Medical Sains : Jurnal Ilmiah Kefarmasian
Vol. 9 No. 1, January - March 2024
https://ojs.stfmuhammadiyahcirebon.ac.id/index.php/iojs

LIQUID SOAP FORMULATION FROM ETHANOLIC EXTRACT OF CASSAVA LEAVES (*Manihot esculenta* Crantz) WITH COCAMIDE DEA AS SURFACTANT

Nooryza Martihandini[1*], Diani Putria Angelica[1], Shandra Isasi Sutiswa[1]
[1]Department of Pharmacy, Politeknik Kesehatan Kementerian Kesehatan Tasikmalaya, Indonesia
**Email Corresponding: nooryzamartihandini@gmail.com*

Submitted: September 22, 2023 Revised: December 20, 2023 Accepted: February 5, 2024

ABSTRACT

The ethanol extract of cassava leaves contains various secondary metabolites that have antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Shigella sp.*, and thus can be used as active ingredients in liquid soap preparation. Liquid soap formulations generally use sodium lauryl sulfate (SLS) as a surfactant, which can cause irritation and skin dryness. This study aimed to formulate an ethanol extract from cassava leaves into a liquid soap preparation using cocamide DEA as a surfactant to reduce skin irritation. The study was conducted in an experimental laboratory. Cassava leaves were extracted by maceration using ethanol. Three liquid soap formulas from cassava leaf extract were developed with different extract concentrations: F1 (1%), F2 (3%), and F3 (5%). The liquid soaps were evaluated in terms of organoleptic properties, pH, homogeneity, viscosity, foam height, and foam stability. The study showed that cassava leaves extract could be formulated into a homogeneous liquid soap with a pH range of 7.0–7.5, viscosity of 143.6–306.2 cps, foam height of 53.33–60.00 mm, and foam stability of 75.01–82.36%. F3 is the optimum formula with the best physical characteristics of the preparation in terms of organoleptic properties, foam height, and foam stability.

Keywords: cocamide DEA, cassava leaves, liquid soap, surfactant

INTRODUCTION

The skin is the largest organ of the body and is located outside. This organ covers the surface of the human body and protects against external factors such as bacteria, chemicals, and temperature. The skin, as a primary defense system, plays a role in preventing exposure to various bacterial infections, such as *Staphylococcus aureus* and *Escherichia coli* (Sari et al., 2022). Soap is a preparation used to clean the skin, remove dirt and grease, and eliminate bacteria that cause infections on human skin. Various soap dosage forms are commercially available, including bars or solids, creams, powders, and liquid preparations. Currently, liquid soap is preferred because it is more practical and hygienic than other dosage forms (Yulianti et al., 2015).

Cassava leaves are generally used as vegetable and animal feed (Hasim et al., 2016). Previous studies have shown that cassava leaves contain flavonoids, tannins, saponins, alkaloids, and steroids. These secondary metabolites act as antibacterial agents in the soap (Pratiwi, 2016; Sahreni et al., 2020). Other studies have shown that the growth of *Escherichia coli* and *Staphylococcus aureus* bacteria is inhibited by the ethanol extract of cassava leaves (Dwiyanto et al., 2017). Cassava leaf ethanol extract also inhibits the growth of *Shigella sp.*, a bacterium that causes digestive tract infections (Pratiwi, 2016). Therefore, ethanol extract of cassava leaves can potentially be used as a natural ingredient in liquid soap formulations.

An important excipient used in liquid soap formulations is a surfactant. Sodium Lauryl Sulfate (SLS) is one of the surfactants widely used in liquid soap formulations. SLS is an anionic surfactant that causes irritation and dry skin (Prayadnya et al., 2017). The use of SLS in liquid soap formulations is limited to a maximum concentration of 1% (Dimpudus et al. 2017). Therefore, it is necessary to use other safer non-ionic surfactants, such as cocamide DEA, to reduce irritation and skin dryness. This material also acts as a foam stabilizer, in addition to its main function as a surfactant (Prayadnya et al., 2017).

Cocamide DEA has several advantages properties. It has good viscosity, is safe for use on sensitive skin, and improves the appearance of liquid soap preparations. Stable foam was produced using cocamide DEA at a concentration of 3%. Cocamide DEA is also stable when stored at room temperature for long periods (Prayadnya et al., 2017). Therefore, this study aimed to formulate and evaluate liquid soap preparations using an ethanol extract of cassava leaves as the active ingredient and cocamide DEA as a surfactant.

RESEARCH METHODS

Equipment and Materials

Equipment: blender (Waring® 8010S), analytical balance (Sartorius® BSA224S-CW), macerator, rotary evaporator, waterbath (Daihan® STS 304), pH meter (Hanna® HI2002-02), viscometer (mrc® VIS-8), caliper (Vernier Calliper), hot plate stirrer (Favorit® HS0707V2).

Materials: Cassava leaf simplicia (*Manihot esculenta* Crantz) was obtained from Tasikmalaya and determined at the ITB School of Life Sciences and Technology with 2520/IT1 determinations.C11.2/TA.00/2022, olive oil (DPH), KOH 40% (DPH), hydroxy propyl methyl cellulose (Merck), cocamide DEA (DPH), stearic acid (Merck), butyl hydroxyanisole (DPH), oleum rosae (DPH), and ethanol (Merck).

Research Procedure

Extraction

Dried cassava leaves with a coarse degree equal to mesh number 4 were extracted using ethanol 70% by maceration at a solvent ratio of 1:10 for 24 hours. The extract was then filtered using filter paper to generate the filtrate. The extraction process was repeated once more using half the volume of the solvent. The filtrate was concentrated using a vacuum rotary evaporator.

Phytochemical Screening

a. **Flavonoid**

Two grams of the extract were added to 5 mL of ethanol and heated for 5 minutes. A few drops of concentrated HCl and 0.2 grams of Magnesium powder were added to the mixture. The presence of flavonoids is indicated by the formation of a dark red color within 3 minutes (Ngajow et al., 2013).

b. **Saponin**

A total of 2 grams of the extract was placed in a reaction tube. Distilled water was then added until the extract was submerged. The mixture was boiled for 2–3 minutes. The mixture was vigorously shaken when cooled. Extracts containing saponins are characterized by the formation of a stable foam (Ngajow et al., 2013).

c. **Polyphenol**

Two grams of the extract was added to ethanol until the sample was completely submerged. A total of 1 mL of the solution was transferred to a new test tube and mixed with 2–3 drops of FeCl3 1%. The presence of polyphenols is indicated by the formation of a bluish black or green color (Ngajow et al., 2013).

d. **Alkaloid**

Two grams of the extract in a test tube was added to 2 mL of HCl and Meyer's reagent. Positive results were indicated by the presence of white precipitate (Ngajow et al., 2013).

e. **Steroid**

Anhydrous acetic acid was added to 2 grams of extract until the sample was completely submerged and then left for 15 minutes. Subsequently, 6 drops of the solution were transferred into a new test tube, and 2–3 drops of concentrated sulfuric acid were added. Extracts containing steroids are indicated by a color change to green or blue green (Dwiyanto et al., 2017).

Liquid Soap Formulation of Ethanolic Extract of Cassava Leaves

Three formulas of liquid soap were prepared with varying concentrations of cassava leaf ethanol extract: 1% (F1), 3% (F2), and 5% (F3). These concentrations were based on Cik Mutia's research on the antibacterial activity of cassava leaf ethanol extracts against *Staphylococcus aureus* and *Escherichia coli*. The results showed that cassava the ethanol extract 1% inhibit the growth of *Escherichia coli* with a diameter of 13,17 mm and *Staphylococcus aureus* with a diameter of 13,23 mm (Mutia, 2017). The formulas of liquid soap preparations are shown in Table I.

Soap paste was prepared by mixing olive oil heated at 50°C with KOH 40% while stirring in a beaker glass. The HPMC was dispersed in distilled water at 80°C in a glass beaker for 30 minutes. The swollen HPMC was then homogeneously mixed into the soap paste. Then, cocamide DEA, stearic acid, and BHA were added to the mixture and stirred. The ethanol extracts of cassava leaves and oleum rosae were poured into the mixture. Distilled water was added at a volume of 50 mL (Winarsih et al., 2021).

Table I. Liquid Soap Formula of Ethanolic Extract of Cassava Leaves

Materials	Formula		
	F1	F2	F3
Ethanol extract of cassava leaves	1%	3%	5%
Olive oil	15mL	15mL	15mL
KOH 40%	8mL	8mL	8mL
HPMC	0.5 g	0.5 g	0.5 g
Cocamide DEA	1 mL	1 mL	1 mL
Stearic acid	0.5g	0.5g	0.5g
BHA	0.5g	0.5g	0.5g
Oleum rosae	3 mL	3 mL	3 mL
Aquadest	ad 50mL	ad 50mL	ad 50mL

Evaluation of Liquid Soap from Ethanolic Extract of Cassava Leaf

a. Organoleptic Test

All liquid soap preparations were observed visually for form, odor, and color properties.

b. Homogeneity Test

Liquid soaps were dropped and spread evenly on a glass object and then observed for mixing and the presence of coarse particles in the preparation. (Laksana et al., 2017).

c. pH Test

The pH of the liquid soap preparations was determined using a pH meter.

d. Foam Height and Stability Test

The liquid soap (2 mL) was placed in a scale tube containing distilled water. The tubes were then closed and shaken for 20 seconds. The formed foam was observed and its height was measured (Clements et al., 2020). The stability of the foam in liquid soap was calculated using the following equation (Oktari et al., 2017):

$$\text{Foam stability} = 100\% - (\%\text{ of foam lost})$$

$$\%\text{ of foam lost} = \frac{\text{the initial foam height} - \text{the final foam height}}{\text{the initial foam height}} \times 100\%$$

e. Viscosity Test

The viscosity of liquid soap preparations was evaluated using a Brookfield viscometer using spindle number 3 (Laksana et al., 2017). This study was performed in triplicate at room temperature.

RESULTS AND DISCUSSION

The ethanolic extract of cassava leaves (*Manihot esculenta* Crantz) was prepared using the maceration method. Maceration was chosen because of its simple tools, easy procedure, and ease of implementation. In addition, the maceration method can reduce damage to the phytochemical constituents of the extract, which are thermolabile, because there is no heating during the extraction. Ethanol (70%) was used as the extraction solvent because it can attract both polar and semi-polar compounds. Ethanol is also harmless and can inhibit the growth of bacteria and molds (Winarsih et al., 2021). The use of 70% ethanol produced more secondary metabolites.

Table II. The Phytochemical Screening of Ethanolic Extract of Cassava Leaves

Group of Phytoconstituent	Screening Result
Flavonoid	+ (Dark red) 
Saponin	+ (The presence of stable foam) 
Polyphenol	+ (Black or blackish green) 
Alkaloid	- (Brick red) 
Steroid	+ (Dark green) 

The obtained cassava leaf extract was subjected to phytochemical screening. According to the screening results presented in Table II, the ethanol extract of cassava leaves contains secondary metabolites, including flavonoids, saponins, tannins, and steroids. Other compounds, such as alkaloids, were not detected in the phytochemical screening test because alkaloid compounds are present at low levels in cassava leaves (Dwiyanto et al., 2017). The secondary metabolites in the cassava leaf extract have antibacterial activity with different mechanisms of action. Flavonoids have antibacterial mechanisms of action through the formation of complex compounds with cell proteins, thereby disrupting the activity of bacterial cell membranes. Saponins function by denaturing proteins and damaging cell walls by forming complexes with proteins and bacterial cell walls. Tannins function by forming complex compounds, inactivating enzymes, and damaging bacterial cell walls (Noviyanti et al., 2017). Steroids reduce the integrity of bacterial cell membranes by interacting with phospholipids in the cell membranes. This triggers lysis and fragility of bacterial cells (Bontjura et al., 2015).

The flavonoid test showed the formation of a complex compound with magnesium when a strong acid was added, which was indicated by the color change to dark red. This reaction causes hydrolysis process converts glycosides of flavonoids into flavonoid aglycones. The polyphenol test results in the formation of a black or blackish green color owing to the formation of complex compounds from covalent bonds between Fe^{+3} ions and O^{-2} from the OH^- group of tannin compounds. The steroid test results showed a color change to dark green. This green color was formed by the reaction of steroid compounds with H_2SO_4 and anhydrous acetic acid (Dwiyanto et al., 2017).

Soap is prepared by saponification using a strong base, resulting in the hydrolysis of fatty acids. This preparation was used to clean the dirt or fat. Soaps containing antibacterial ingredients have also been used to clean the skin against bacteria (Dimpudus et al., 2017). In this study, the liquid soap formulation used olive oil with KOH as the primary ingredient in the soap base. Olive oil was chosen because it can remove dead skin cells, moisturize scaly skin, and can be used on dry skin (Widyasanti & Rohani, 2017). KOH in liquid soap formulations functioned as an alkaline base. In this study, KOH was used at a concentration of 40% so that the alkali content did not exceed 0.1% in the liquid soap preparations (Kasenda et al., 2016). According to SNI 06-4085-1996, the alkali content requirement in liquid soap preparations should not more than 0.1%.

Cocamide DEA was used as a surfactant in liquid soap formulations because it is safer than Sodium Lauryl Sulfate (SLS). SLS is an anionic surfactant that can irritate skin. Additionally, its use should not be more than 1% (Dimpudus et al., 2017). Cocamide DEA is a nonionic surfactant which has several advantages. It can maintain foam stability, dissolve in water, and cause a low level of skin irritation. The cocamide DEA concentration used for all formulas was 2%. A low concentration of cocamide DEA can maintain the pH of the soap in accordance with SNI standards because cocamide DEA is alkaline (Prayadnya et al., 2017). The use of cocamide DEA in liquid soap preparations can also be combined with anionic surfactants to produce large amounts of stable foam.

HPMC in liquid soap formula was used as a thickening agent. HPMC has low toxicity, produces a strong film on dry skin, produces stable viscosity, and can provide a cooling effect.

Liquid soap preparations were developed using three formulas with different concentrations of cassava leaves. The obtained preparations were then evaluated for its physical characteristics, including organoleptic properties, homogeneity, pH, viscosity, height, and foam stability.

Table III. Organoleptic of Liquid Soap of Ethanolic Extract of Cassava Leaves

Formula	Organoleptic		
	Form	Odor	Color
Base (0%)	Viscous	Distinctive odor	Milky white
F1 (1%)	Viscous	Distinctive odor	Light green
F2 (3%)	Viscous	Distinctive odor	Dark green
F3 (5%)	Viscous	Distinctive odor	Dark green

The organoleptic test of the preparation aims to observe the physical appearance of liquid soap in terms of form, odor, and color (Dimpudus et al., 2017). The results of the organoleptic test showed that the liquid soap base had a milky white color, as presented in Table III, because the soap base did not contain cassava leaf extract. The use of extracts at different concentrations can affect the characteristics of the preparation. The higher concentration of cassava leaf extract in the liquid soap preparation produced a more intense color of the soap preparation. All liquid soap preparations had the characteristics of a thick liquid with a distinctive odor.

Table IV. Homogeneity, pH, and Viscosity of Liquid Soap of Ethanolic Extract of Cassava Leaves

Formula	Homogeneity	pH	Viscosity
F1 (1%)	Homogeneous	7.50 ± 0.00	306.2 ±8.94 cPs
F2 (3%)	Homogeneous	7.07 ± 0.06	266.0 ±12.7 cPs
F3 (5%)	Homogeneous	7.00 ± 0.00	143.6 ± 97.1 cPs

As presented in Table IV, all the liquid soaps were homogeneous. This is indicated by the absence of coarse particles when the product was spread on a glass slide. All the ingredients were homogeneously mixed during the manufacturing process.

The degree of acidity/alkalinity of the preparation is an important parameter to be tested on liquid soap because it is in direct contact with the skin. High or low pH has a negative impact on the skin because it can cause irritation and dryness (Widyasanti & Rohani, 2017). The pH measurements demonstrated that the three formulas were in the pH range of 7.00–7.50. The pH value of the ethanol extract of cassava leaves was 5.90, while the pH value of the soap base was 9.80. The soap base was made from KOH, which is a strong base, so that it had an alkaline pH. The low pH of the cassava leaf extract is likely to cause a decrease in the pH of the alkaline soap base, resulting in a neutral pH of the liquid soap. An increase in the extract concentration in the liquid soap preparation will reduce the pH value of the soap due to the acidic pH of the extract.

Viscosity tests were performed to determine the viscosity of the liquid soap preparations. The high viscosity of the liquid soap can stabilize the preparation because it reduces the frequency of collisions between particles in the liquid soap (Rosmainar, 2021). Based on the evaluation of viscosity, F1 containing a cassava leaf extract concentration of 1% had the highest viscosity value. This is in line with a previous study by Rosmaniar (2021), which stated that the viscosity will be higher if the extract concentration in the liquid soap preparation is smaller. Another study showed that the viscosity of the HPMC-based gel was influenced by pH. A higher pH changes the conformation of HPMC polymer molecules and leads polymers to overlap and become entangled, increasing the viscosity (Punitha et al., 2020). The pH of F1 was the highest among those of the other formulas; hence, it may be suggested to have the highest viscosity.

Table V. Foam Height and Stability of Liquid Soap of Ethanolic Extract of Cassava Leaves

Formula	Foam Height (mm) ± SD		Foam Stability
	H_0	H_5	
Basis	66.67 ± 5.77	50 ± 0	75%
F1	53.33 ± 5.77	40 ± 0	75.01%
F2	60.00 ± 10.00	46,67 ± 5,77	77.79%
F3	56.67 ± 5.77	46,67 ± 5,77	82.36%

H_0 = initial height foam; H_5 = final height foam (for 5 minutes)

Foam height is one of the quality parameters for liquid soap preparations and shows the amount of foam produced (Dimpudus et al., 2017). The foam in the liquid soap is generated by the use of surfactants in the formula. In this study, cocamide DEA was used as a foaming agent. According to SNI 06-4085-1996, the foam height that complies with the requirements for liquid soap is 13–220 mm. The results of the foam height test for 5 minutes showed that all liquid soap formulas met the requirements. All liquid soap formulas had stable foams. The components in the formula that play a role in maintaining foam stability are the cocamide DEA and HPMC. HPMC is a cellulose derivative that stabilizes foam through gelatinization in addition to its main function as a thickening agent. The HPMC polymer structure strengthens the walls of the foam bubbles and slows the flow of water; hence, the foam becomes denser and more stable (Anggraeni et al., 2020). The formula with the largest amount and highest foam stability was F3, which contained an extract concentration of 5%. This was due to the presence of saponin compounds, which influenced the height of the foam. The higher the saponin content in the extract, the higher the value and stability of the foam during the liquid soap preparation.

CONCLUSION

The ethanol extract of cassava leaves can be formulated into a liquid soap preparation using a cocamide DEA surfactant as the foaming agent. Formula 3 (F3) of the liquid soap preparation with a concentration of 5% cassava leaves ethanol extract showed better physical characteristics than other formulas in terms of organoleptics, foam height and foam stability.

REFERENCES

Anggraeni, Y., Nisa', F., & Betha, O. S. (2020). Karakteristik Fisik dan Aktivitas Antibakteri Sabun Cair Minyak Nilam (*Pogostemon cablin* Benth.) yang Berbasis Surfaktan Sodium Lauril Eter Sulfat. *Jurnal Kefarmasian Indonesia, 0,* 1–10. https://doi.org/10.22435/jki.v10i1.499

Bontjura, S., Waworuntu, O. A., & Siagian, K. V. (2015). Uji Efek Antibakteri Ekstrak Daun Leilem (*Clerodendrum minahassae* L.) terhadap Bakteri *Streptococcus mutans*. *Pharmacon Jurnal Ilmiah Farmasi – Unsrat, 4*(4).

Clements, G., Yamlean, P. V. Y., & Lolo, W. A. (2020). Formulasi dan Uji Aktivitas Antibakteri Krim Ekstrak Etanol Herba Seledri (*Apium graveolens* L.) terhadap Bakteri *Staphylococcus aureus*. *Pharmacon*, *9*(2), 226.

Dimpudus, S. A., Yamlean, P. V. Y., & Yudistira, A. (2017). Formulasi Sediaan Sabun Cair Antiseptik Ekstrak Etanol Bunga Pacar Air (*Impatiens balsamina* L.) dan Uji Efektivitasnya Terhadap Bakteri *Staphylococcus aureus* Secara In Vitro. *PHARMACON Jurnal Ilmiah Farmasi-UNSRAT, 6*(3), 208–215.

Dwiyanto, Harlis, & Budiart, R. S. (2017). Pengaruh Konsentrasi Ekstrak Daun Singkong Gajah (*Manihot utilissima* pohl var. gajah) terhadap Pertumbuhan Bakteri *Escherichia coli* untuk Pengayaan Materi pada Praktikum Mata Kuliah Mikrobiologi. *Artikel Ilmiah*, 3–13.

Hasim, Falah, S., & Dewi, L. K. (2016). Effect of Boiled Cassava Leaves (*Manihot esculenta* Crantz) on Total Phenolic, Flavonoid and its Antioxidant Activity. *Current Biochemistry*, *3*(3), 116–127. http://biokimia.ipb.ac.id

Kasenda, J. C., Yamlean, P. V. Y., & Lolo, W. A. (2016). Cair Ekstrak Etanol Daun Ekor Kucing (*Acalypha hispida* Burm. F) Terhadap Pertumbuhan Bakteri *Staphylococcus aureus*. *PHARMACON Jurnal Ilmiah Farmasi*, *5*(3), 40–47.

Laksana, K. P., Oktavillariantika, A. A. I. A. S., Pratiwi, N. L. P. A., Wijayanti, N. P. A. D., & Yustiantara, P. S. (2017). Optimasi Konsentrasi HPMC terhadap Mutu Fisik Sediaan Sabun Cair Menthol. *Jurnal Farmasi Udayana*, *6*(1), 15–22.

Mutia, C. (2017). Uji Aktivitas Antibakteri Ekstrak Etanol Daun Singkong (*Manihot esculenta* Crantz) terhadap Bakteri *Escherichia coli* dan *Staphylococcus aureus* Secara In Vitro. *Prosiding Farmasi*, *3*(0), 358–365.

Ngajow, M., Abidjulu, J., & Kamu, V. S. (2013). Pengaruh Antibakteri Ekstrak Kulit Batang Matoa (*Pometia pinnata*) terhadap Bakteri *Staphylococcus aureus* secara In vitro. *Jurnal MIPA*, *2*(2), 128. https://doi.org/10.35799/jm.2.2.2013.3121

Noviyanti, L. A., Rachmawati, D. A., & Sutejo, I. R. (2017). Efektifitas Penyuluhan Gizi pada Kelompok 1000 HPK dalam Meningkatkan Pengetahuan dan Sikap Kesadaran Gizi. Digital Repository Universitas Jember, *3*(3).

Oktari, S. A. S. E., Wrasiati, L. P., & Wartini, N. M. (2017). Pengaruh Jenis Minyak dan Konsentrasi Larutan Alginat Terhadap Karakteristik Sabun Cair Cuci Tangan. *Jurnal Rekayasa Dan Manajemen Argoindustri*, *5*(2), 47–57.

Pratiwi, A. P. (2016). Aktivitas Antibakteri Ekstrak Daun Singkong (*Manihot esculenta* Crantz.) terhadap *Shigella* sp. *Jurnal Kesehatan*, *7*(1), 161. https://doi.org/10.26630/jk.v7i1.134

Prayadnya, I. G. Y., Sadina, M. W., Kurniasari, N. L. N. N., Wijayanti, N. P. D., & Yustiantara, P. S. (2017). Optimasi Konsentrasi Cocamid Dea dalam Pembuatan Sabun Cair terhadap Busa yang dihasilkan dan Uji Hedonik. *Jurnal Farmasi Udayana*, 11. https://doi.org/10.24843/jfu.2017.v06.i01.p03

Punitha, S., Uvarani, R., & Panneerselvam, A. (2020). Effect of pH in Aqueous (Hydroxy Propyl Methyl Cellulose) Polymer Solution. *Results in Materials*, *7*(June), 100120. https://doi.org/10.1016/j.rinma.2020.100120

Rosmainar, L. (2021). Formulasi dan Evaluasi Sediaan Sabun Cair dari Ekstrak Daun Jeruk Purut (*Citrus hystrix*) dan Kopi Robusta (*Coffea canephora*) serta Uji Cemaran Mikroba. *Jurnal Kimia Riset*, *6*(1), 58. https://doi.org/10.20473/jkr.v6i1.25554

Sari, M., Chan, A., Nasution, G. S., & Mendrofa, D. K. (2022). Uji Antiseptik Sabun Cair Ekstrak Daun *Lantana camara* L. Terhadap Pertumbuhan *Staphylococcus* sp. *Majalah Farmasetika*, *7*(3), 227. https://doi.org/10.24198/mfarmasetika.v7i3.37876

Sahreni, S., Isramilda, & Sururi, M. R. (2020). Uji Aktivitas Antibakteri Ekstrak Etanol Daun Singkong (*Manihot esculenta*) Terhadap Pertumbuhan *Staphylococcus aureus* dan *Escherichia coli*. *Ibnu Sina: Jurnal Kedokteran Dan Kesehatan - Fakultas Kedokteran Universitas Islam Sumatera Utara*, *19*(1), 22–27. https://doi.org/10.30743/ibnusina.v19i1.11

Widyasanti, A., & Rohani, J. M. (2017). Pembuatan Sabun Padat Transparan Berbasis Minyak Zaitun dengan Penambahan Ekstrak Teh Putih. *Jurnal Penelitian Teh dan Kina*, *20*(1), 13–29.

Winarsih, L. D., Amri, Z., & Krisyanella. (2021). Formulasi Sediaan Sabun Cair dari Ekstrak Etanol Daun Singkong (*Manihot utilissima* Pohl.). *Journal Pharmacopoeia*, *1*(1), 22–32. https://doi.org/10.33088/jp.v1i1.139

Yulianti, R., Nugraha, D. A., & Nurdianti, L. (2015). Formulasi Sediaan Sabun Mandi Cair Ekstrak Daun Kumis Kucing (*Orthosiphon aristatus* (Bl) Miq.). *Kartika Jurnal Ilmiah Farmasi*, *3*(2). https://doi.org/10.26874/kjif.v3i2.98