



LITERATURE REVIEW: THE EFFECTIVENESS OF MORINGA OLEIFERA LEAF EXTRACT IN SIMPLE OINTMENT FORMULATION FOR WOUND HEALING

Yosep Frandi¹, Rita Sari²

University of Muhammadiyah Pringsewu^{1,2}

*Corresponding author, e-mail: yoseph.dmc@gmail.com

Abstract

Purpose: This study evaluates the effectiveness of Moringa oleifera leaf extract in a simple ointment formulation for wound healing, particularly for diabetic foot ulcers (DFU), through a comprehensive literature review. *Literature Review:* Chronic wounds such as DFU pose significant global health challenges. Natural alternatives like Moringa oleifera, known for its anti-inflammatory, antioxidant, and antimicrobial properties, have gained attention. Studies from 2017 to 2023 were reviewed to assess its potential in wound management. *Methodology:* A Literature review of experimental studies was conducted using databases like PubMed and Google Scholar. Keywords included "Moringa Leaf Extract," "Wound Healing," "Diabetic Foot Ulcer," and "Wistar Rats." An initial title and abstract screening were followed by a full-text evaluation, resulting in 7 studies meeting inclusion criteria. *Results:* The analysis showed that Moringa oleifera leaf extract accelerates wound healing in Wistar rats through enhanced collagen production, reduced inflammation, and antioxidant enzyme activation, leading to faster tissue repair across various wound types. *Conclusions:* Moringa oleifera leaf extract in ointment form shows strong potential as an effective and safe wound healing agent. The findings suggest its applicability in clinical settings, although further research in human subjects, especially for DFU, is needed. *Recommendations:* Clinical trials in human subjects are recommended to validate the extract's efficacy. Exploring optimal dosage and formulation could further enhance its effectiveness as a cost-effective wound care solution, particularly in resource-limited areas. *Additional Data:* Out of 1,343 articles identified, 108 were reviewed in full, with 7 studies demonstrating consistent positive effects of Moringa oleifera in wound healing, supporting its therapeutic potential.

Keywords: Moringa leaf extract, Wound Healing, Literature Review

INTRODUCTION

The wound healing process is a complex series of biological stages aimed at restoring the function and structure of damaged tissues. These stages include hemostasis, where the body stops bleeding through coagulation mechanisms, followed by inflammation to prevent infection, and finally, the proliferation and remodeling phases that form new tissue and strengthen the structure (Boateng & Catanzano, 2015; Purnama et al., 2017). Natural wound healing is often disrupted by factors such as infection, poor circulation, or chronic diseases like diabetes, making chronic wounds difficult to heal (Guo & DiPietro, 2010).

Globally, acute and chronic wounds present a significant health challenge. The World Health Organization (WHO) reports more than 300 million non-fatal wound cases annually, resulting from accidents, burns, and surgeries (WHO, 2021). In Indonesia, the prevalence of chronic wounds such as diabetic ulcers and pressure sores has increased alongside the growing elderly population and rising chronic diseases like diabetes (Kementeriaan Kesehatan RI, 2018). Untreated wounds can lead to severe complications such as infection, amputation, or even death. Therefore, effective, affordable, and accessible solutions are necessary to accelerate wound healing and prevent further complications.

In recent years, the use of natural materials as alternative therapies for wound healing has gained attention. One promising natural ingredient is Moringa leaf (*Moringa oleifera*), which is rich in bioactive compounds such as flavonoids, tannins, saponins, and vitamin C (Gupta et al., 2010). These compounds have anti-inflammatory, antibacterial, and antioxidant properties that are crucial in accelerating the wound healing process. Research shows that Moringa leaf extract stimulates fibroblast cell proliferation, increases collagen synthesis, and reduces the risk of infection (Kasolo et al., 2010; Gupta et al., 2010).

Using Moringa leaf extract in simple ointment formulations is a compelling solution, especially in regions with limited access to conventional medical care. This formulation is affordable, easy to access, and effective compared to more expensive commercial products. Experimental studies on rats have shown that Moringa leaf extract speeds up the healing of various types of wounds, including burns and wounds resulting from metabolic disorders like diabetes (Erwiyani et al., 2020; Paranadia et al., 2017; Cahyani, 2018). The extract has also been shown to increase collagen density, reduce inflammation, and lower the risk of bacterial infection, particularly from *Staphylococcus aureus* (Puspita et al., 2023), although most research has been conducted on animal models, these findings open up opportunities for further research in humans. This study provides a strong foundation for developing new, safe, effective, and affordable therapies based on Moringa leaf extract, especially for complex chronic wounds.

Objective

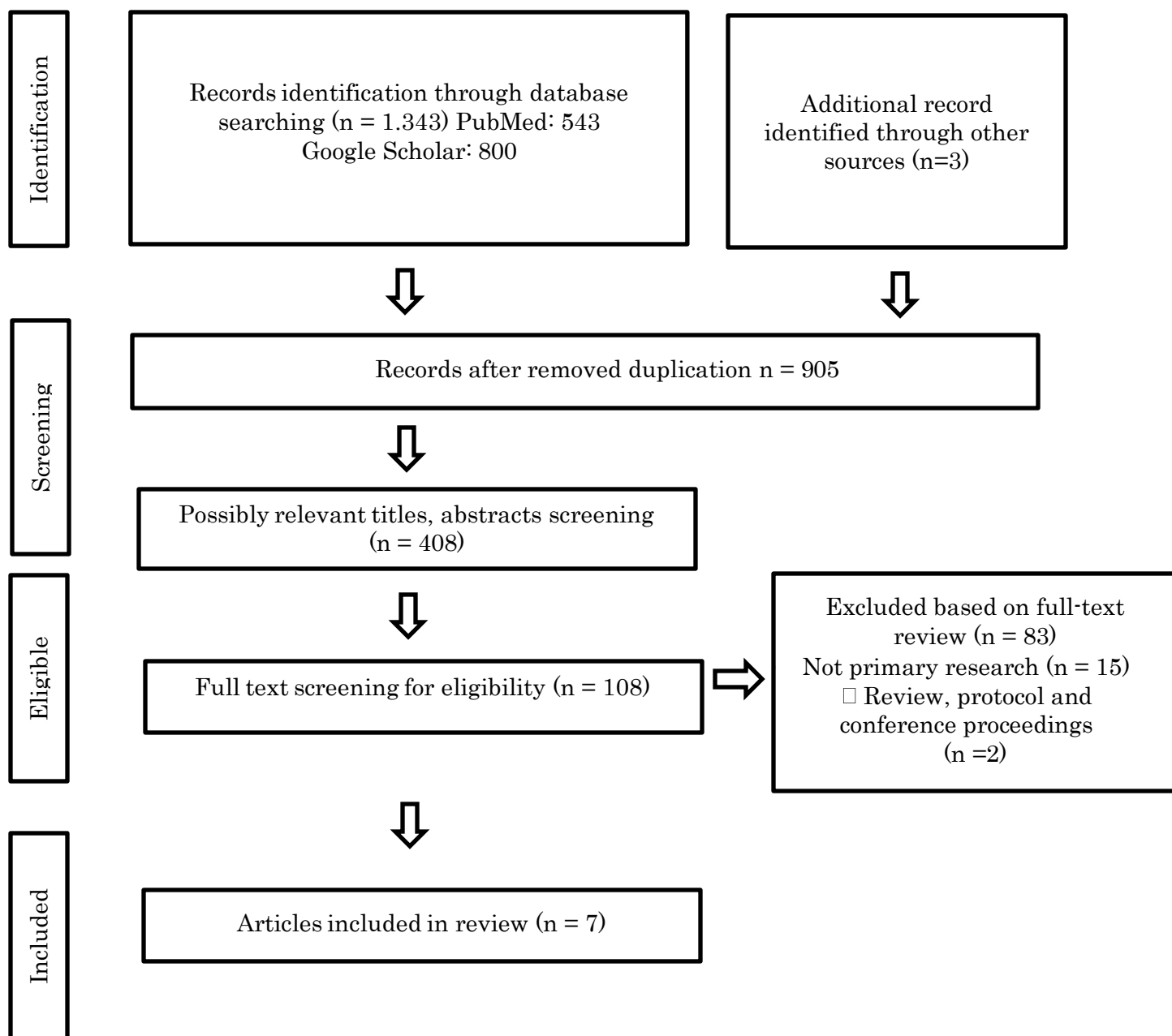
This study aims to review the literature on the effectiveness of Moringa leaf extract in simple ointment preparations for wound healing in Wistar rats. The findings are expected to serve as a basis for further research in humans and the clinical application of Moringa leaf extract for wound healing.

METHODS

The literature search was conducted using major scientific databases, including PubMed and Google Scholar, with keywords: "Moringa Leaf Extract," "Wound Healing," "Diabetic Foot Ulcer," and "Wistar Rats." Selected studies had to meet inclusion criteria, including the use of Moringa leaf extract, Wistar rats as subjects, and parameters related to wound healing. Data were analyzed qualitatively to assess the effects of Moringa leaf extract on various wound healing stages, including, inflammation, proliferation, and remodeling.

a. Search Strategy

The search strategy was carefully designed to identify relevant studies on the effectiveness of Moringa leaf extract in simple ointment preparations for wound healing in Wistar rats. The process began with selecting major scientific databases such as PubMed and Google Scholar, known for their broad coverage and accessibility to scientific literature. Keywords used in the search included variations such as —Moringa Leaf Extract, | —Wound Healing, | and —Diabetic Foot Ulcer| to ensure all relevant and potential studies were identified. The screening process was carried out in two stages. In the initial screening, articles were evaluated based on titles and abstracts to determine their relevance. Studies that were irrelevant or did not meet the inclusion criteria were excluded. Inclusion criteria involved studies examining the effects of Moringa leaf extract on wound healing, using Wistar rats as subjects, published between 2017 and 2023, with clear data and methods. The initial screening resulted in 905 articles out of a total of 1,343 articles identified. The second screening involved a full- text evaluation of the 108 articles that passed the initial screening. At this stage, articles were further evaluated to ensure methodological quality and data relevance. Studies that did not meet the methodological or relevance standards were excluded. After the second screening, 7 articles that met the inclusion criteria were analyzed further.



Flow diagram of article study selection

No.	Year	Title	Purposes	Methods	Result	Conclusion
1	Agitya Resti Erwiyani, Dedi Haswan, Andre Agasi, Sikni Retno Karminingtyas (2020)	The Effect of Gel and Cream Preparation s of Ethanolic Extract of Moringa Oleifera Leaves on Burn Wound Reduction in Rats	To assess the effect of gel and cream preparations of ethanolic extract of Moringa oleifera leaves on burn wound healing in rats.	Experimental test with 3 groups of rats: one group given gel preparation, one group given cream, and one control group without treatment. Observations were made by measuring the burn wound area before and after	Agitya Resti Erwiyani, Dedi Haswan, Andre Agasi, Sikni Retno Karminingtyas (2020)	The Effect of Gel and Cream Preparations of Ethanolic Extract of Moringa Oleifera Leaves on Burn Wound Reduction in Rats
2	Atika Putri Paranadia, Zainur Sabta Nugraha, Uhkti Jamil Rustiasari (2017)	The Effect of Ethanolic Extract of Moringa Oleifera Leaves on Collagen Fiber Density in the Wound Healing Process in Rats (Rattus Norvegicus)	To analyze the effect of ethanolic extract of Moringa oleifera leaves on collagen fiber density in rats as an indicator of wound healing.	Experimental test using Rattus norvegicus rats with induced wounds. Rats were divided into treatment group (given ethanolic extract of Moringa oleifera) and control group. Collagen fiber density was observed using a microscope after several days of	Atika Putri Paranadia, Zainur Sabta Nugraha, Uhkti Jamil Rustiasari (2017)	The Effect of Ethanolic Extract of Moringa Oleifera Leaves on Collagen Fiber Density in the Wound Healing Process in Rats (Rattus Norvegicus)
3	Sucia Fadillah, Dhirgo Adji, Devita Anggraeni (2022)	Utilization of Moringa Oleifera Leaf Extract for Wound Healing in Ovariectomized Rats Fed a High-Fat Diet	To assess the effect of Moringa oleifera leaf extract on wound healing in ovariectomized rats fed a high-fat diet	Experimental study using ovariectomized rats fed a high-fat diet. Rats were divided into treatment group given Moringa	Sucia Fadillah, Dhirgo Adji, Devita Anggraeni (2022)	Utilization of Moringa Oleifera Leaf Extract for Wound Healing in Ovariectomized Rats Fed a High-Fat Diet

			to simulate a disturbed metabolic condition.	oleifera leaf extract and control group.		
4	Eka Puspita, Puspita Septie Dianita, Tiara Mega Kusuma (2023)	Formulation and Antibacterial Activity Test of Moringa Oleifera Leaf Ethanolic Extract Ointment Against Staphylococcus Aureus Using Kirby Bauer Method	To develop a formulation of ethanolic extract ointment of Moringa oleifera leaves and test its antibacterial activity against Staphylococcus aureus.	In vitro test using the Kirby Bauer method to evaluate the antibacterial activity of the ethanolic extract ointment of Moringa oleifera leaves against Staphylococcus aureus bacteria.	The ethanolic extract ointment of Moringa oleifera leaves showed a significant inhibition zone against the growth of Staphylococcus aureus.	The ethanolic extract of Moringa oleifera leaves is effective as an antibacterial agent and has the potential to be used in the treatment of wounds infected with Staphylococcus aureus.
5	Dian Laksmiawati, Umi Marwati, Wahyu Widowati, Rachmawati Noverina, Tri Suciati, Ahmad Faried, Sinisa Stojanoski (2023)	The Effect of Topical CM-Hwjmsc Therapy Combined with Oral Moringa Oleifera Extract on Wound Healing in Diabetic Rats	To analyze the effect of a combination of topical CM-Hwjmsc therapy and oral Moringa oleifera extract on wound healing in diabetic rats.	Experimental study on diabetic rats with wounds, given a combination of topical CM-Hwjmsc therapy and oral Moringa oleifera extract.	The combination therapy significantly accelerated wound healing compared to the control group.	The combination of topical CM-Hwjmsc therapy and oral Moringa oleifera extract is effective in accelerating wound healing in diabetic rats, strengthening the clinical potential of both therapies.
6	Shang A Tofiq, Hoshayr A Azeez, Hemn Hassan Othman (2021)	Wound Healing Activity of Moringa Oleifera Leaf Extract Cultivated in Kurdistan-Iraq	To assess the wound healing activity of Moringa oleifera leaf extract cultivated in the Kurdistan-Iraq region.	Experimental test on rats with induced wounds, treated with Moringa oleifera leaf extract and compared with the control group.	Moringa oleifera leaf extract significantly accelerated wound healing in rats compared to the control group.	Moringa oleifera leaf extract has significant potential in accelerating wound healing, especially in the traditional and regional context of Kurdistan-

7	Yulia Triastuti, Nadya Nazimuddin, Muhammad Nawal Hasya, et al. (2023)	Effectiveness Test of Moringa Oleifera Leaf Extract Cream on Incision Wound Healing on the Skin Surface of Male Wistar Rats (Rattus Norvegicus)	To test the effectiveness of Moringa oleifera leaf extract cream on incision wound healing in male Wistar rats.	Experimental study with Wistar rats given incision wounds, then applied with Moringa oleifera leaf extract cream. Wound healing results were measured based	Yulia Triastuti, Nadya Nazimuddin, Muhammad Nawal Hasya, et al. (2023)	Effectiveness Test of Moringa Oleifera Leaf Extract Cream on Incision Wound Healing on the Skin Surface of Male Wistar Rats (Rattus Norvegicus)
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RESULTS AND DISCUSSION

Based on the analysis of several studies, Moringa leaf extract has been proven effective in accelerating wound healing in animal models. Research by Erwiyani et al. (2020) and Cahyani (2018) demonstrated that the use of Moringa leaf ethanol extract-based ointment significantly accelerated epithelialization in burn wounds. This aligns with findings from Paranadia et al. (2017), who observed an increase in collagen fiber density in rats treated with Moringa leaf extract, which sped up the formation of new tissue. In addition to its anti-inflammatory and tissue healing properties, research by Puspita et al. (2023) revealed that Moringa leaf extract has strong antibacterial activity, especially against *Staphylococcus aureus*, which often infects wounds. This reinforces its potential as an agent that not only speeds up wound healing but also prevents secondary infections, which frequently hinder the healing process.

Research by Laksmiawati et al. (2023) further expanded on the therapeutic potential of Moringa by showing that a combination of Moringa extract and cellular therapy was more effective in accelerating diabetic wound healing compared to using a single treatment. This highlights the strong synergy between herbal and cellular therapies in treating complex wounds such as diabetic foot ulcers. Studies by Tofiq et al. (2021) and Triastuti et al. (2023) also confirmed that Moringa leaf extract, whether in cream or ointment form, was able to accelerate epithelialization and reduce inflammation in incised wounds. This underscores the antioxidant and anti-inflammatory effects of Moringa leaf extract, which play a critical role in shortening the wound healing duration.

CONCLUSION

Based on this review, Moringa leaf extract (*Moringa oleifera*) shows significant potential in accelerating wound healing, primarily through increased collagen density, reduced inflammation, and antibacterial activity. This study provides a strong scientific foundation for clinical applications, especially in the treatment of acute and chronic wounds. However, despite promising results in animal models, further research in humans is necessary to confirm its effectiveness, safety, and optimal dosage. Therefore, Moringa leaf extract can serve as a natural, affordable, and effective alternative therapy, particularly in regions with limited access to conventional medical care.

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