for topical preparations, namely 4.5–8 [13]. Other research sources also state that hand sanitizer gel preparations can be said to be safe if they match the skin's pH, which is 4.6–6.5 [14]. In this study, the concentration of banana peel extract did not have enough effect on changes in the preparation's pH because the results showed that the PH was not significantly different.

The third evaluation is the observation of the homogeneity of the preparation. This test was carried out with the aim of determining the homogeneity of the hand sanitizer gel preparation by looking at the uniformity of the particles in the preparation. A preparation is said to be homogeneous if it shows a homogeneous arrangement of particles and no coarse grains are visible [12,15]. The results of observing the homogeneity of hand sanitizer gel preparations are presented in Table 4.

Table 4. The result of homogeneity test for Ambon banana peel extract hand sanitizer gel

No	Formula	Homogeneity	Particles/granules
1	F1 Replicate 1	Homogeneous	No coarse particles/grains
	F1 Replicate 2	Homogeneous	No coarse particles/grains
	F1 Replicate 3	Homogeneous	No coarse particles/grains
2	F2 Replicate 1	Homogeneous	No coarse particles/grains
	F2 Replicate 2	Homogeneous	No coarse particles/grains
	F2 Replicate 3	Homogeneous	No coarse particles/grains
3	F3 Replicate 1	Homogeneous	No coarse particles/grains
	F3 Replicate 2	Homogeneous	No coarse particles/grains
	F3 Replicate 3	Homogeneous	No coarse particles/grains

The results of the observations showed that the hand sanitizer gel preparation did not show any coarse grains and showed a harmonious arrangement. All formulations have fulfilled the homogeneity requirements of gel preparations.

The next evaluation is the measurement of the spreadability of the hand sanitizer gel. A spreadability test was carried out to determine the ability of the gel to spread on the skin surface [13]. The results of measuring the spreading power of hand sanitizer gel preparations are arranged in Table 5.

Table 5. The results of spreadability test for the Ambon banana peel extract hand sanitizer gel

No	Formulation	Diameter of Scatter	Mean	Standard Deviation
1.	F1 Replicate 1	5.2 cm	5.266	0.208167
	F1 Replicate 2	5.1 cm		
	F1 Replicate 3	5.5 cm		
2.	F2 Replicate 1	5.4 cm	5.4	0.2
	F2 Replicate 2	5.2 cm		
	F2 Replicate 3	5.6 cm		
3.	F3 Replicate 1	5.3 cm	5.2	0.152753
	F3 Replicate 2	5.4 cm		
	F3 Replicate 3	5.1 cm		

Semi-solid products are expected to spread easily at distribution sites without significant pressure. The easier it is to apply to the skin, the greater the contact surface area of the nutrient substance with the skin and the optimal drug absorption. Semi-solid preparations that are comfortable to use have a spread of 5-7 cm [12].

Based on the results obtained, it was shown that all the formulas made met the requirements for a good distribution, namely in the range of 5. However, the results obtained did not show a significant effect related to the concentration of banana peel extract on the spreadability of the preparations. This is different from a study whose results stated that the concentration of the active component affected the spreadability of the preparation. The higher the concentration of the components used, the greater the spreadability of the preparation [12,13].

The last evaluation carried out in this study was the measurement of the adhesion of the hand sanitizer gel preparation. Measurement of adhesion aims to determine how long the contact between the hand sanitizer gel and the skin surface lasts [14]. The results of the adhesiveness test of the preparations are shown in Table 6.

Table 6. The results of adhesion test for the Ambon banana peel extract hand sanitizer gel

No	Formulation	Sticking Duration	Mean	Standard Deviation
1.	F1 Replicate 1	1.24 second	1.1833	0.066583
	F1 Replicate 2	1.20 second		
	F1 Replicate 3	1.11 second		
2.	F2 Replicate 1	1.45 second	1.653	0.415251
	F2 Replicate 2	1.36 second		
	F2 Replicate 3	2.12 second		
3.	F3 Replicate 1	1.20 second	1.3833	0.141539
	F3 Replicate 2	1.44 second		
	F3 Replicate 3	1.54 second		

The results of measuring the adhesion of each formulation showed that the hand sanitizer gel from Ambon banana peel extract met the requirements because the adhesive duration was more than 1 second. A preparation can be said to be good if it has great adhesion because adhesion aims to determine how long the contact between the hand sanitizer gel and the skin surface is. The longer the contact time with the skin, the greater the working ability of the active substance, so that the effect is also greater [14,16].

The stickiness of hand sanitizer can be affected by the materials used in its manufacture. The use of materials such as carbopol and triethanolamine, which are gel developer agents, can increase adhesion. The more concentrated the gel is, the more sticky it will feel on the skin and last longer on the skin surface [17]. The results of the adhesion test for each formula in this study were not much different because the additives had the same concentration; it was just that the first formula (F1) had the smallest adhesive power compared to the other two formulas.

From the results of several physical evaluations, it was shown that the three hand sanitizer gel formulations of Ambon banana peel extract met the preparation requirements that could be accepted or applied to the skin. Physical evaluation of topical preparations is important to conclude that these preparations can be applied to the skin safely and comfortably. In addition, the concentration of the extract in the three formulations did not show a significant effect on each of the results of the physical evaluation of the preparations.

4. CONCLUSION

It can be concluded that all hand sanitizer gel formulations containing Ambon banana peel extract meet the physical evaluation criteria, so that their use can be said to be comfortable for the skin. The three formulas did not show significant differences, so the concentration of the active ingredients in this study did not have a major effect on the physical condition of the preparations. Making Ambon banana peel hand sanitizer gel can also be an interesting innovation because it increases the economic value of banana peels, which were previously considered trivial. Furthermore, further testing needs to be carried out regarding the irritation test to test the safety of the preparation and activity or potential test of this hand sanitizer gel preparation as an antiseptic.

References

- [1] Bonifant, H.; Holloway, S. A review of the effects of ageing on skin integrity and wound healing. *British journal of community nursing* **2019**, *24*, S28-S33.
- [2] Syaifuddin. *Anatomi Tunuh Manusia untuk Mahasiwa Keperawatan*; Salemba Medika: Jakarta, 2009
- [3] Singh, P.; Potlia, I.; Malhotra, S.; Dubey, H.; Chauhan, H. Hand sanitizer an alternative to hand washing—a review of literature. *Journal of Advanced Oral Research* **2020**, *11*(2), 137-142.
- [4] Rini, E.P.; Nugraheni, E.R. Uji Daya Hambat Berbagai Merek Hand Sanitizer Gel Terhadap Pertumbuhan Bakteri Escherichia coli dan Staphylococcus aureus. *JPSCR: Journal of Pharmaceutical Science and Clinical Research* **2018**, *3*(1), 18-26.
- [5] Ambari, Y.; Ningsih, A.W.; Sinaga, B.; Nurrosyidah, I.H. Efektifitas Antiseptik Gel Hand Sanitizer Ektrak Etanol Pelepah Pisang Kepok (*Musa paradisiaca* L.) Terhadap Bakteri Staphylococcus aureus dan Escherichia coli. *Jurnal Ilmiah Medicamento* **2020**, *6*(2).
- [6] Harto, A.B.; Prastiwi, P.A.D.; Ariadji, F.N.; Suwardhi, D.; Dwivany, F.M.; Nuarsa, I.W.; Wikantika, K. Identification of banana plants from unmanned aerial vehicles (UAV) photos

- using object based image analysis (OBIA) method (a case study in Sayang Village, Jatinangor District, West Java). *HAYATI Journal of Biosciences* **2019**, 26(1), 7-7.
- [7] Arifki, H.H.; Barliana, M.I. Karakteristik dan manfaat tumbuhan pisang di Indonesia: Review Artikel. *Farmaka* **2018**, 16(3).
- [8] Ismail, A.; Wicaksana, N.; Daulati, Z. Heritabilitas, variabilitas dan analisis kekerabatan genetik pada 15 genotip pisang (*Musa paradisiaca*) varietas ambon asal Jawa Barat berdasarkan karakter morfologi di Jatinangor. *Kultivasi* **2015**, 14(1).
- [9] Ananta, G.B.T.; Rita, W.S.; Parwara, M.O.A. Potensi Ekstrak Lumbuh Kulit Pisang Lokal (*Musa* sp) Sebagai Antibakteri Terhadap *Escherichia coli* dan *Staphylococcus aureus*. *Jurnal Cakra Kimia Indonesia* **2018**, 6(1), 21-29
- [10] Ardiansyah, J.; Simarmata, M. Study Literature Tentang Pemberian Getah Pisang Ambon Terhadap Luka. *Jurnal Gentle Birth* **2023**, 6(1), 27-34.
- [11] Safitri, E. A.; Fatmawati, A. Inhibition Activity Of Ethanolic Extract Of *Ulva lactuca* Against *Staphylococcus aureus*. *Pharmaceutical Journal of Indonesia* **2021**, 7(1), 43-48.
- [12] Rambe, R.; Pangondian, A.; Paramitha, R.; Zulmai R.; Gultom, E.D. Formulation And Evaluation Of Hand Sanitizer Gel From Clove Flower Extract (*Eugenia aromatica* L.). *International Journal of Science, Technology & Management* **2022**, 3(2), 484-491.
- [13] Anita, S.H.; Asishe, A.; Syafriana, V.; Febriani, A.; Zulfiana, D.; Oktaviani, M.; et al. Hand Sanitizer Gel Formulation with Laccase Enzyme as an Antibacterial Against *Staphylococcus aureus* and *Escherichia coli*. *Borneo Journal of Pharmacy* **2022**, 5(4), 375-383.
- [14] Ariyanthini, K.S.; Angelina, E.; Permana, K.N.B.; Thelmalina, F.J.; Prasetya, I.G.N.J.A. Antibacterial activity testing of hand sanitizer gel extract of coriander (*Coriandrum sativum* L.) Seeds against *Staphylococcus aureus*. *J. Pharm. Sci. Appl* **2021**, 3(2), 98-107.
- [15] Sulastri, L.; Zamzam, M.Y. Formulasi gel hand sanitizer ekstrak etanol daun kemangi konsentrasi 1, 5%, 3%, dan 6% dengan gelling agent carbopol 940. *Medimuh: Jurnal Kesehatan Muhammadiyah* **2018**, 1(1).
- [16] Rahmatullah, S.; Slamet, N.W.; Dewi, N.K. Formulasi dan Evaluasi Sediaan Gel Hand Sanitizer sebagai Antiseptik Tangan dengan Variasi Basis Karbopol 940 dan Tea. *CHMK Pharm Sci J* **2020**, 3(3), 189-194.
- [17] Santoso, J.D.; Prasetyaningsih, A.; Madyaningrana, K. Potency of *Citrus reticulata* Peel Extract as Active Compound of Non Alcohol Based Gel Hand Sanitizer. *Sciscitatio* **2020**, 1(2), 79-86

