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Formulation of Hand Sanitizer Gel Jatropha Sap (*Jatropha curcas* L) as Antiseptic

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Abstract

Jatropha curcas (*Jatropha curcas* L) is a medicinal plant that is often used, especially its sap. Jatropha sap contains secondary metabolite compounds in the form of saponins, flavonoids, and tannins which have antibacterial activity. This study aims to determine the antibacterial activity of Jatropha sap against *Escherichia coli* and *Staphylococcus aureus*, to determine the antibacterial activity of jatropha hand sanitizer gel preparation against *Escherichia coli* and *Staphylococcus aureus*, and to find out the best formula for hand sanitizer gel from jatropha that has antibacterial effectiveness against *Escherichia coli* and *Staphylococcus aureus*. This research was conducted by formulating hand sanitizer gel from jatropha sap with various concentrations. Based on the research data, the best data obtained for the concentration of jatropha sap which has antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* is 10% with inhibition values of 13.33±0.57 and 12.86±0.51 the best concentrations of gel preparations. Hand sanitizer from jatropha sap which has antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* is 10% with inhibitory value of 12.63±0.35 and 12.10±0.17 and the best formula for hand sanitizer gel contains jatropha sap fence with a concentration of 5% with a diameter value of 6.36 cm, pH 4.89, a viscosity of 4.60±0.14 Pa.S, a clear whitish color with a gel-shaped texture and a homogeneous preparation.

Keywords: Jatropha curcas L, Hand Sanitizer Gel, Antibacterial

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1 Introduction

Indonesia is a country rich in medicinal plants. Most of the people use these plants as medicine because their use is quite simple. One example of medicinal plants that are often used by the community is jatropha (*Jatropha curcas* L). Jatropha contains secondary metabolite

compounds such as flavonoids, saponins, and tannins which are useful as antibacterial properties in the sap [1].

Antiseptic is a substance used to eliminate microbes found on the skin. Antiseptics work by inhibiting the growth and development of microbes on the skin. Antiseptics can be used to prevent infection caused by pathogenic microorganisms such as viruses, fungi, bacteria, and parasites [2].

The category of antibacterial bonding power can be seen from the diameter of the formed hambat zone. The value of the hambat zone is less than equal to 5 means that the antibacterial activity is weak, the value of the hambat zone is between 5-10 meaning that the antibacterial activity is moderate, the niali of the hambat zone is between 10-20 meaning that the antibacterial activity is strong, and if the value of the hambat zone is above 20 means that the antibacterial activity is very strong [3].

The use of antiseptic gel that is gel hand sanitizer is a practical solution in maintaining cleanliness. Easy use without needing to rinse with water and can be carried away makes gel hand sanitizer much in demand by the public [2]. The way of use is simply drip on the palm of the hand and then flattened without the need to rinse using water [4]. The feeling of cold and comfort in the skin makes the preparation of this gel much liked by the public.

Based on the background, it can be done research formulations of gel hand sanitizer preparations from the jatropha sap. The benefit of this study is getting a gel hand sanitizer formula from the active ingredient of jatropha sap as an antiseptic, and providing scientific data information for subsequent researchers, as well as useful information for cosmetic manufacturers and the public.

2 Materials and Methods

2.1 Collection and Prearation of Plant Materials

Jatropha sap is obtained by cutting the jatropha stems using a cutter and accommodated in a clean container.

2.2 Antibacterial Test

2.2.1 Sterilization

Petri dish and test tube wrapped in paper, then sterilized using autoclaves at a temperature of 121°C for 15 minutes pressure 1 atm.

2.2.2 Preparation of NA (Nutrient Agar) Media

A total of 5 grams of synthetic NA medium is dissolved with 250 ml of aquades in an erlemeyer flask. Then heated on a hot plate and stirred until homogeneous. After a homogeneous medium, cover the pumpkin with a gauze cover and autoclaved at 121°C for 15 minutes at 1 atm pressure.

2.2.3 Preparation of Bacteria Suspension

The test microbes used are *Escherichia coli* and *staphylococcus aureus*. Made oblique media NA on the test tube. Taken 1 isolate ose from subculture media then inoculated on oblique media NA. Incubated at a temperature of 37ºC for 1 × 24 hours. Made microbial suspension test by suspending test microbes in a sterile NaCl solution inside the test tube with a ratio of 1:40.

2.2.4 Antibacterial Activity Test

Testing for antibacterial activity using the well diffusion method. Thawed sterile NA over a water bath. 7 ml of sterile NA was poured into a petri dish and homogenized. Left to half solidify and added 1 ml of test microbial suspension. 10 ml of sterile NA medium was poured and then homogenized and allowed to solidify. A well is made using a pencadang with a certain distance on a petri dish. The test for the antibacterial activity of jatropha sap was carried out by inserting 0,02 ml of Jatropha sap with each concentration and sterile distilled water as a negative control. Testing of the antibacterial activity of hand sanitizer gel was carried out by inserting 0,02 ml of hand sanitizer gel into a well, negative control using gel-based preparations, and positive control using preparation x. Replicated 3 times, then incubated at 37°C 1×24 hours and measured the diameter of the clear zone formed.

2.3 Formulation of Hand Sanitizer Gel

The hand sanitizer gel formula was prepared by weighing the ingredients used, namely 1 gram of carbomer, 0,25 ml of TEA, 6 ml of propylene glycol, 6 ml of polyethylene glycol, and 5 ml of glycerol. Dissolved 1 gram of carbomer with 77 ml of distilled water for 1 hour. Added 0,25 ml of TEA to form a gel. Add each 6 ml of propylene glycol and polyethylene glycol and 5 ml of glycerol, continue to stir until homogeneous. Jatropha sap is added with variations in the concentration of 5%, 8%, and 10%.

2.4 Evaluation of the Characteristics of Physical and Chemical Properties

2.4.1 Organoleptic Test

Organoleptic tests that descriptively include color, texture, aroma, and taste [5].

2.4.2 pH Test

Dissolved 1 gram of sample in 10 ml of aquades, then dipped electrode pH meter and seen the value that appears to analyze the sample is acidic or alkaline. Replication 3 times [6].

2.4.3 Viscosity Test

Viscosity test of chemical physics properties using Viscometer Rheosys tool with speed 50 rpm for jatropha sap and 2 rpm for preparation, conducted for 60 seconds and replicated 3 times [7].

2.4.4 Density Test

Density measurement uses a 25 ml piknometer for jatropha sap and a 10 ml measuring glass for preparations. Pre-weighed piknometer and empty measuring cup. Weighed piknometer contains aquades, piknometer contains jatropha sap and measuring glass contains preparations. Then calculated the lifetime value of aquades, density of jatropha sap, and density of preparations. Then calculated density of jatropha sap and preparation with equation 1 and 2.

$$\rho = \frac{\text{Sample Weight}}{\text{Volume Picnometer}} \quad \text{(Equation 1)}$$

$$\text{Density} = \frac{\rho \text{ Sample}}{\rho \text{ Aquades}} \quad \text{(equation 2)}$$

2.4.5 Solubility Test

Solubility testing uses polar solvents (aquades, ethanol, methanol), semi-polar solvents (ethyl acetate), and non-polar solvents (N-Hexane). Inserted 1 ml of the sample into the test tube. Added 0.5 ml of each solvent and shaken. Silenced for 1 minute and observed solubility of the sample.

2.4.6 Moisture Test

Test the moisture content using the oven. Put in the oven an empty petri dish at a temperature of 105 °C for 30 minutes. Put the petri dish that has been ovened into the desikator to remove moisture due to heating. Weighed empty petri dish. Put 5 grams of the sample into an empty petri dish and weigh again. Put a petri dish containing the sample into the oven at a temperature of 105 °C for 60 minutes. Cooled petri dish containing samples after heating inside the desikator. Weighed back the petri dish containing the sample after heating and calculated the moisture content value with equation 3.

$$\text{Moisture} = \frac{W^1 - W^2}{\text{Sample Weight}} 100\% \quad \text{(equation 3)}$$

W^1 = Sample weight and weight of petri dish before heating
W^2 = Sample weight and weight of petri dish after heating

2.4.7 Homogeneity Test

Homogeneity test is done by putting the sample on the surface of the glass object then closed and flattened with paper glass and replicated 3 times. Homogeneity is indicated by the absence of coarse granules on the preparation [8].

2.4.8 Spreadability Test

A total of 1 gram of sample is placed on a glass plate measuring 20×20 cm. Next covered with other glass of the same size and placed weights on it that is 10 grams, 20 grams, 40

grams, 50 grams, and 100 grams, then measured diameter after silence for 1 minute. Replication tests were conducted 3 times [9].

2.4.9 Stability Test

The stability test of the jatropha sap hand sanitizer gel was carried out for one month on the 1st, 3rd, 5th, 7th, 14th, 21st and 28th days at room temperature (28±2 °C) and carried out a physical evaluation. The evaluation includes organoleptic test, homogeneity test, pH test, viscosity test, and dispersibility test [10].

3 Results and Discussion

3.1 Antibacterial Activity Test of Jatropha Sap

The test for the antibacterial activity of jatropha sap can be seen in Table 1 of antibacterial testing against *Escherichia coli* bacteria and Table 2 against *Staphylococcus aureus* bacteria. Antibacterial activity test of jatropha sap (*Jatropha curcas* L) was carried out by the well diffusion method against *Escherichia coli* bacteria in Figure 1 and *Staphylococcus aureus* in Figure 2 shows that at a concentration of 5% it is categorized as a moderate inhibition zone.

Table 1. Diameter of Inhibiton Zone Jatropha Sap (*Jatropha curcas* L) Against *Escherichia coli*

Concentration	Diameter of Inhibiton Zone (mm)			Average ± SD (mm)	Category
	I	II	III		
5%	10	10	10	10 ± 0	Moderat
8%	11	12	11.3	11.43 ± 0.51	Potent
10%	13	14	13	13.33 ± 0.57	Potent
Control Negative	0	0	0	0	Inactivity

Table 2. Diameter of Inhibiton Zone Jatropha Sap (*Jatropha curcas* L) Against *Staphylococcus aureus*

Concentration	Diameter of Inhibiton Zone (mm)			Average ± SD (mm)	Category
	I	II	III		
5%	10	10	10	10 ± 0	Moderat
8%	12	12	11	11.66 ± 0.57	Potent
10%	13	13.3	12.3	12.86 ± 0.51	Potent
Control Negative	0	0	0	0	Inactivity

At a concentration of 8% and 10% are categorized as a strong inhibition zone. The largest bacterial inhibition zone produced in this test is at a concentration of 10%. The higher the concentration of jatropha sap, the higher the antibacterial activity.

The results of statistical analysis using t Independent Samples Test method of antibacterial activity of jatropha sap against *Escherichia coli* and *Staphylococcus aureus* between concentrations of 5%, 8%, 10% showed a signification value of >0.05 which means there was no significant difference in antibacterial activity between the three concentrations.

3.2 Preformulation of Jatropha Sap

The results of the evaluation of the physical characteristics of the jatropha sap can be seen in Table 3.

Table 3. Characteristics of Physical and Chemical Properties of Jatropha Sap (*Jatropha curcas* L)

Characteristics	Value
Color	Yellowish white
Texture	Liquid and foamy
Aroma	Distinctive Sap
Taste	Chelat
pH	4.4 ± 0.09
Density	1.06
Viscosity	0.02±0.001 Pa.S
Solubility	Soluble in water, ethanol, methanol and slightly soluble in ethyl acetate and insoluble in N-hexane.
Moisture	42.89 %

Based on the analysis of the chemical physical properties of Jatropha curcas (*Jatropha curcas* L), the organoleptic test results of the Jatropha sap have a yellowish white color with a liquid and foamy texture, a distinctive aroma and taste chelating sap. Jatropha sap has a pH value of 4.4 ± 0.09 which means it is acidic, this is influenced by secondary metabolites found in jatropha sap, namely flavonoids and tannins which are acidic. The density of the Jatropha sap is 1.06 where the density of the Jatropha sap is greater than that of water which has a specific gravity of 1.The viscosity of the Jatropha sap is 0.02±0.001 Pa.S shows that the Jatropha sap is more slightly thick from the water. The solubility test of Jatropha sap can be seen in Figure 3 showing that Jatropha sap is soluble in water, ethanol, methanol and slightly soluble in ethyl acetate and insoluble in N-hexane. Jatropha sap water content is quite high with a value of 42.89%.

3.3 Formulation of Hand Sanitizer Gel Jatropha Sap

The formula for making hand sanitizer gel can be seen in Table 4. Based on the results of the concentration orientation of each ingredient in the jatropha hand sanitizer gel preparation formula which can be seen in Figure 4.

Formula I has a light yellowish white color, formula II and III have a color. yellowish white. The resulting color difference is influenced by the amount of jatropha sap content added to the base of the gei hand sanitizer preparation. Formulas I, II, III contain 5% jatropha sap. 8%, and 10%. The addition of jatropha sap did not affect the thickness of the hand sanitizer gel preparation.

3.4 Evaluation of the Characteristics of Physical Properties and Stability Hand Sanitizer Gel Jatropha Sap (Jatropha curcas L)

The results of the evaluation of the physical characteristics and stability of the jatropha sap hand sanitizer gel can be seen in table 5 organoleptic test, table 6 homogeneity test, table 7 pH test, table 8 spreadability test, and table 9 viscosity test.

Table 4. Formula of Hand Sanitizer Gel

No.	Material Name	Concentration			
		FI	FII	FIII	Control
1.	Jatropha Sap	5%	8%	10%	0%
2.	Carbomer	1%	1%	1%	1%
3.	TEA	0.25%	0.25%	0.25%	0.25%
4.	Propylene glycol	6%	6%	6%	6%
5.	Polyethylene Glycol	6%	6%	6%	6%
6.	Glycerol	5%	5%	5%	5%
7.	Aquades	Ad 100 ml	Ad 100 ml	Ad 100 ml	Ad 100 ml

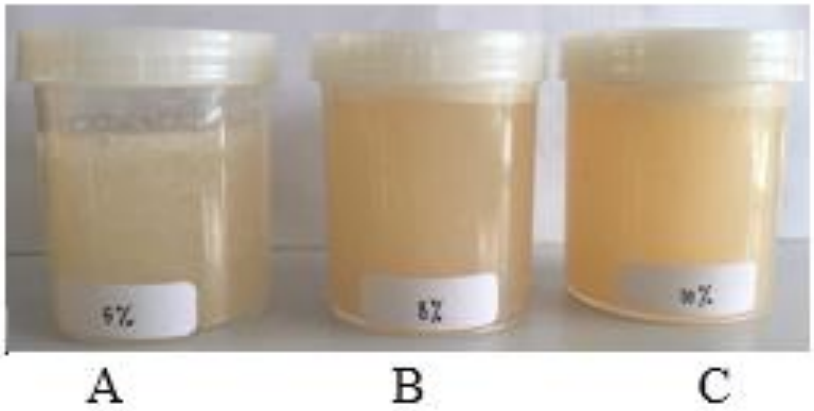

Figure 4. Formula of hand sanitizer gel Jatropha sap: (A) Formula I, (B) Formula II, (C) Formula III.

Table 5. Evaluation Organoleptic Test Hand Sanitizer Gel of Jatropha Sap (*Jatropha curcas* L)

Parameters	Formula			
	I	II	III	Kontrol
Color	Light yellowish white	Yellowish white	Yellowish white	Colorless
Texture	Gel	Gel	Gel	Gel
Aroma	Not flavorful	Not flavorful	Not flavorful	Not flavorful
Density	1.1	1.1	1.1	1.3

Table 6. Evaluation Homogeneity Test Hand Sanitizer Gel of Jatropha Sap (*Jatropha curcas* L)

Formula	Homogeneity
I	Homogeneous
II	Homogeneous
III	Homogeneous
Control	Homogeneous

Table 7. Evaluation pH Test Hand Sanitizer Gel of Jatropha Sap (*Jatropha curcas* L)

Formula	pH						
	1	3	5	7	14	21	28
I	4.89±0.05	4.82±0.11	4.77±0.09	4.73±0.09	4.68±0.07	4.65±0.06	4.62±0.06
II	4.69±0.03	4.67±0.02	4.61±0.02	4.56±0.02	4.53±0.01	4.53±0.01	4.50±0.01
III	4.66±0.03	4.65±0.02	4.60±0.01	4.54±0.01	4.50±0.01	4.50±0.01	4.50±0.01
Control	6.20±0.01	6.16±0.01	6.15±0.01	6.15±0.01	6.11±0.02	6.10±0.01	6.07±0.03

Table 8. Evaluation Spreadability Test Hand Sanitizer Gel of Jatropha Sap (*Jatropha curcas* L)

Formula	Spreadability (cm)						
	1	3	5	7	14	21	28
I	6.36±0.05	6.43±0.05	6.46±0.05	6.53±0.05	6.63±0.05	6.73±0.05	6.90±0.10
II	6.53±0.05	6.56±0.05	6.63±0.05	6.70±0.10	6.76±0.05	6.76±0.05	6.93±0.05
III	6.73±0.05	6.76±0.05	6.83±0.05	6.86±0.05	6.93±0.05	6.96±0.05	7.00±0.10
Control	5.73±0.15	5.76±0.15	5.86±0.05	6.33±0.20	6.56±0.25	6.66±0.20	6.83±0.15

Tabel 9. Evaluation Viscosity Test Hand Sanitizer Gel of Jatropha Sap (*Jatropha curcas* L)

Formula	Viscosity (Pa.S)						
	1	3	5	7	14	21	28
I	4.60±0.14	4.43±0.12	4.37±0.09	4.36±0.05	4.22±0.06	4.20±0.05	4.11±0.01
II	3.87±0.03	3.82±0.15	3.58±0.02	3.41±0.05	3.35±0.08	3.18±0.06	3.11±0.01
III	2.91±0.08	2.77±0.19	2.77±0.08	2.71±0.18	2.46±0.18	2.32±0.05	2.21±0.01
Control	7.13±0.08	7.10±0.09	6.96±0.23	6.86±0.18	6.71±0.24	6.52±0.19	6.29±0.16

The results of the evaluation of the physical characteristics of the organoleptic test in formula I have a light yellowish white color, formula II and III have a yellowish white color, and the gel base is clear. Formulas I, II, III, and gel bases have a gel texture and have no aroma. Formulas I, II, and III have a specific gravity of 1.1 and basis have a specific gravity of 1.3. The specific gravity between the formula and the base is different due to the addition of jatropha sap to the jatropha hand sanitizer gel preparation formula. The addition of Jatropha latex affected the consistency of the gel base which caused a decrease in the specific gravity value of the gel base.

The results of the evaluation of the physical characteristics of the homogeneity test were carried out by visually observing the presence or absence of coarse grains on the jatropha hand sanitizer gel preparation and gel base. The preparation meets the requirements if there are no coarse granules in the gel

preparation, which indicates that the resulting preparation is homogeneous. Formulas I, II, III, and bases show no coarse grains on the preparation. This indicates that the ingredients in the formulation are mixed and the preparation is homogeneous during the formulation process.

The pH test aims to determine the acidity level of the formulated jatropha hand sanitizer gel and gel base. A pH that is too acidic can cause skin irritation and a pH that is too alkaline can cause dry skin. The pH that meets the skin requirements is 4.5-6.5. The results of the evaluation of the physical characteristics of Jatropha hand sanitizer gel formulas I, II, III, and bases, respectively, have a pH value of 4.89±0.05, 4.69±0.03, 4.66±0.03, and 6.20±0.01. The pH of formulas I, II, III, and bases meets the range of requirements, which means that the pH of the hand sanitizer gel preparations does not irritate the skin or cause dry skin. The addition of jatropha sap to the formulation causes the hand sanitizer gel preparation to be acidic because the chemical properties of jatropha sap have an acidic pH, this causes the addition of jatropha sap in the formulation to affect the pH of the jatropha hand sanitizer gel preparation due to its acidic nature jatropha sap.

The spreadability test aims to determine the dispersibility ability of hand sanitizer gel formulas I, II, III, and bases. This is a simulation of the dispersibility of Jatropha sap hand sanitizer gel preparation when applied to the skin. A good spreadability is the spreadability that is in the range of 4-7 cm requirements. The results of the evaluation of the physical characteristics of Jatropha hand sanitizer gel formulas I, II, III, and bases, respectively, have a dispersive power value of 6.36±0.05, 6.53±0.05, 6.73±0.05, and 5.73±0.15. Based on the results of the physics evaluation of dispersive power, the formula and basis have a dispersion value that meets the requirements. So it can be stated that the hand sanitizer gel formulas I, II, III can spread well on the skin. The spreadability value in the formulation was higher than the base, which meant that the addition of Jatropha sap to the hand sanitizer gel formulation affected the dispersibility of the gel preparation.

The viscosity test aims to determine the level of viscosity of the jatropha sap hand sanitizer gel. Evaluation of the physical characteristics of the viscosity of the preparation was carried out using a Rheosys viscometer with a rotation speed of 2 rpm for 60 seconds. The requirements for the viscosity value of a good hand sanitizer gel are in the 2-4 Pa.S. The results of the evaluation of the physical characteristics of Jatropha hand sanitizer gel formulas I, II, III, and base respectively had a viscosity value of 4.60±0.14, 3.87±0.03, 2.91±0.08, and 7.13±0.08. The viscosity value of the jatropha hand sanitizer gel formulas I, II, and III met the requirements, but the viscosity value of the gel base did not meet the requirements. Gel base has a high viscosity value because there is no addition of jatropha resin to the base. The addition of jatropha sap affects the viscosity of the formulated preparation.

3.5 Antibacterial Activity Test of Hand Sanitizer Gel Jatropha Sap

Antibacterial activity test of Jatropha sap hand sanitizer gel can be seen in Table 10 of antibacterial test against *Escherichia coli* bacteria and table 11 against *Staphylococcus aureus* bacteria.

Table 10. Diameter of Inhibiton Zone Hand Sanitizer Gel Jatropha Sap (*Jatropha curcas* L) Against *Escherichia coli*

Formula	Diameter of Inhibiton Zone (mm)			Average ± SD (mm)	Category
	I	II	III		
I	9.3	10	9.3	9.53 ± 0.40	Moderat
II	11	10.6	10.6	10.73 ± 0.23	Potent
III	13	12.6	12.3	12.63 ± 0.35	Potent
Control Positive	8	8.3	7.6	7.96 ± 0.35	Moderat
Control Negative	0	0	0	0	Inactivity

Table 11. Diameter of Inhibiton Zone Hand Sanitizer Gel Jatropha Sap (*Jatropha curcas* L) Against *Staphylococcus aureus*

Formula	Diameter of Inhibiton Zone (mm)			Average ± SD (mm)	Category
	I	II	III		
I	9.3	9.3	9.6	9.4 ± 0.17	Moderat
II	11	11	10,6	10.86 ± 0.23	Potent
III	12	12.3	12	12.10 ± 0.17	Potent
Control Positive	9.6	8.6	9.3	9.16 ± 0.51	Moderat
Control Negative	0	0	0	0	Inactivity

Shows that in Formula I it is categorized as a moderate inhibition zone. Formulas II and III are categorized as a strong inhibition zone. The positive control using the X brand market preparation was included in the moderate category and the negative control had no inhibition zone, which means that the hand sanitizer gel base did not have the ability to inhibit bacterial growth. The largest bacterial inhibition zone produced in this test is formula III. The higher the concentration of jatropha sap contained in the hand sanitizer gel, the higher the antibacterial activity produced.

The results of statistical analysis using the t-test method Independent Samples Test for antibacterial activity of the Jatropha sap hand sanitizer gel against Escherichia coli and Staphylococcus aureus between Formulas I, II, III showed a significance value >0.05, which means that there is no significant difference between the three formulas. The t test Independent Sample Test between formulas I, II, III with positive control, obtained a significance value >0.05, which means that there is no significant difference between formulas I, II, III and positive control. Then the t test Independent Sample Test between formulas I, II, III with negative control, obtained a significance value <0.05, which means that there is a significant difference between formulas I, II, III and negative control. The next statistical analysis test was to use the Paired Samples Test t test method on jatropha sap with a hand sanitizer gel preparation of Jatropha sap against the antibacterial activity of Escherichia coli and Staphylococcus aureus. The test results show a significance value >0.05, which means that there is no significant effect of adding jatropha sap on the basis of the antibacterial activity of hand sanitizer gel preparations.

4 Conclusions

Jatropha sap has the greatest antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* at a concentration of 10% with an inhibition zone of 13.33±0.57 mm (*Escherichia coli*) and 12.86±0.51 mm (*Staphylococcus aureus*).

Formula of hand sanitizer gel jatropha sap that has the greatest antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* is at a concentration of 10% with a bland zone of 12.63±0.35 mm (*Escherichia coli*) and 12.10±0.17 mm (*Staphylococcus aureus*).

Based on the research data obtained the best data for formula 1 containing jatropha sap with a concentration of 5% with a spread diameter value of 6.36±0.05 cm, pH 4.89±0.05, viscosity 4.11±0.01 Pa.S, whiteish clear preparation color with gel texture and homogeneous preparations.

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6 Conflicts of Interest

The authors declare no conflict of interest.

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