

# EFFECTIVENESS OF *JATROPHA CURCAS* AS A BURN HEALING GEL PREPARATION

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## ABSTRACT

This study aims to determine the formulation of *jatropha curcas* gel preparations as a burn healer, to determine the characteristics and physical properties of *jatropha curcas* gel preparations, and to determine the effectiveness of *jatropha curcas* gel as a burn healer.

The method in this study used an experimental method with five treatments. The treatments are: P1 (4% sap), P2 (8% sap), P3 (16% sap), P4 (Negative control), and P5 (Positive Control).

The results showed that the formulation of *jatropha curcas* gel positively contained saponin compounds that had a burn healing effect in male white rats (*Rattus novergicus*). The *jatropha curcas* gel formulation has been shown to have a healing effect on burns of male white rats (*Rattus novergicus*) with a concentration of 16% providing the best healing effect with the occurrence of 100% healing (wound closure) on the third day, followed by a concentration of 8% healing (wound closure) 100% occurring on the sixth day, and a 4% concentration of 100% healing (wound closure) occurring on the ninth day.

**Keywords** : *jatropha sap, gel, burns*

## INTRODUCTION

A wound can be defined as the disconnection of epithelium tissue and the opening of connective tissue under it. Injuries can be caused by various kinds of intentionally or unintentionally [1]. Injuries can be made intentionally with a specific purpose, such as surgical wounds, accidental injuries such as traumatic injuries, sharp or blunt wounds and accidental injuries [3]. Wounds can be classified by nature, type and healing process.

Burns are the most commonly experienced injuries by humans compared to other injuries. Burns can occur due to contact with heat sources or very low temperatures, chemicals, electricity, radiation, and light. Various daily activities carried out can also be the cause

of burns such as accidents that cause vehicle explosions, holding equipment in a hot state while cooking, being stung by a hot currentor for other reasons [8].

Luka burn causes 195,000 deaths per year worldwide, especially in poor developing countries in ASEAN having high burn rates from other regions, of which 27% contribute to causing death worldwide and almost 70% are the cause of death in Southeast Asia [5]. the incidence of burns is very high in low-income countries with almost 90% mortality and high in Pakistan, and India [7].

At the moment many selection of treatments that use folk remedies. People's experiences for generations can be used as a reference for what types of plants are suitable to be used as medicines for

diseases or health disorders. One of them that is often used as a traditional medicine is *jatropha curcas* which is used empirically by the public in the treatment of burns [4].

*Jatropha* sap contains alkaloids, flavonoids, saponins, and tannins. Saponins have the ability to cleanse and trigger the formation of collagen I which is a protein that plays a role in wound healing. Saponins can also stimulate the formation of new epithelial cells and support the epithelialization process so that it can lead to a reduction in the size of the burn [13].

The use of *jatropha curcas* in wound healing has not been maximized, because its use is less practical if it must be prepared and given directly. Therefore, it is necessary to develop a formula that can facilitate its use such as gel preparations. Agel preparation is a semi-solid system consisting of a suspension made from small inorganic particles or large organic molecules, which are penetrated by a liquid [7].

Gel preparations are formulated because they are easier to use and spread on the skin faster. In addition, the gel has soothing properties, moisturizes, easily penetrates the skin so that it provides a healing effect, gel preparations also do not leave a layer of oil on the skin so as to reduce the risk of inflammation in the skin. *Jatropha curcas* formulated as gel preparations is expected to produce gel preparations that meet the requirements of physical characteristics, namely organoleptic, viscosity, dispersal, and pH.

## RESEARCH METHODS

This study uses a quantitative approach and experimental type of research with the design of *Experiment Laboratory* to determine the effectiveness of healing burns using *jatropha* sap gel.

The tools used are viscometers, universal pH sticks, glass objects, 4×2 cm iron metal plates.

The materials used in this study were *jatropha curcas*, aquadest, carbopol, TEA, glycerin, methyl paraben, Bioplacenton gel, lidocaine, veet cream, cotton.

### 1. Phytochemical Screening

Phytochemical screening was carried out to determine the secondary metabolites contained in the 96% ethanol extract. These secondary metabolites that have been qualitatively tested include alkaloids, flavonoids, saponins, tannins [11].

#### a. Flavonoid Test

A total of 0.5 grams of sap is dissolved in 2 ml of 96% ethanol and 3 drops of NaOH solution are added. A change in the intensity of the color to yellow with the addition indicates the presence of flavonoid compounds [11].

#### b. Saponin Test

A total of 0.5 grams of sap dissolved in 20 ml of aquades gives rise to a foam of up to 1 cm indicating the presence of saponin compounds [11].

#### c. Tannin Test

A total of 0.5 grams of sap is dissolved in 2 ml of 96% ethanol, simmered in 10 mL of aquades in a test tube then filtered. 3 drops of 0.1% ferric chloride solution were added and the formation of a brownish-green or bluish-black color was observed, indicating the presence of tannins [11].

## 2. Gel Dosage Formulations

Table 1. Formula Design

No	Material	F1%	F2%	F3%
1	<i>Jatropha</i> sap	4	8	16
2	Carbopol	1,25	1,25	1,25
3	Glycerine	12,5	12,5	12,5
4	Methyl Parabens	0,18	0,18	0,18
5	TEA	0,2	0,2	0,2
6	Aquades	AD 100	AD 100	AD 100

Source: Data processed, 2022.

Carbopoles are developed in aquadest 70°C, then grinded until a homogeneous dispersion is formed. After expanding, methyl parabens that have been dissolved in glycerin are added until homogeneous. Then *jatropha curcas* and aquadest sap are added to the desired volume by continuous slow stirring until it forms a homogeneous gel. Then it is added with TEA drop by drop until the desired pH. The gel is stored in a gel container at room temperature. The same procedure is also performed on *jatropha curcas* with concentrations of 4%, 8% and 16%. Then a physical evaluation of the gel preparation is carried out.

## 2. Evaluation Test

### a. Organoleptic Test

Organoleptic testing carried out includes observation of the color, aroma, and texture of gel preparations. The criteria for a good organoleptic gel preparation are the soft, color and aroma of the gel according to the extract used [11].

### b. pH test

Done by dipping the pH meter electrode into each gel preparation that has previously been dissolved with aquadestilata. After the electrode is dipped, it is then allowed to stand until the screen on the pH meter shows a stable number. The pH requirement for topical preparations is between 5-10, or gel preparations must match the skin pH of 4.5- 6.5 [11].

### c. Viscosity Test

The viscosity test is carried out by means of the rotor mounted on the test equipment, arranged until the rotor is immersed in the gel. The tool is activated, the indicated scale is read until it shows a stable number. Gel viscosity measurements were performed using a *Brookfield Viscometer* using *spindles* 5 and 4 at a speed of 50 rpm [11].

### d. Spread Power Test

Dispersion testing is carried out to determine the speed at which the gel spreads on the skin when applied to the skin. A total of 1 gram of gel preparation is carefully placed on a glass measuring 20x20 cm. then covered with another glass and used ballast on it until the weight reaches 125 grams and measured in diameter after 1 minute. The dispersion requirement is between 5-7 cm [11].

## 3. Effectiveness of Burns

The white mouse shaved the fur on its back, then anesthetized using ether. The back is cleaned with 70% ethanol then the skin is injured using a heated 2 cm diameter burn-inducing device, for five seconds. Each rat had a burn on its skin.

### a. Grouping of Test Animals

In this study, male white rat test animals with body weight ranging from 150-200 grams were used. The animal is pre-acclimated for approximately 1 week before treatment. Animals are adapted to the new dwelling by providing food and drink. This treatment is equated in all rodents. This treatment aims for all objects of study so that the experimental animals do not experience stress and are in the same state when the study begins [9].

The rats used in this study were 25 heads where the calculation results were as follows:

$$(T-1) (n-1) \geq 15$$

$$t = \text{number of groups}$$

$$T-1) (N-1) \geq 15$$

$$(5-1) (n-1) \geq 15$$

$$4n - 4$$

$$4n \geq 19 \text{ so } n = \frac{19}{4} = 4.75 = 5 \times 5 =$$

$$25 \geq 15$$

So the number of mice in each test group (5 treatments) was as many as 5 heads.

### b. Provision of Wound Test Materials

#### Burn

In the first burn, applied aquadest as a negative control. In the second burn is given a smear of bioplacenton gel as a positive control. In the third burn, a 4% jatropha sap gel was given as a test group one. In the fourth burn, 8% jatropha sap gel was given as a test group two. In the fifth burn was given a 16% jatropha sap gel as a test group three. Every three days is observed for 15 days.

### c. Parameter Observation

The parameters used in this study were changes in wounds such as redness, fluid, edema and narrowing of burns. Every three days, direct observation for 15 days of changes in the narrowing of burns is carried out.

## RESULTS AND DISCUSSION

### Phytochemical Screening Results

The content of secondary metabolites found in *jatropha curcas* is identified by phytochemical screening. The content of secondary metabolite compounds tested includes groups, tannins, saponins, and flavonoids, and alkaloids. The results of phytochemical screening carried out on *jatropha curcas* can be seen in table 2:

**Table 2** Phytochemical Screening

Compound Group	Reagents	Result
Saponins	Aquadest	Formed Foam (+)
Tannins	Ethanol + FeCl <sub>3</sub>	brownish-green color (+)
Flavonoids	Ethanol + NaOH	Yellow color (+)
Alkaloids	HCl+ Mayer Reagent	Yellow Precipitate (+)

Source : Data processed, 2022

The components contained in the jatropha sap were analyzed from the compound with several reagents for the saponin, tannin, flavonoid, and alkaloid compound groups. The results of phytochemical screening from jatropha sap include saponin compounds, tannins, flavonoids, and alkaloids.

### Gel Preparation Evaluation Results

#### 1. Organoleptic Test

**Table 3.** Organoleptic Test of Gel Preparations

Test	F1 (4%)	F2 (8%)	F3 (16%)
Smell	Characteristic smell	Characteristic smell	Characteristic smell
Color	White	White hamper Brownish	Brownish
Shape	Semi Solid	Semi Solid	Semi Solid

Source: Data in process, 2022.

#### 2. pH test

**Table 4** pH test

Gel Dosage Formulations	pH Preparation
F1	6
F2	6
F3	6

Source: Data in process, 2022.

#### 3. Spread Power Test

**Table 5** Spread Power Test

Load imposed	F1cm	F2cm	F3cm
Glass only	5,74	5,84	6,2
100 gr	6,11	6,43	6,81
200 gr	6,87	7,09	7,87
300 gr	7,11	7,12	7,89
Average	6,45	6,62	7,12

Source: Data in process, 2022.

#### 4. Viscosity Test

**Table 6** Viscosity Tests

replication	Viscosity Test		
	F1cps	F2cps	F3cps
1	3860	2702	1310
2	3691	2907	1480
3	3391	2305	1692
Average	3647	2548	1494

Source: Data in process, 2022.

**Results of Research Observations**

The results of the observations of the research instruments outline the results of observations of the healing process of burns in the inflammatory phase (redness, edema, fluid) and the proliferation phase (narrowing of the wound area) in the treatment group and control group.

**1. Burn Observation Results**

**a. Presence of fluid**

The results of observations regarding the presence of pus in the wound area were not found macroscopically by researchers in all five groups of both the treatment group and the control group.

**b. Edema**

Hasil observations regarding edema in all samples of the negative control group and the positive control group there was no edema around the wound on day 3 to day 15.

**c. Redness**

The results of observations regarding redness in all samples of the negative control group, positive control, and treatment group experienced redness around the wound. Redness in the study samples from all three treatment groups and control groups decreased gradually and on day 12 there was no longer any redness around the wound area.

**d. Extensive narrowing of the wound**

**Table 7.** Average Measurement of Burn Area

No	Group	Day Observation -				
		3	6	9	12	15
1	Negative control	40	3,84	3,52	0	0
2	Control Positive	3,70	3,14	1,18	0	0
3	F1	3,74	2,74	0	0	0
4	F2	2,64	0	0	0	0
5	F3	0	0	0	0	0

Source: Data in process, 2022.

**DISCUSSION**

Burns are the response of the skin and subcutaneous tissue to temperature/thermal trauma. A partial thickness burn is a burn that does not damage the epithelium of the skin nor damages only part of the epithelium. It can usually recover with conservative treatment. Full thickness burns damage all sources of epithelial regrowth of the skin and can require excision and skin grafts if extensive [7].

The sample used is a plant that is often used as a traditional medicine is jatropha curcas (*Jatropha curcas*) which is used empirically by the public in the treatment of burns [4]. The results of phytochemical screening observations on jatropha sap samples showed the presence of saponin compounds, tannins, alkaloids and flavonoids.

Jatropha sap (*Peperomia pellucida L*) is formulated in gel dosage form. The use of jatropha sap in healing burns is considered less practical and less comfortable to use so that a preparation with a specified consistency is needed so that it is easy to apply without causing pain when exposed to wounds. The gel dosage form is easily applied to skin preparations with wet wounds and can be spread evenly [12].

The *Jatropha curcas* plant is widely used in traditional medicine to cure various diseases such as skin infections, diarrhea, fever and some other diseases caused by microorganisms. Castor plant seeds can be used as environmentally friendly fuel. Jatropha leaves are often used to treat rheumatism, sprains, bleeding wounds, itchy itching, water fleas. Meanwhile, the juice of the leaf liquid starch is used as a cough medicine and postpartum antiseptic. Jatropha plant sap can be used to treat scabies, constipation and toothache [14].

*Jatropha curcas* has several benefits related to the various phytochemical content it has ethanol extract of *Jatropha curcas* bark has antibacterial activity with a concentration of 20 mg / ml against *Escherichia coli* and *Staphylococcus aureus* bacteria.

*Jatropha* sap contains flavonoids that can function as antifungi, antiseptics, and anti-inflammatories. Saponin compounds can spur collagen growth in the healing process and also have the effect of relieving pain and stimulating the formation of new cells. Saponins can inhibit growth or kill microbes by interacting with sterol membranes. The main effect of saponins against bacteria is the release of proteins and enzymes from within the cells. *Jatropha curcas* is also antimicrobial so that it can repel bacteria such as *staphylococcus*, *streptococcus*, and *escherchia cholii* [15].

The reason for choosing an oil-in-water (M/A) gel preparation is because this type has a high moisture content, it can provide a hydrating effect on the skin. In addition, the oil-in-water (M/A) gel type has low viscosity, is non-sticky, provides a moisture effect on the skin and has a good spreading ability [2].

The gel has a dispersion system that is composed of a lot of water and is very susceptible to physical, chemical and microbial instability. In general, the physical instability that occurs in the gel is syneresis where the dispersion medium comes out of the system due to the contraction of the gel polymer system. The factor of changes in extreme storage temperatures is one of the main factors that occur in syneresis experienced during the cycling test. There is a decrease in osmotic pressure in the system as well as changes in the shape of molecules can occur in the freezing process during the cycling test. This wrinkled molecule forces the exit of the medium from the matrix system. At low concentrations of gelling agents,

syneresis can usually occur. Syneresis indicates the presence of thermodynamic instability phenomena [16].

Gels have the following formation mechanism, when polymeric compounds or micromolecules (complex structures) that are hydrophilous (hydrocolides) are dispersed into water, they will expand. Then the process of hydration of water molecules occurs through the formation of hydrogen bonds, where water molecules will be trapped in the structure of complex molecules and a rigid or chewy gel period will form [17].

The results of the evaluation of gel preparation observations showed that the results of the gel preparation organoleptic test in formula 1 (4%) produced a distinctive odor, with a white color and a semi-solid shape while in formula 2 (8%) produced a distinctive odor with a brownish white color and a solid semi shape and in formula 3 (16%) produced a characteristic odor with a brownish color and a semi-solid shape.

The pH test results of the *jatropha* sap gel formula show that the three formulas have a pH of 6, which means that they have met the requirements, namely 4-7. The pH test aims to ensure that the preparation made has a pH that matches the physiological pH of the skin. According to research conducted by Swastika in 2013, it obtained an average pH result of  $5.04 \pm 0.25$ , where this value meets skin pH standards. If the pH of the gel is below 4.5 the gel is acidic which can irritate the skin and if the pH of the gel is above 6.5 then the gel is alkaline which can cause dry and flaky skin.

The results of the dispersion test observations indicate that there are differences in each formula with some given load. In formula 1 (4%) with a given load weight (0 g) = 5.74 cm, (100g) = 6.11 cm, (200 g) = 6.87 cm, (300 g) = 7.11 cm. Then in formula 2 (8%) with the weight of the given load (0 g) = 5.84 cm, (100 g) = 6.43 cm, (200 g) = 7.09 cm, (300 g) = 7.12 cm and in

formula 3 (16%) with fallow t the given load (0 g) = 6.2 cm, (100 g) = 6.81 cm, (200 g) = 7.87 cm, (300 g) = 7.89.

From the test results of the three formulas have met the spread power requirement, which is 5-7 cm for gel preparations. A dispersal test is carried out to determine the ability to spread the gel on the skin. The easier the gel is flattened on the skin, the more it will expand the skin area and the absorption of the active substance will be greater [6]. According to the journal Dunia Farmasi in 2020, if the distribution power results are <5cm and >7 cm, it cannot be said to be a stable preparation, so this preparation can be said to be stable because it is still in the range of 5-7 cm.

The viscosity test results showed differences in the average of formula 1 (4%) 3647 cps, formula 2 (8%) 2548 cps, formula 3 (16%) 1494 cps. From the viscosity test results, the three formulas have met the viscosity requirements, which are 2000-50,000 cps. The ideal gel viscosity is more than 5000 cps and according to SNI 16-4399-1996 on gel preparation quality standards, the viscosity of good preparations ranges from 2000-50,000 cps [10]. A viscosity test is performed to determine the viscosity of the gel preparation. According to Rinaldi's research in 2020, if the viscosity value is still in the viscosity range of topical preparations, which is 2000-50,000 cps, then the preparation can be said to be stable.

The formulation of *jatropha curcas* gel is made in 3 concentrations, namely concentrations of 4%, 8%, and 16% based on previous research states that *jatropha* sap is very effectively used as a wound healing medicine.

The test results on observations on all samples of the negative control group and the positive control group did not have any edema around the wound on day 3 to day 15. The absence of edema in this study was

because mast cells were not formed in the connective tissue producing *serotonin* and *histamine* which increased capillary permeability so that exudation occurred, inflamed cell shrinkage, accompanied by *vasodilation* which causes edema [12].

The test results on the observation of fluid showed that in all samples of the negative control group and the positive control group there was no fluid around the wound on day 3 to day 15. The absence of in the treatment group was thought to be due to the effect of tannin, saponin, and flavonoid content derived from *suruhan* leaves. ) tannins and flavonoids have antiseptic and antibacterial activities. The alleged mechanism is to interfere with the components of peptidoglycan preparation in bacterial cells, so that the cell dividing layer is not formed completely and causes bacterial cell death. [11] Tannin compounds have the ability to stop exudate and bleeding. Saponins have the ability as a cleanser and antiseptic that functions to kill and prevent the growth of microorganisms [11].

The absence of edema around the wound in the treatment group is thought to be due to the effect of tannin content derived from *jatropha curcas*, but the mechanism of action of tannin has not been explained exactly. The results of the analysis in accordance with the research of Vagashiya et al (2007) revealed that *jatropha* sap has acute and chronic inflammatory activity seen from a decrease in the area of edema in white rats in the first 1,2 and 3 hours.

The test results on the observation of redness of all samples of the negative control group, positive control, and the treatment group experienced redness around the wound. Redness in the study samples from all three treatment groups and control groups decreased gradually and on day 12 there was no longer any redness around the wound area.

Pexists when a wound occurs,

vasoconstriction of the arteries and capillaries occurs to help stop the bleeding. This process is mediated by epinephrine, norepinephrine, and prostaglandins secreted by injured cells. Blood vessels will undergo vasodilation after 10 to 15 minutes after the need. Vasodilation of blood vessels is mediated by histamine, serotonin, prostaglandin, and kinin which the substance causes an increase in blood flow to the area of occurrence of the wound and increases capillary permeability. Increased blood flow to the wound area causes the wound area to appear red and warm.

The acceleration of the redness time around the wound in the treatment group was thought to be due to the effect of the active compound content derived from the *Jatropha* sap. Anti-inflammatory activity of *Jatropha* sap due to the presence of flavonoid group compounds, saponins, tannins and alkaloids.

The test results on the observation of extensive narrowing of the wound showed that the wound healing of these three gels provided a rapid wound closure effect after formula administration. The best burn healing effect is given by a gel with a concentration of *Jatropha* sap of 16%, this is characterized by the occurrence of healing (wound closure) up to 0 mm on the 3rd day, for a concentration of 8% healing (wound closure) up to 0 mm occurs on the 6th day, while for a concentration of 4% healing (wound closure) up to 0 mm occurs on the 9th day. For bioplacenton® gel as a control healing (wound closure) up to 0 mm occurs on the 9th day. This means the healing process using all three formulas takes place faster than normal wound healing. This is due to the content of active substances contained in *Jatropha curcas* due to the content of active substances contained in *Jatropha* sap, especially saponins, tannins and flavonoids [15]. Saponins found in plants can spur the formation of collagen which plays a role in

the wound healing process while tannins and flavonoids have activity as antiseptics and antibacterials. Flavonoids inhibit the growth of bacteria by damaging the permeability of bacterial cell walls, microsomes and lysosomes as a result of the interaction between flavonoids and bacterial DNA and are also able to release absorption energy against the cytoplasmic membrane of bacteria and inhibit bacterial motility. While tannins function as astringents that can cause shrinking of skin pores, harden the skin, stop exudate and minor bleeding, so as to cover the wound and prevent bleeding that usually arises in the wound [14].

From the results of the study, formula 3 with a concentration of 16% faster gave a burn healing effect than the positive control group using bioplacenton. This is because the greater the concentration of *Jatropha* sap, the greater the healing effect of burns because more compounds are produced.

## CONCLUSION

Based on the results of research that has been carried out, it can be concluded that:

1. *Jatropha curcas* can be formulated as a gel preparation using additives such as carbopol which is used as a base, TEA as an alkalizing agent, glycerin as a humectant, and methyl paraben as a preservative.
2. There are characteristics and physical properties of *Jatropha curcas* gel preparations with concentrations of 4%, 8%, and 16% have semi-solid dosage forms, and have a distinctive smell, but there are color differences at concentrations of 4% have a clear white color, 8% concentrations have a almost brownish white color, and 16 have a brownish color. The pH test showed that the 4% sap gel preparation, 8% gum gel, and 16ml gum gel had a pH of 6. The dispersion power test showed that the 4% sap gel preparation has a dispersion

power of 6.45 cm, the 8% sap gel preparation has a dispersion power of 6.62 cm, and the gel preparation is 7.12 cm. The viscosity test showed that the 4% sap gel preparation has a viscosity of 3860 cps, the 8% sap gel preparation has a viscosity of 2548 cps, and the 16% sap gel preparation has a viscosity of 1494 cps.

3. There is an effectiveness of *Jatropha curcas* gel with the best burn healing effect given by gel with 16% *Jatropha* sap concentration, this is characterized by the occurrence of 100% healing (wound closure) on day 3, for a concentration of 8% healing (wound closure) 100% occurs on day 6, while for a concentration of 4% 100% healing (wound closure) occurs on the 9th day.

#### SUGGESTION

It is necessary to conduct a histopathological examination to obtain microscopic observations, so that various changes can be seen in collagen cells, PMN (neutrophil) cells, and monocyte and lymphocyte cells both in the inflammatory phase and the proliferation phase so that the results obtained are more accurate. It is necessary to conduct further research on toxicity tests and irritation tests, and *Jatropha curcas* isolation tests so that research can be carried out using humans as research samples. This research can be used as a research basis for development in the pharmaceutical field.

#### BIBLIOGRAPHY

- [1] Armando and Rochim. 2009. Producing Quality Essential Oils. Prints I. Self-Help Spreader Publishers. Jakarta.
- [2] Ansel, H. C., 2008, *Introduction to Pharmaceutical Dosage Forms*, ed IV, Ibrahim, F. Jakarta : UI Press.
- [3] Burn, A. 2012. *Clinical Dentistry*. Yogyakarta: CV. Quantum Synergistic Media Kartika.
- [4] Bakarbesy, E., Tumbel, F. T., Rehena, J. 2013. Some types of medicinal plants and their use as antimalarials. Symbiosis, *Journal of Biology and Its Learning Biology Education Study Program, Pattimura University, Ambon*. Vol. 6, No. 2.
- [5] Directorate General of PoM, Ministry of Health of the Republic of Indonesia. 2000. General Standard Parameters of Medicinal Plant Extracts. Ministry of Health of the Republic of Indonesia. Jakarta.
- [6] Garg, A., D. Aggarwal, S. Garg, and A. K. Sigla. (2002). *Spreading of Semisolid Formulation*. USA: Pharmaceutical Technology.
- [7] Grace, Pierce A, neil R. Borley. 2007. *At a Glance of Surgical Sciences*. third edition. Jakarta: Erlangga.
- [8] Jackson D.M. *The diagnosis of the depth of burning*. Br J Surg 2018;40:588-596
- [9] Kawatu, C., Bodhi, W. & Mongi, J., 2013, *Test of the Effect of Cat Leaf Ethanol Extracts (Acalypha indica L.) on Blood Sugar Levels of Wistar Male White Rats (Rattus norvegicus)*. Pharmacon Scientific Journal of Pharmacy, 2(1), 81-87
- [10] Salamah, N. & Hanifah.L., 2014. Test of Antioxidant Activity of Suruhan Leaf Ethanol Extract (*Paperomia pellucida* ( L) H.B&K) with Phospholibdat Method. Proceedings of SPOA XVI and Mukhtar XII PERHIPBA, pp.341-349.
- [11] Tiwari R, Ausman LM, Agho KE. Determinant of Stunting and Severe Stunting Among Under-Fives: Evidence from the 2011 Nepal Demographic and Health Survey. BMC Pediatr. 2014;(1):1-15
- [12] Wijaya, R. A. 2013. *Aloe vera Extract Gel Formulation as an Alternative to Healing Burns*. Semarang:

- Department of Chemistry, Faculty of Mathematics and Natural Sciences, Semarang State University
- [13] Yes. 2019. "Activity Of Antifungal Ethanol Extract 50% And Ethanol 96% Leaf Henna Nail Lawsonia inermis L Against Trichophyton mentagrophytes". Scientific Journal of Basic and Environmental Sciences .19(1) : 12-19
- [14] Yapa, KS 2009, *Management of Burns in the Community, Wounds, United Kingdom*, pp. 8-48, accessed 28 August 2017
- [15] Yarfati, K. Eriani, and A. Damhoeri. 2011. *The Potential of Chinese Distance (Jatropha multifida, L) Secretion in Healing New-Wounded Mice. Jurnal Natural. Faculty of Mathematics and Natural Sciences, Syiah Kuala Press University, Banda Aceh*
- [16] Zeniyanti A, Ratnawati H, Puradisastra S. 2009: 8(2): 132-138. *Comparison of Ozone, Chinese Castor Sap (Jatropha Multifida L.) and Povidone iodine 10% Against Wound Healing Time In Webster's Swiss Strain Female Mice. Maranatha Journal of Medicine*
- [17] Zainal Ch., Muntiaha, Pauliana V. Y yamlean, & Widya A. L. 2014. *Effectiveness Test of Chinese Castor Sap Cream Preparation (Jatropha multifida L.) for the Treatment of Cuts Infected with Staphylococcus aureus Bacteria in Rabbits (Orytolagus cuniculus)*. Pharmacy Study Program FMIPA UNSRAT Manado. ISSN : 2302-2493.