

# Potential of the Betadine Plant (*Jatropha multifida L*) for Wound Healing: Literature Review

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## ABSTRACT

One of the therapies used in wound care is the betadine plant to accelerate wound healing. It contains active substances, including flavonoids, tannins, saponins, and alkaloids, which act as antioxidants, anti-inflammatories, and antimicrobials. The type of research carried out was a literature review type. Literature search regarding the potential of betadine plant leaf extract (*Jatropha multifida L*) for wound healing using Google Scholar, Pubmed, Sci-Hub, and Science Direct. Articles were selected based on exclusion and inclusion criteria, resulting in a sample of 7 articles in Indonesian and English. The research results show that using betadine plants can heal cuts, post-tooth extraction wounds, and chemical burns. Administration is carried out two times a day with a treatment time of 1 to 4 weeks, and evaluation is done twice during the intervention. Wound treatment uses the betadine plant as an alternative therapy, which is helpful for wound healing. It is hoped that the betadine plant can be used as an alternative in wound care and can be applied by the community, especially for DM sufferers.

**Keywords:** betadine plants, healing, wounds

## INTRODUCTION

Wounds occur due to disruption of tissue continuity due to injury or surgery. Wounds can be classified based on anatomical structure, nature, healing process, and time. A wound is also defined as damage to a tissue unit/component, where, specifically, a tissue substance is damaged or missing. Wounds are a problem considered minor and often experienced by everyone, even though wounds can cause infection (Lukman, 2023).

Research from the Indonesian Ministry of Health (2008) stated that the prevalence of burns in Indonesia was 2.2%. Burns are injuries with the highest morbidity and degree of disability in hospitals. Burns can be caused by hot touches, electric currents, or chemicals that contact the skin, mucosa, and tissue.

The presence of wounds requires immediate treatment because delays in treating wounds can cause infection, which results in delays in the wound-healing process. Wounds that last a long time can disrupt the healing process, usually caused by multifactorial problems in the sufferer (Maghfuri, 2015). Wound treatment can be done using antimicrobial wound dressings. The

development of formulas can be used to help the healing process. Active substances from natural ingredients are increasingly developing as alternative treatments (Purnama et al., 2017).

The wound healing process is a form of skin tissue repair process after an injury consisting of four phases: hemostasis, inflammation, proliferation, and maturation/remodeling. Wound management based on the principles of wound care includes washing the wound appropriately, carrying out debridement according to the type of wound, and choosing the proper wound dressing (dressing) (Wijaya, 2018).

Using herbal ingredients from plants for traditional medicine is widespread in Indonesia. Several plants can be applied to wounds, including binahong leaves (Samirana et al., 2016), god leaves (Aaron et al., 2016), betadine leaves (Liana & Utama, 2018), aloe vera (aloe vera) (Kurnia & Ratnapuri, 2019), and zigzag plants (Fauziah & Soniya, 2020).

Betadine plants are also known as Chinese distance, iodine tree, Tintir distance (Java), octopus distance (Sundanese), and balance batai (and rate) (Darmawi et al., 2013). The Chinese *Jatropha* plant is in the Euphorbiaceae family and belongs to the *Jatropha multifida* Linn species. Commonly used by the public as a wound medicine, it is reported that Chinese castor latex can be used as a wound and ulcer therapy, as well as extracts from *J. multifida* roots showing antibiotic activity that can fight *Escherichia coli* (Alekhya et al., 2013).

The results of Lukman's research (2023) stated that there was an effect of iodine plant sap (*Jatropha multifida*) on wound healing in white rats (*Rattus norvegicus*), with the group treated with *Jatropha multifida* sap; the wounds improved on days 4 to 5 with the fastest process. they were healing within 3 days and a maximum of 6 days. Meanwhile, in the control group, the average wound improved on day 6, with the fastest wound healing process on day 5 and the slowest on day 8.

Zakiah's research results stated that a concentration of 3% was a more effective concentration because it could approach the diameter of the wound or be equal to zero, or new tissue could have formed covering the wound. Rinawati's research (2015) results indicated a correlation between the administration of Chinese castor tree sap (*Jatropha multifida* L) and a decrease in wound length. There was no correlation between administering Chinese castor tree sap (*Jatropha multifida* L) and decreasing erythema in white rats (*Rattus norvegicus*) with contaminated wounds.

Based on the research results of Liana and Utama (2018), the statistical test results of betadine plant leaf extract ointment had the same effect as Cassel ointment on the thickness of

granulation tissue and the distance of wound edges in white rat cuts. The most effective dose is 40% Betadine leaf extract ointment.

Based on the background description above, the author is interested in conducting a literature review regarding the potential of betadine leaves for wound healing. The absence of specific research regarding the potential of the betadine plant for healing chronic and acute burns supports this search using a literature review or literature review design using the PICO systematic framework. PICO is an abbreviation for Problem, Intervention, Comparison, and Outcome.

The problem is a rat with burns. The intervention is using betadine plant gel preparations to heal wounds. The comparison is the effect of betadine plant gel preparations on wound healing. The outcome is knowing the wound type and healing process using the betadine plant gel preparation.

The keywords used in Indonesian are betadine plant and wound healing and in English, b, betadine plant a, and wound healing. The inclusion criteria used by researchers include 1) published articles for a maximum of 10 years, namely 2012 to 2023, 2) articles that are accredited and Synta 1 to 6, 3) articles that have full text available, 4) are experimental research, 5) the respondents in the article are rats who suffered burns, 6) use Indonesian and English.

Meanwhile, the exclusion criteria are 1) results of theses, dissertations, and theses and 2) articles discussing literature reviews. Search and selection of studies via Google Scholar, Proquest, Science Direct, Neliti, and PubMed. Data extraction was carried out with a summary in a table containing the author's name, title, year, research objectives, research methods, statistical tests, findings, and regional country.

Researchers use data analysis in the form of content analysis. Content analysis is a research technique that is carried out objectively, systematically, and with quantitative descriptions based on the visible content of communication and correct data, taking into account the context (Eriyanto, 2011).

## **RESULTS**

Researchers received seven articles that could be analyzed according to keywords. Based on seven accredited Indonesian journals. The year of publication of the articles obtained was 2012 with 1 article, 2015 with 1 article, 2016 with 1 article, 2018 with 2 articles, 2021 with 1 article, and 202 with 2 with 1 article, le. The types of wounds obtained were burns totaling 5 articles

cut,s totaling 1 article, and wounds after tooth extraction 1 article. The most widely used research design is an experimental study using a post-test-only control group design with 7 articles.

Based on 7 articles reviewed, it shows the influence of the betadine plant on wound healing. The study group had a faster healing process after the dressing with betadine plant gel was applied compared to the control group. The results showed that the average diabetic wound score before intervention was 42.83. The study results showed that administering betadine plant extract and discharge planning accelerated the healing of burns, cuts, and post-tooth extraction wounds. Betadine plant gel can prevent the occurrence of pressure sores in the intervention group. Using betadine plant gel preparation for at least 3 days reduces wound pain; at least 1 week of using betadine plant ointment shows healing of surgical wounds in diabetes patients. Administration of betadine plant gel is more effective in epithelialization and wound healing than 2% Nitrofurazone ointment. Betadine plant gel can be applied to heal wounds after tooth extraction, speeding up the healing process of wound implications, and betadine plant extract can increase the number of platelets in dengue sufferers through muscle testing.

**Table 1. Potential of the Betadine Plant (*Jatropha multifida* L) for Wound Healing: Literature Review**

Author/Year/Topic/ Publisher/Doi	Study Objectives	Methods	Statistical Techniques	Play Findings	Regions
<p>Okarisman et al. (2012)</p> <p>The Influence of <i>Jatropha multifida</i> and Leaves of <i>Carica papaya</i> Extract Combination Gel toward Chemical Burn Injury Healing on Rat.</p> <p>Mutiara Medika, 12(1): 49-55.</p>	<p>The study objective is to investigate the effect of a combination gel of <i>Jatropha multifida</i> and papaya leaf extracts on the healing of chemical burns in white rats induced by sulfuric acid.</p>	<p>The methodology involved an experimental in vivo study using 30 female white Sprague Dawley rats to investigate the effect of a combination gel of iodine plant extract and papaya leaf on the healing of chemical burns induced by sulfuric acid. The rats were divided into treatment and control groups, with wound healing measured using the Morton method.</p>	<p>Hypothesis testing for mean comparison</p>	<p>The combination gel of <i>Jatropha multifida</i> and papaya leaf extracts in a 1:2 ratio significantly accelerated the healing of chemical burns in white rats induced by sulfuric acid (<math>p = 0.011</math>).</p>	<p>Indonesia</p>
<p>Rinawati et al. (2015)</p> <p>Wound Healing by Reducing Erythema in White Rats (<i>Rattus Norvegicus</i>) Given Chinese <i>Jatropha</i> Stem Sap (<i>Jatropha multifida</i> L.)</p> <p>World of Nursing: Journal of Nursing and Health, 3(1).</p>	<p>The study objectives are to analyze the correlation between wound healing and reduction in erythema in white rats given <i>Jatropha multifida</i> L. stem sap.</p>	<p>The methodology involved an experimental design with 42 white rats divided into 14 groups, measuring wound length reduction and erythema using specific tools and software, and analyzing the data with correlation and regression tests.</p>	<p>Spearman correlation and nonlinear regression</p>	<p>The study found a correlation between the application of <i>Jatropha multifida</i> L. stem sap and the reduction in wound length in white rats, with a faster reduction observed in the treated group compared to the control group. There was no correlation between applying <i>Jatropha multifida</i> L. stem sap and reducing erythema in white rats with contaminated wounds. The average time for wound length reduction was shorter in the group treated with <i>Jatropha multifida</i> L. stem sap compared to the control group.</p>	<p>Indonesia</p>

Author/Year/Topic/ Publisher/Doi	Study Objectives	Methods	Statistical Techniques	Play Findings	Regions
<p>Lukman and Kurniawan (2023)</p> <p>The Effect of Iodine Plant Sap (<i>Jatropha multifida</i>) on the Wound Healing Process in White Rats (<i>Rattus Norvegicus</i>)</p> <p>Undergraduate Degree in Nursing Study Program Faculty of Health Sciences Kusuma Husada University of Surakarta</p>	<p>The study objective is to examine the effect of <i>Jatropha multifida</i> plant latex on the wound-healing process in white rats.</p>	<p>The study's methodology is a quantitative experimental laboratory design with a post-test-only control group design. Respondents were randomly divided into two groups, one serving as the treatment group and the other as the control group.</p>	<p>Independent t-test</p>	<p><i>Jatropha multifida</i> latex accelerates wound healing in white rats compared to the control group, with an average difference of 2 days in wound recovery time.</p>	<p>Indonesia</p>
<p>Rusdy et al. (2021)</p> <p>Research report</p> <p>Effectiveness of betadine stem sap (<i>Jatropha et al.</i>) on wound healing after tooth extraction in Sprague-Dawley rats.</p> <p><a href="https://doi.org/10.24198/jkg.v33i2.32563">https://doi.org/10.24198/jkg.v33i2.32563</a></p>	<p>The study objectives are to analyze the effectiveness of <i>Jatropha multifida</i> L. sap on wound healing and signs of infection post-tooth extraction in rats.</p>	<p>The methodology involved an experimental laboratory design with a post-test-only control group design using 30 Sprague-Dawley rats, divided into treatment and control groups, administering <i>Jatropha multifida</i> L. latex and tranexamic acid, respectively. Observations were made post-tooth extraction on days 1, 3, and 7, with data analysis using the Shapiro Wilk norShapiro-Wilknd Mann Whitney statMann-Whitney.</p>	<p>Shapiro-Wilk test for normality and Mann-Whitney test for comparing the effectiveness of <i>Jatropha multifida</i> L. sap on wound healing post-tooth extraction</p>	<p>Betadine plant latex was more effective in accelerating wound healing post-tooth extraction than tranexamic acid.</p>	<p>Indonesia</p>
<p>Thahir and Nurfitriah (2019)</p> <p>Test of the Effectiveness of Burn Wound Healing Gel with Ethanol Extract of Chinese <i>Jatropha</i> Leaves (<i>Jatropha multifida</i>) on Rabbits (<i>Oryctolagus cuniculus</i>).</p>	<p>The study aims to evaluate the effectiveness of ethanol extract gel (<i>Jatropha multifida</i>) in treating burn wounds in rabbits.</p>	<p>The methodology involved an experimental laboratory study testing the efficacy of <i>Jatropha multifida</i> extract gel on burn wounds in male rabbits. Different treatments were applied to</p>	<p>Not applicable</p>	<p>The study's main finding was that the 3% concentration of ethanol extract gel from <i>Jatropha multifida</i> was more effective in healing burn wounds in rabbits than the 5% concentration, as it approached zero wound diameter or had new tissue covering the wound.</p>	<p>Indonesia</p>

Author/Year/Topic/ Publisher/Doi	Study Objectives	Methods	Statistical Techniques	Play Findings	Regions
Yamassi Makassar Health Journal, 3(1).		induce and monitor first-degree burn wounds over ten days.			
Sundaryono et al. (2016)  Potential of Betadine Plant Leaf Extract to Increase the Number of Platelets in DHF Sufferers Through Testing on Mus Musculus  National Science Education Seminar	Testing the Effect of Jatropha multifida leaf extract on platelet count in male Mus musculus - Isolating the active compounds in Jatropha multifida leaf extract.	The methodology involved testing the EffectEffect of Jatropha multifida leaf extract on platelet count in male Mus musculus, isolating active compounds through maceration, fractionation, and purification using TLC and column chromatography, and identifying compounds using FTIR and 1 H-NMR spectroscopy.	Not applicable	The main findings of the study include the effectiveness of Betadin plant leaf extract in increasing platelet count in thrombocytopenic M. musculus and the identification of flavonol glycoside as the active compound in the plant.	Bengkulu, Indonesia
Liana and Utama (2018)  Effectiveness of administration of betadine (jatropha multifidus linn) leaf extract on granulation tissue thickness and wound edge distance in wound healing in white rats (Rattus norvegicus)  Jurnal Kedokteran dan Kesehatan Publikasi Ilmiah Fakultas Kedokteran Universitas Sriwijaya 5(3):114-123.  <a href="https://doi.org/10.32539/JKK.v5i3.6313">https://doi.org/10.32539/JKK.v5i3.6313</a>	This study aims to assess the effectiveness of betadine leaf extract on the thickness of the granulation tissue and the edge distance of white rat (Rattus norvegicus) incision wounds.	The study's methodology involved an experimental design with a post-test-only compost-test-only sign, a sample size of 30 white rats, and statistical analyses, including analyses for homogeneity and comparisons between groups.	Levene test, Independent t-test, Way ANOVA, post hoc multiple comparisons, Games-Howell t-test	The effectiveness of betadine leaf extract is similar to made Cassel ointment in improving granulation tissue thickness and wound edge distance in white rat incision wounds, with the most effective dose being 40% betadine leaf extract.	Palembang, Indonesia

## DISCUSSION

Based on the results of a review of 7 articles, it was found that the types of wounds that can be applied using the betadine plant (*Jatropha multifida* L) are burns, cuts, and wounds after tooth extraction. Studies show that most people empirically use betadine (J. et al.) for traditional medical purposes to heal wounds. The stem of the *J. multifid* L. plant, which contains flavonoids, is known to have adequate antimicrobial power against gram-positive bacteria (Sari & Sari, 2015). Apart from that, Chinese castor sap (J. et al.) is widely used for wound healing (Alekhya et al., 2013). In research (Muntiaha, 2014), it was concluded that Betadine latex cream preparations containing flavonoid compounds can speed up the wound healing process by providing an antibacterial effect for the treatment of cuts infected with *Staphylococcus aureus* bacteria in rabbits (*Orytolagus cuniculus*). Flavonoids function as antibacterials and antioxidants, which can prevent damage to skin tissue and help cell regeneration, which will speed up the inflammatory phase in the wound healing process (Robinson, 1995).

Flavonoid compounds help wound healing by increasing collagen formation, reducing macrophages from tissue edema, and increasing the number of fibroblasts (Madhavan, 2007). Apart from that, flavonoids also reduce the occurrence of cell necrosis by reducing lipid peroxidation. Inhibiting lipid peroxidation can increase collagen fiber viability and blood circulation, prevent cell damage, and increase DNA synthesis in the wound-healing process (Reddy, 2011). Another study by (Fauziah & Fitrianiingsih, 2016) concluded that administering Betadine sap to blood samples proved effective in speeding up coagulation time. Research (Syarfati, 2011) also explains that the effectiveness of Betadine sap shows that treating wounds using Betadine accelerates the formation of scabs and that applying Betadine sap to the surface of the injured skin makes the skin form perfectly as before.

The use of betadiBetadineplied to burns. Several preliminary studies have used sult burns to explain that the betadine plant can significantly affect healing burns. The results of Lukman's research (2023) stated that there was an effect of iodine plant sap (*jatropha multifida*) on wound healing in white rats (*Rattus norvegicus*), with the group treated with *Jatropha multifida* sap; the wounds improved on days 4 to 5 with the fastest process. they were healing within 3 days and a maximum of 6 days. Meanwhile, in the control group, the average wound improved on day 6, with the fastest wound healing process on day 5 and the slowest on day 8.

Zakiah's research results stated that a concentration of 3% was more effective because it could approach the diameter of the wound or be equal to zero, or new tissue could have formed



covering the wound. Rinawati's research (2015) showed a correlation between giving the sap of the Chinese castor tree (*Jatropha multifida* L) and reducing the wound length. There was no correlation between giving the sap of the Chinese castor stem (*Jatropha multifida* L) and reducing erythema in white rats (*Rattus norvegicus*) with contaminated wounds.

Based on the research results of Liana and Utama (2018), the statistical test results of betadine plant leaf extract ointment had the same effect as Cassel ointment on the thickness of granulation tissue and the distance of wound edges in white rat cuts. The most effective dose is 40% Betadine leaf extract ointment.

In several types of wounds above, the results of the researchers' analysis showed that betadine had been applied to burns, cuts, and post-tooth extraction wounds. Healing of burn wounds can be seen from the results where the wound diameter is close to zero or equal to zero, namely on day 10. The results of the healing time graph show that the gel that provides the fastest healing time is with a concentration of 3% because it is close to the wound diameter or the same wound diameter. With zero, new tissue has formed, covering the wound.

In the wound healing process, there is an inflammatory phase where this phase has a functional priority, namely promoting hemostasis, removing dead tissue, and preventing infection by pathogenic bacteria, especially bacteria. In the initial inflammatory phase, blood will fill the injured tissue, and blood exposure to collars will result in platelet degranulation and activation of the agent factors. homogeneity will then trigger other biological systems, such as the activation of complement quinine, the clotting cascade, and the formation of plasmin. This situation will amplify the signal from the injured area, which activates the formation of a clot that unites the wound edges and the accumulation of several mitogens that attract chemicals to the injured area. PMN (poly morpho nuclear) is the first cell to enter. Its function is to phagocytose incoming bacteria.

The flavonoids and tannins in betadine (*Jatropha multifida* L) can help the wound healing process because they function as antioxidants and antimicrobials that affect wound healing and accelerate epithelialization. Apart from that, the tannin compound also plays a role in the healing process of white rat cuts because tannin is helpful as an astringent, where the astringent will cause the permeability of the mucosa to decrease and the bonds between the mucosa to become strong so that microorganisms and chemical irritants cannot enter the wound. Tannin plays a role in inhibiting mucosal fluid hypersecretion and neutralizing inflammatory proteins.

Tannin compounds contain antibacterial compounds that help shrink cell walls or cell membranes, inhibiting the permeability of bacteria to grow.

The addition of flavonoids to wounds will speed up the wound-healing process. Flavonoids can accelerate the process of epidermal tissue regeneration and infiltration of inflammatory cells in the wound area. Epithelial cells undergo stratification and differentiation, so in this study, it was seen that the group given betadine plant leaf extract showed a better wound-healing process. Judging from the size of the distance between the wound's edges, it was getting smaller when compared to the group given Betadine leaf extract. The flavonoid and tannin content contained in betadine leaf extract stimulates the formation of new epithelial cells and supports the epithelialization process so that it can be concluded that reducing the size of the wound edge distance is positively correlated with the re-epithelialization process because the faster the re-epithelialization process, the less the size of the wound, thereby shortening the wound size—the wound healing process.

*Jatropha multifida* L stems contain several compounds such as Multifidone, Japodagron, Multidione, Multifolone Jatrogrossidentadione, and macrocyclic diterpenoids. *Jatropha multifida* L stems are known to have antibacterial activity against several Gram-positive bacteria. Betadine plant sap is known to contain atropine alkaloid, atropine peptide and phenolic peptides, glucoside. Betadine plant sap is known to produce wound healing activity and hemostasis effects. Based on experience from generation to generation, the betadine plant is very efficacious in treating new wounds and is an excellent alternative, as shown by its very effective results in helping speed up the blood clotting process.

If the wound-healing process is hampered, local infection will occur in the wound, which can be caused by bacterial colonization of the wound. If bacteria increase to 10<sup>5</sup>-10<sup>6</sup> organisms/gram on the wound surface, it can interfere with wound healing (Perdanakusuma & Hariani, 2015). This infection will spread to the surrounding tissue and develop into a systemic infection. Infection can arise due to delayed wound healing, increased exudate, foul odor, damaged wound boundaries, brittle tissue around the wound, increased size of the wound, and increased pain. Bacterial control is an effort to prevent an increase in bacterial colonies, thereby reducing the release of exudate and the risk of infection, which inhibits the healing process. To overcome wound complications, you can use wound-cleansing fluids and topical antimicrobials to improve wound healing (Powers et al., 2016).

## CONCLUSION

The results of the analysis of 7 pieces of literature conducted by researchers regarding the administration of betadine plant gel for wound healing can be concluded that the administration of aloe vera gel can speed up the healing process of burns, cuts, and wounds after tooth extraction. So, it can be used as an alternative in wound care. This can be seen from previous research on accelerating the wound healing process using the betadine plant by providing betadine plant intervention two times a day with a treatment period of 1 to 3 weeks after the intervention is given. Evaluation must be carried out 3 times to assess the wound healing process. Giving betadine plants is safe, does not cause side effects, and is easy to apply. It is independent and affordable for the public, so it is highly recommended to be used to speed up healing when treating wounds.

## LIMITATION

This research can determine the Betadine Plant (*Jatropha multifida* L) for Wound Healing. It can also be the basis for additional information to improve health.

## REFERENCES

- Alekhya, V., Deepan, T., Ramachandran, S., & Dhanaraju, M. D. (2013). Preliminary phytochemical investigation of *Jatropha multifida*. *World Journal of Agricultural Sciences* 9(3): 251-257.
- Aaron, A. H., & Wuisan, J. (2016). They are testing the Effect of dewa leaf extract (*Gyanurasegetum* [Lour]. Merr) on the healing period of skin incision wounds in rabbits (*Oryctolagus cuniculus*) Thesis Candidate, Faculty of Medicine, Sam Ratulangi University, Manado. The Indonesian people have known and used it for a long time. *E-Biomedik*, 4(1), 15-18.
- Darmawi, M. Z. H., & Putranda, F. (2013). Inhibitory power of Chinese Castor sap (*Jatropha et al.*) against *Staphylococcus aureus* in vitro. *Jurnal Medika Veterinaria*, 7(2). 113–115.
- Eriyanto, (2015). *Content analysis*. Jakarta: Kencana.
- Fauziah, N. N., & Fitriainingsih, S. P. (2017). The effect of adding Chinese *Jatropha* Sap (*Jatropha et al.*) to the wound healing process is seen by examining the coagulation time. *Proceedings of the Unisba Academic Community Research Seminar Pharmacy*, 3(2). 172–177.
- Fauziah, M., & Soniya, F. (2020). Potential of the Zigzag Plant as a Wound Healer. *Journal of Professional Nursing Research*, 2(1), 39–44. <https://doi.org/10.37287/jppp.v2i1.41>.
- Indonesian Ministry of Health. (2018). Indonesia Health Profile 2016. *In Bali Province Health Profile*. <http://www.depkes.go.id/resources/download/pusdatin/profil-kesehatan-indonesia/Profil-Kesehatan-Indonesia-2016.pdf>.
- Liana, Y., & Utama, A. Y. (2018). Effectiveness of administration of Betadine (*Jatropha et al.*) leaf extract on granulation tissue thickness and wound edge distance in wound healing in white rats (*Rattus Norvegicus*). *Jurnal Kedokteran dan Kesehatan Publikasi Ilmiah*

*Fakultas Kedokteran Universitas Sriwijaya* 5(3):114-123.  
<https://doi.org/10.32539/JKK.v5i3.6313>

- Lukman, A., & Kurniawan, T. S. (2023). Effect of iodine plant sap (*Jatropha multifida*) on wound healing processes in white rats (*Rattus Norvegicus*). *Undergraduate Degree in Nursing Study Program Faculty of Health Sciences Kusuma Husada University of Surakarta*.
- Kurnia, D., & Ratnapuri, P. H. (2019). Review: Pharmacological activity and product development of aloe vera (*Aloe et al.*). *Pharmascience Journal*, 6(1), 38. <https://doi.org/10.20527/jps.v6i1.6073>
- Madhavan, S., Ambiga, S., Narayanan, R., Gowri, D., & Sukumar, D. (2007). Evaluation of wound healing activity of flavonoids from *Ipomoea carnea* Jacq. *National Library of Medicine*, 26(3):45-51.
- Maghfuri, A. (2016). *Clever book for diabetes mellitus wound care*. Jakarta: Salemba Medika.
- Muntiaha, M. C. (2014). Test the effectiveness of Chinese *Jatropha* (*Jatropha multifida* L) cream preparations for treating cut wounds infected with *Staphylococcus aureus* bacteria in rabbits (*Orytolagus cuniculus*). *Pharmacon*, 3(3). <https://doi.org/10.35799/pha.3.2014.5446>
- Okarisman, H., & Makiyah, S. N. N. (2012). The influence of *Jatropha multivida* and leaves of *Carica papaya* extract combination gel toward chemical burn injury healing on rat. *Mutiara Medika*, 12(1): 49-55.
- Perdanakusuma, D. S., & Hariani, L. (2015). Modern wound management indication and application. *Petra Media*.
- Powers, J. G., Higham, C., Broussard, K., & Phillips, T. J. (2016). Wound healing and treating wounds Chronic wound care and management. *Journal of the American Academy of Dermatology*, 74(4), 607–625. <https://doi.org/10.1016/j.jaad.2015.08.070>
- Purnama, H., Sriwidodo, S., & Mita, S. R. (2017). Wound healing and treatment process: A Systematic review. *Pharmaca*, 15(2). <https://doi.org/10.24198/jf.v15i2.13366.g6184>
- Reddy, B. K. (2011). Study of wound healing activity of aqueous and alcoholic bark extract of *Acacia catechu* on rats. *Journal of Pharmaceutical Sciences*, 1(3).
- Rinawati, Agustina, R., & Suhartono, E. (2015). Wound healing by decreasing erythema white rats (*Rattus Norvegicus*) given sap Chinese targets (*Jatropha et al.*). *World of Nursing: Journal of Nursing and Health*, 3(1).
- Robinson, T. (1995). *High plant organic content*. Bandung: Bandung Institute of Technology Publishers.
- Rusdy, H., Saruksuk, A. S. P., Dalimunte, R. S., & Dohude, G. A. (2021). Effectiveness of Betadine (*Jatropha et al.*) stem sap on wound healing after tooth extraction in Sprague-Dawley rats. *Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatra, Indonesia*. <https://doi.org/10.24198/jkg.v33i2.32563>
- Samirana, P. O., Swastini, A. D., Subratha, I. D. G. P. Y., & dan Ariadi, K. A. (2016). Test of the wound healing activity of ethanol extract of Binahong leaves (*Anredera scandens* (L.) Moq.) on eight male Wistar rats. *Sainsmat: Scientific Journal of Natural Sciences*, 5(2), 19–23.
- Sari, F. P., & Sari, S. M. (2015). *An antimicrobial active substance extracted from the iodine plant (Jatropha et al.) as an alternative raw material for natural antibiotics*. Department of Chemical Engineering, Faculty of Engineering. Diponegoro University.
- Sundayono, A., Firdaus, M. L., Firdaus, S., & Karyadi, B. (2016). Potential of Betadin Plant Leaf Extract for Increasing the Patient's Platebocyte Number Dhf through a Test against *Mus Musculus*. *National Science Education Seminar*
- Syarfati, D. (2011). The potential of Jarak Cina (*Jatropha multifida*) secretion in healing new-wounded mice. *Natural Journal*, 11(1): 16–19.

- Thahir, Z., & Nurfitriah. (2018). Testing the effectiveness of healing burns of Chinese leaf ethanol extract gel (*Jatropha multifida*) in rabbits (*Oryctolagus Cuniculus*). *Yamassi Makassar Health Journal*, 3(1).
- Wijaya, M. S. (2018). *Wound care with a multidisciplinary approach*, (1st ed.). ANDI.