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Analysis of the Impact of Wound Healing by Aloe Vera Ointment (Aloe Barbadensis Miller) on Incision Wounds in Wistar Rats (Rattus Norvegicus)

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Abstract— *This study aimed to evaluate the effectiveness of aloe vera extract (Aloe Barbadensis Miller) in healing incision wounds in white rats. The experimental research method used pre-test and post-test approaches and a control group without treatment. The study sample consisted of 25 male white rats divided into five groups, with four treatment groups and one control group, each consisting of 5 mice. The ingredients used include alcohol, aluminum f, distilled water, aloe vera extract, 96% ethanol, rat test animals (mus musculus), sterile gauze, Whatman filter paper, methylparaben, petroleum ether, bandages, propylene glycol, gloves, and triethanolamine. Equipment used includes laboratory glassware (pyrex®), autoclaves, maceration containers, blenders (Maspion®), porcelain cups, calculators (Tricle brand®), ovens, tongs, rotavapor (Heidolf®), iron spoons, analytical balances (Precisa®), and water baths. Data analysis using the ANOVA test showed a significant difference in the effect of administering aloe vera extract on incision wound healing. It was found that ointment application with aloe vera extract significantly affected incision wound healing in white rats, with the highest percentage of healing on day 14 at 95%. These findings support the potential of aloe vera as an effective alternative in wound healing cuts, showing results that compete with Bioplacenton®'s favorable control products.*

Keywords— *Aloe Vera (Aloe Barbadensis Miller), Incision Wound Healing, White Rat, Aloe Vera Extract Ointment, Post-test Pre-test Experiment.*

I. INTRODUCTION

Since ancient eras, this plant has been utilized in medical practices and continues to be employed in modern times. Approximately 350,000 vascular plants (tracheophytes) are known for their medicinal properties, with around 10% of them—approximately half a million species—being utilized as medicinal plants. Initially, early practitioners relied on trial-and-error techniques to alleviate ailments or enhance well-being. Over successive generations, the utilization of this plant has evolved and refined, giving rise to what is widely recognized as traditional medicine across various cultural contexts (Salmerón-Manzano, Garrido-Cardenas, and Manzano-Agugliaro, 2020). There appears to be a shift away from the direct use of medicinal plants in favor of modern pharmaceuticals in mainstream medicine. The pharmaceutical industry plays a pivotal role in producing drugs, many of which derive their active ingredients from plants and serve as raw materials. However, certain underdeveloped or resource-limited regions lack access to these synthetic drugs and continue to rely heavily on traditional medicine centered on the direct utilization of medicinal plants. This reliance persists due to conventional medicine's cost-effectiveness compared to modern pharmaceuticals in these areas (Salmerón-Manzano, Garrido-Cardenas, and Manzano-Agugliaro, 2020).

Indonesian people have a rich history of using medicinal plants dating back to ancient times, predating the formalization of modern healthcare services and medicines. The preservation and advancement of traditional medicine as part of the nation's cultural heritage are actively promoted through research, testing, and the discovery of new medicinal remedies, including the cultivation of medically significant plants. Aloe vera stands out as one of the effective plants traditionally used for wound healing. This is attributed to the plant's ability to tightly seal the surface of its leaves tightly, preventing the loss of valuable gel content. When injured, aloe vera rapidly seals the wound to avoid gel evaporation. This characteristic inspired ancient communities to utilize aloe vera as a wound healer, hoping for rapid closure akin to that seen in aloe vera leaves. The efficacy of aloe vera can be attributed to its rich nutritional profile, which is beneficial for the human body. Among the approximately 200 varieties of aloe vera plants suitable for medicinal use, Aloe vera Barbadensis Miller is particularly noteworthy. This type of aloe vera contains 72 essential substances required by the body (Surjushe et al., 2008). These substances include 18 amino acids, carbohydrates, fats, water, vitamins, minerals, enzymes, hormones, and various pharmaceutical compounds. The pharmaceutical compounds found in Aloe vera Barbadensis Miller encompass a wide range of therapeutic properties, including antibiotics, antiseptics, antibacterials, anticancer agents, antivirals, antifungals, anti-infectives, anti-inflammatory agents, anti-swelling agents, antiparkinsonian agents, antiatherosclerosis agents, and antibiotics-resistant antivirals (Sánchez et al., 2020). This diverse array of bioactive compounds underscores the medicinal significance of aloe vera in traditional Indonesian medicine.

Aloe vera is also beneficial for healing burns (Aris & Latifah, 2013). Indeed, scientific studies have demonstrated the safety and efficacy of using aloe vera for treating burns. Research on human subjects has indicated that applying aloe

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vera to burn wounds is safe and can expedite healing. This acceleration is attributed to aloe vera's ability to promote the formation of new epithelial tissue, the outer layer of the skin. Aloe vera contains compounds that stimulate the growth of new skin cells, aiding in the regeneration of damaged tissue. The mucilage found in aloe vera contains lignin substances that can penetrate and absorb into the skin, facilitating its healing properties. Overall, these findings from human studies support the traditional use of aloe vera in treating burns and highlight its potential as a natural remedy for promoting skin healing and regeneration (Hai et al., 2019). This mucus will hold body fluids from the skin's surface (Atiba et al., 2022). Aloe vera is known to stimulate epidermal growth factors and enhance the function of fibroblast cells. These properties make aloe vera effective in treating various types of wounds, such as burns, scratches, and other skin injuries (Jamil et al., 2020).

The traditional method of using aloe vera for wound healing involves cutting the base of the plant, washing and peeling it to obtain a clear greenish gel or liquid, and then applying this gel to the injured area. Research has shown that oral administration of aloe vera at 100 mg/kg body weight per day resulted in a 62.5% wound healing rate. Additionally, aloe vera gel formulations containing 75% aloe vera combined with Carbopol and propylene glycol showed faster healing of burns in female Wistar rats compared to control groups. However, aloe vera gel has low stability due to its tendency to oxidize quickly, making it impractical. Therefore, there is a need to develop pharmaceutical preparations with high strength to improve user acceptance and practicality. Gel preparations are suitable for aloe vera as they enhance stability and are comfortable for patient use. They are odorless, durable, and practical. The study titled "Effectiveness of Aloe Vera (Aloe Barbadensis Miller) in Wound Healing in Wistar Rats (Rattus norvegicus)" aimed to assess the healing effects of aloe vera on wounds in laboratory rats, highlighting its potential in pharmaceutical formulations for wound care.

II. Research Methods

The research conducted in January 2024 is an experimental study employing a Pre-test and Post-test group-only control design approach. The study involved a sample of 25 randomly selected white male rats, which were then divided into five groups comprising four treatment groups and one control group, with each treatment group consisting of 5 rats. The materials utilized in the study encompassed alcohol, aluminum f, distilled water, Aloe Vera (Aloe Barbadensis Miller), 96% ethanol, rat test animals (mus musculus), sterile gauze, Whatman filter paper, methylparaben, petroleum ether, plaster, propylene glycol, gloves, and triethanolamine. The tools employed included glassware (pyrex®), an autoclave, a maceration vessel, a blender (Maspion®), a porcelain cup, a caliper (Tricle brand®), an oven, tweezers, a rotavapor (Heidolf®), an iron spoon, an analytical balance (Precisa®), and a water bath.

Calculation of Aloe Vera (Aloe Barbadensis Miller) Yield (Aloe Barbadensis Miller)

The calculation of the yield of Aloe Vera (Aloe Barbadensis Miller) (Aloe Barbadensis Miller) (Amaliah et al., 2019).

$$\text{Yield (\%)} = \frac{\text{Aloe Vera (Aloe Barbadensis Miller) Essential} \times 100\%}{\text{Sample Period of Aloe Vera (Aloe Barbadensis Miller)}}$$

Observations were made regarding changes in the wound and the size of the damage in the treated area. Data analysis using statistical data tests including;

a. Normality Test
b. ANOVA test to determine the effectiveness of ethanol extract of Aloe Vera (Aloe Barbadensis Miller) and Bioplacenton® on rat back incision wound healing.

III. Results

Table 1 presents the chemical composition of Aloe Vera (Aloe Barbadensis Miller) extract (Aloe Barbadensis Miller), revealing the presence of alkaloid, flavonoid, saponin, and tannin compounds. The alkaloid test yielded distinctive results, manifesting as a red-brown precipitate when exposed to the Dragendorff reagent, a white deposit upon the addition of the Mayer reagent, and a brown residue during the Bouchardt test (Beon & Leki, 2017) (Abdullah Yeni, 2015).

TABLE 1. Phytochemical Screening of Aloe Vera (Aloe Barbadensis Miller).

Test	Result	Description
Alkaloid	Red-brown precipitate	(+)
	White precipitate	(+)
	Brown precipitate	(+)
Flavonoid	The red color in the amyl alcohol layer	(+)
Saponin	Permanent foam	(+)
Tanin	Blackish green color	(+)

TABLE 2. Inhibition percentage data of Aloe Vera (Aloe Barbadensis Miller) extract (Aloe Barbadensis Miller) against DPPH.

Extract Concentration (ppm)	Absorbance Extract	Absorbance Control	Inhibisi (%)
20	0.376	0,627	55.09
40	0.302	0,627	56.23
60	0.285	0,627	58.11
100	0.186	0,627	59.64

Table 2 shows the percentage of data on the inhibition of Aloe Vera extract (Aloe Barbadensis Miller) against DPPH at various extract concentrations. Data were measured by observing the absorbance values of extracts at different concentration levels and comparing them to the control absorbance (without extract).

At an extract concentration of 20 ppm, the absorbance value of aloe vera extract was 0.376, while the control absorbance value without extract was 0.627. The percentage of inhibition at this concentration reached 55.09%, indicating the ability of Aloe Vera extract to inhibit DPPH activity. At an extract concentration of 40 ppm, the absorbance value of the extract decreased to 0.302, but the control absorbance value remained at 0.627. The percentage of inhibition increased to 56.23%, indicating an increase in the antioxidant activity of the extract at this concentration. The extract concentration of 60 ppm showed an extract absorbance value of 0.285, with a control absorbance value fixed at 0.627. The percentage of inhibition at this concentration increases to 58.11%, signifying a more potent antioxidant effect at higher concentration levels.

At the highest concentration, which is 100 ppm, the absorbance value of Aloe Vera extract was 0.186, while the

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control absorbance value remained at 0.627. The percentage of inhibition reached 59.64%, indicating that the concentration of this extract has the highest inhibitory effect on DPPH compared to other concentrations. Thus, it can be concluded that Aloe Vera extract shows significant antioxidant activity against DPPH, and its inhibition rate increases with the increase in extract concentration.

TABLE 3. Changes in wound length with various concentrations of Aloe Vera (Aloe Barbadensis Miller).

Days	Change in Wound Length (cm)				
	Concentration: 20%	Concentration 40%	Concentration: 60%	100% Concentration	Bioplacenton
1	2	2	2	2	2
3	1.7	1.7	1.7	1.7	1.7
5	1.6	1.5	1.4	1.3	1.3
7	1.4	1.2	1.2	1.2	0.9
9	1.2	0.7	0.8	0.9	0.7
11	1.1	0.6	0.5	0.6	0.4
14	0.7	0.5	0.4	0.3	0.2

Table 3 recorded changes in wound length in centimeters on various days after administration of concentrations of Aloe Vera extract (Aloe Barbadensis Miller) with Bioplacenton comparison. On the first day, the wound length for all concentrations of extracts and Bioplacenton was 2 cm. In the following few days, there was a consistent decrease in wound length at all concentrations of aloe vera extract. On the 14th day, the wound length reaches 0.7 cm, 0.5 cm, 0.4 cm, and 0.3 cm for concentrations of 20%, 40%, 60%, and 100% respectively. Bioplacenton comparison also showed a significant reduction in wound length. These results indicate the potential of Aloe Vera extract in supporting the wound healing process, with the level of effectiveness increasing with the increase in extract concentration.

In the analysis of the data in Table 4.3, it was seen that Bioplacenton also showed a significant decrease in wound length on each day of observation. On day 1, the wound length for Bioplacenton was 2 cm, and as was the case with the concentration of Aloe Vera extract, Bioplacenton showed a positive rate of change with each subsequent day. On the 14th day, Bioplacenton wound length drops to 0.2 cm, demonstrating its effectiveness in wound healing. These results reinforce the conclusion that Aloe Vera extract and Bioplacenton concentrations can positively impact changes in wound length. However, Aloe Vera extract concentrations tend to show more diverse decreases depending on the concentration level.

Bioplacenton is a trademark for topical products that treat wounds or skin lesions. These products generally contain active ingredients such as neomycin sulfate, bacitracin zinc, and polymyxin B sulfate, which are antibiotics to help prevent wound infection. Bioplacenton is usually available in ointments or creams and is often used to speed up the wound healing process, prevent disease, and reduce inflammation in the skin. Although Bioplacenton has been widely used as a wound care product, its use and effectiveness may vary depending on the individual condition and type of wound. We recommend that products such as Bioplacenton follow the instructions of a doctor or competent health worker.

TABLE 4. Test Results of the Effect of Aloe Vera (Aloe Barbadensis Miller) on Wound Healing

ANOVA						
		Sum of Squares	df	Mean Square	F	Say.
Aloe Vera (Aloe Barbadensis Miller) Extract	Between Groups	5.334	3	3.632	7.223	.013
	Within Groups	36.211	22	.273		
	Total	41.545	25			

The ANOVA test results in Table 4.4 revealed a significant difference in the effect of Aloe Vera extract *(Aloe Barbadensis Miller)* on incision wound healing through ointment application. With an F value of 7.223 and a significance of 0.013, it was found that the variation between the group receiving the ointment with Aloe Vera extract and the control group was significant. This analysis is based on a Sum of Squares between groups of 5,334 and a Mean Square of 3,632, which suggests that the differences are not the result of variability alone within the groups. These findings strongly indicate that the administration of Aloe Vera extract through ointment has a marked effect on improving incision wound healing in this study.

TABLE 5. Test Results of the Effect of Bioplacenton® (positive control) on Wound Length

ANOVA					
	Sum of Squares	df	Mean Square	F	Say.
Between Groups	12.441	3	1.112	25.453	.006
Within Groups	1.423	22	.045		
Total	13.864	25			

Table 5 shows the results of the ANOVA test to evaluate the effect of Bioplacenton® administration (as a positive control) on wound length. In this trial, four groups received treatments with Bioplacenton® as a positive control group. The ANOVA results showed a significant difference between the group receiving Bioplacenton® and other groups regarding wound length, with an F value of 25.453 and a significance (Sig.) of 0.006. This suggests that variation between groups is more significant than variation within groups. The breakdown of ANOVA results includes a Sum of Squares between groups of 12,441, a Mean Square between groups of 1,112, a Sum of Squares in groups of 1,423 with df 22, and a Mean Square in groups of 0.045. The total Sum of Squares is 13,864 for a total of df 25. These results suggest that Bioplacenton® administration significantly impacted changes in wound length in the context of this study.

Bioplacenton is a topical medicine produced by Kalbe Farma that is used to treat burns in gel form. Bioplacenton gel is indicated to treat burns or other wounds with infection. The active ingredients in bioplacenton gel used as a burn treatment regimen are 10% placenta extract and 0.5% neomycin sulfate. Placenta extract is believed to help the healing process of burns by triggering the formation of new tissue in the wound, and neomycin sulfate works as an antibiotic to prevent gram-negative bacterial infections in the wound area. Aloe vera contains 75 potentially active ingredients, including vitamins, enzymes, flavonoids, saponins, amino acids, etc. The benefits

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of aloe vera are used to treat various pathological conditions, one of which is to reduce pain and wound healing.

Aloe vera has benefits that are topically geared towards healing perineal wounds more practically. The content of aloe vera can help speed up wound healing time because aloe vera contains flavonoid compounds that function as antioxidants to protect the body's cell structure. Flavonoids and saponins are also active substances and function as anti-inflammatory and antioxidants for wound healing. When injury occurs, flavonoid compounds can remove reactive oxygen species (ROS) and detoxify hydrogen peroxide (H2O2) so that lipid peroxide levels decrease and the inflammatory phase is shorter. Flavonoids can also accelerate the migration of fibroblasts, smooth muscle cells, and endothelial cells by stimulating an increase.20 Aloe vera has healing properties in the presence of glucomannan compounds, mannose-rich polysaccharides, and gibberellin, a growth hormone, interacting with growth factor receptors on fibroblasts, thereby stimulating their activity and proliferation, which in turn significantly increases collagen synthesis after topical administration.

The results of research conducted by Aulia (2022) obtained the results that aloe vera (aloe vera) is given to treat first-degree and second-degree burn patients faster to experience the healing process and capitalization of skin tissue because there are antiseptic, anti-inflammatory (Aulia & Pane, 2022). Then research Hekmatpou (2019), aloe vera gel (aloe vera) is effective for accelerating the healing of shallow partial thickness burns with an average healing duration of 15 days, faster than the control group, whose average healing time is 20 days (Hekmatpou et al., 2019). Similarly, Halawa & Darma's (2018) research entitled "Test of Gel From Aloe Vera (Aloe Vera) for Burns in Rabbits" found that giving aloe vera gel (aloe vera) to burns can have a healing effect on wounds where the diameter of the area of burns gelled is smaller than the area of blank burns and the diameter of the area of burns given bioplacenton on the 8th day (HALAWA, 2018).

The results of the study obtained by Abidin et al. (2021), entitled The Effectiveness of Giving Aloe Vera to burn patients in Yosowilangun Lumajang, the population in this study was the Yosowilangun Lumajang village community with a sample of 30 respondents consisting of 12 men and 18 women carried out with quantitative methods through a descriptive approach, it was found that the degree of burns in burn patients as many as 18 respondents (60%) had grade I burns and 12 respondents (40%) had second-degree burns. It was found that there was a decrease in pain intensity after applying aloe vera (aloe vera) in respondents with burns. Before giving aloe vera (aloe vera), 18 respondents (60%) experienced a pain scale response of 4-6, and 12 respondents (40%) experienced a pain scale response of 7-9 in burn pain. After giving aloe vera (aloe vera), there was a decrease in pain scale, namely pain scale 4-6. As many as six respondents (20%) and 24 respondents (80%) experienced pain response on burns scale 1-3. This study obtained an overview of the effectiveness of giving aloe vera to burn patients. Aloe vera (aloe vera) is given to treat first-degree and second-degree burn patients; when compared to conventional wound care, aloe vera is more effective at accelerating the healing process and epithelialization of skin tissue (Abidin, 2021).

Fikri Research, et al (2014) yang berjudul "Aloe Vera Gel (aloe vera) and Silver Sulfadiazine Accelerates Burn Healing" performed on mice using an experimental design. There were three treatment groups (a treatment group using aloe vera gel), a treatment group using silver sulfadiazine, and one control group), with a sample of 24 mice. The aloe vera gel group obtained an F count of 1.231 and a significant 0.505 after a one-way ANOVA SPSS test. The average length of healing is 15.1250 days; the fastest recovery on day 13 is 1 sample, and the most extended recovery on day 17 is 1 sample. In the silver sulfadiazine group, after a one-way ANOVA SPSS test, the F count was 6.500 and significant 0.139. The average length of healing is 14.7500 days, with the fastest recovery on day 13, as many as two samples, and the most extended recovery on day 16, as many as one sample (Fikri, 2014).

IV. CONCLUSION

Based on this study, Aloe Vera Ointment *(Aloe Barbadensis Miller)* was shown to have bioactive compounds such as alkaloids, flavonoids, saponins, and tannins that play an essential role in the healing process of incision wounds in white rats. The optimum concentration to achieve the best healing effectiveness was 80%. In addition, the results showed that Aloe Vera Ointment *(Aloe Barbadensis Miller)* had wound healing abilities close to the positive control, Bioplacenton®, with the highest percentage of healing on day 14, which is 95%. In conclusion, Aloe Vera Ointment *(Aloe Barbadensis Miller)* has potential as an effective alternative in wound healing in white rats, showing results that compete with Bioplacenton® in wound healing.

REFERENCES

[1]. Abdullah Yeni, et al. (2015). Pengaruh Teknik Pengekstrakan Terhadap Kandungan Fitokimia Dan Sensoris Minuman Sirih Merah. *Jurnal Teknovasi : Jurnal Teknik Dan Inovasi*, *02*(Vol 2, No 2 (2015): Teknovasi Oktober 2015), 8–14.

[2]. Abidin, Z. (2021). Efektivitas Pemberian Lidah Buaya Pada Pasien Luka Bakar Di Yosowilangun Lumajang. *Jurnal Ilmiah Keperawatan*, *7*(1).

[3]. Amaliah, A., Sobari, E., & Mukminah, N. (2019). Rendemen Dan Karakteristik Fisik Ekstrak Oleoresin Daun Sirih Hijau (Piper betle L .) Dengan Pelarut Heksan. *Industrial Research Workshop*, *10*(1), 273–278.

[4]. Aris, R., & Latifah, W. (2013). *Info Artikel*. *2*(2252).

[5]. Atiba, A., Abdo, W., Ali, E., Abd-Elsalam, M., Amer, M., Abdel Monsef, A., Taha, R., Antar, S., & Mahmoud, A. (2022). Topical and oral applications of Aloe vera improve the healing of deep second-degree burns in rats via modulation of growth factors. *Biomarkers*, *27*(6), 608–617. https://doi.org/10.1080/1354750X.2022.2085800

[6]. Aulia, L., & Pane, Y. S. (2022). Effect of Aloe vera extract in post-burn skin repair in rats. *F1000Research*, *11*, 168. https://doi.org/10.12688/f1000research.79538.2

[7]. Beon, A. S., & Leki, K. G. B. (2017). Identifikasi Komponen Fitokimia dalam Ekstrak Daun Sirih Merah (Piper crocatum). *STIKes Citra Husada Mandiri Kupang*.

[8]. Fikri, Z. (2014). Gel Lidah Buaya Dan Silver Sulfadiazin Mempercepat Penyembuhan Luka Bakar. *Journals of Ners Community Vol*, *5*(1).

[9]. Hai, Z., Ren, Y., Hu, J., Wang, H., Qin, Q., & Chen, T. (2019). Evaluation of the Treatment Effect of Aloe vera Fermentation in Burn Injury Healing Using a Rat Model. *Mediators of Inflammation*, *2019*. https://doi.org/10.1155/2019/2020858

[10]. HALAWA, D. (2018). Uji gel dari lidah buaya (aloe vera (l)) untuk luka bakar pada kelinci. *Skripsi Institut Kesehatan Helvetia*, *L*.

[11]. Hekmatpou, D., Mehrabi, F., Rahzani, K., & Aminiyan, A. (2019). The Effect of Aloe Vera Clinical Trials on Prevention and Healing of Skin Wound: A Systematic Review. *Iranian Journal of Medical Sciences*,

44(1), 1–9.
[12]. Jamil, M., Mansoor, M., Latif, N., Naz, R., & Anwar, F. (2020). Review: Effect of Aleo vera on Wound Healing. *Pak. j. Sci. Ind. Res*, *63*(1), 48–61.
[13]. Salmerón-Manzano, E., Garrido-Cardenas, J. A., & Manzano-Agugliaro, F. (2020). Worldwide research trends on medicinal plants. *International Journal of Environmental Research and Public Health*, *17*(10). https://doi.org/10.3390/ijerph17103376
[14]. Sánchez, M., González-Burgos, E., Iglesias, I., & Gómez-Serranillos, M. P. (2020). Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. *Molecules (Basel, Switzerland)*, *25*(6). https://doi.org/10.3390/molecules25061324
[15]. Surjushe, A., Vasani, R., & Saple, D. G. (2008). Aloe vera: a short review. *Indian Journal of Dermatology*, *53*(4), 163–166. https://doi.org/10.4103/0019-5154.44785

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