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Angsana sap vs. povidone-iodine for wound healing in tropical and military settings: A narrative review

Tessalonika Shinta Ratriani[1], Astheria Eryani[2], AJ Didy Surachman[1], Dian Andriani Ratna Dewi[1]

1. Faculty of Military Medicine, Republic of Indonesia Defense University, Bogor, Indonesia
2. Departement of Histology, Faculty of Military Medicine, Republic of Indonesia Defense University, Bogor, Indonesia

Email: tessalonikashinta@gmail.com

Abstract

Background: Wound infection remains a significant cause of morbidity in trauma patients, especially in battlefield and tropical settings where access to standard antiseptics is limited. Povidone-iodine 10% is commonly used due to its broad-spectrum antimicrobial activity; however, concerns about cytotoxicity and logistical constraints necessitate alternative antiseptic options.
Methods: A narrative review was conducted using literature from PubMed, Scopus, and Google Scholar databases. Relevant studies were identified using combinations of MeSH terms and free-text keywords related to *Pterocarpus indicus*, natural antiseptics, povidone-iodine, wound infection, and trauma care. Findings were synthesized through thematic analysis.
Result: Angsana (*Pterocarpus indicus*) sap contains bioactive compounds such as flavonoids, tannins, and terpenoids with antimicrobial and anti-inflammatory properties. These compounds may contribute to bacterial inhibition and enhanced tissue healing. Compared with povidone-iodine, which offers a broader antimicrobial spectrum, angsana sap may provide supportive effects on wound repair with potentially lower cytotoxicity. Evidence suggests it could serve as an alternative or adjunct in resource-limited environments, particularly in tropical and military contexts.
Conclusion: Angsana sap demonstrates promising potential as a natural antiseptic for wound management. However, it cannot yet replace povidone-iodine due to limited clinical evidence. Further well-designed studies are needed to confirm its safety, efficacy, and applicability in clinical practice.
Keywords: Pterocarpus indicus*, angsana sap, povidone-iodine, wound infection, wound healing.*

Background

Wound management remains a major challenge in trauma care, particularly in battlefield and tropical environments where contamination risk is high and access to sterile medical facilities is limited. Military personnel, including members of the Indonesian National Armed Forces (TNI), represent a high-risk population due to intense physical demands and operational exposure, increasing the incidence of traumatic wounds during training and deployment. Under such conditions, wound infection significantly contributes to morbidity, delayed healing, and potential systemic complications.[1]
Povidone-iodine (PVP-I) 10% is widely used as a standard antiseptic due to its broad-spectrum antimicrobial activity against bacteria, fungi, and viruses. However, its use has limitations, including cytotoxic effects on fibroblasts and keratinocytes that may impair wound healing, reduced efficacy in the presence of organic material, and logistical constraints in resource-limited settings.[2] These challenges highlight the need for alternative, accessible, and effective antiseptic agents.
Indonesia is a megabiodiversity country with approximately 40,000 types of medicinal plants, yet only a small fraction has been scientifically explored. Growing health awareness encourages communities to utilize traditional herbal medicines from surrounding plants as emergency remedies. Natural products have gained attention as potential alternatives, particularly in tropical regions with abundant medicinal plants. *Pterocarpus indicus* (angsana) has traditionally been

used for wound treatment and contains bioactive compounds such as flavonoids, tannins, and terpenoids with antimicrobial, anti-inflammatory, and antioxidant properties. Traditionally, the deep red liquid exudate (sap) obtained from incisions in the angsana trunk is applied topically to treat open wounds. Therefore, this review article aims to review and compare the available evidence on the potential role of angsana sap and 10% povidone-iodine in wound healing and infection prevention. Given its traditional use and reported bioactive properties, angsana sap may have potential relevance for wound care in tropical and military settings. However, further studies are needed to clarify its clinical utility and safety.

Discussion

Wound Healing Mechanism

Wound healing is a complex biological process involving overlapping phases of hemostasis, inflammation, proliferation, and remodeling.[3-5] Successful healing depends on coordinated cellular and molecular responses, while infection and excessive inflammation may delay tissue repair.[6,7] Therefore, appropriate antiseptic management is important to prevent infection and support optimal wound healing.[8-10]

Importantly, angsana sap also exhibits antioxidant properties that neutralize free radicals generated during the inflammatory phase, thereby creating a favorable microenvironment for tissue repair.[19] These combined effects support multiple stages of wound healing simultaneously, including fibroblast activation, collagen synthesis, and re-epithelization. This process continues until the epidermis restores its function as a protective barrier, preventing infection and excessive moisture loss. Re-epithelialization is a key component of wound closure, and without it, skin wounds cannot heal properly.[20]

Experimental studies have demonstrated that angsana extract produces wound healing outcomes comparable to povidone-iodine, with no significant difference in re-epithelialization thickness observed in animal models at day 7 and day 14.[2] Support for this regenerative hypothesis is also reinforced by laboratory experimental designs using a randomized controlled parallel method on incised rat models (*Rattus norvegicus*) of the Sprague-Dawley strain**.** Through randomization, groups involving negative control, positive control (10% Povidone Iodine), and liquid angsana sap treatment were observed from day 0 to day 21. Microscopic analysis of skin histological preparations using Hematoxylin Eosin (HE) staining was conducted to measure the scale length, thickness, and width of the epithelial gap under a stereo microscope to visually confirm the accelerated wound closure. This suggests that despite differences in antimicrobial strength, angsana may possess preclinical regenerative potential.

Povidone-Iodine Profile

Antiseptics play a central role in preventing infection and facilitating wound healing. Povidone-iodine remains one of the most widely used topical antiseptics because of its broad-spectrum antimicrobial activity against bacteria, fungi, and viruses.[2,11] Clinical evidence supports its effectiveness in infection prevention and wound management. However, some experimental studies have reported cytotoxic effects on fibroblasts and keratinocytes, particularly at certain concentrations and exposure durations, highlighting the importance of appropriate clinical use.[12] Additionally, its reduced activity in the presence of organic material and logistical limitations in austere environments restrict its effectiveness in certain contexts.

Despite these limitations, povidone-iodine benefits from extensive clinical validation, standardized formulations, and established guidelines, ensuring consistent outcomes across various settings.

Angsana Phytochemistry

In contrast, *Pterocarpus indicus* (angsana) (Figure 1) sap offers a promising alternative due to its rich phytochemical composition. A study by Senthilkumar et al. reported that phytochemical screening of angsana (*Pterocarpus indicus*) bark (Figure 2)

Figure 1. Angsana Tree

identified the presence of various chemical constituents, including alkaloids, flavonoids, tannins, phenols, terpenoids, sterols, quinones, proteins, steroids, anthocyanins, carbohydrates, and stigmasterol.[13] In addition, quantitative analysis of its secondary metabolites indicated that angsana is a significant plant rich in bioactive compounds and has potential for use in traditional medicine. Notable compounds found include pterostilbene, epicatechin, pterosupin, marsupsin, as well as five newly identified flavonoids, which contribute to its antimicrobial and anti-inflammatory activities.[13,14]

Figure 2. Angsana Tree Sap

These compounds act by disrupting bacterial cell membranes, inhibiting enzymatic activity, and interfering with microbial replication, thereby providing a broad antibacterial effect against common wound pathogens such as *Staphylococcus aureus, Shigella dysenteriae* and *Escherichia coli.*[15,16] Furthermore, flavonoids regulate inflammatory responses by inhibiting COX-2 and lipoxygenase pathways, reducing tissue damage and promoting healing (Figure 3).[14-17]

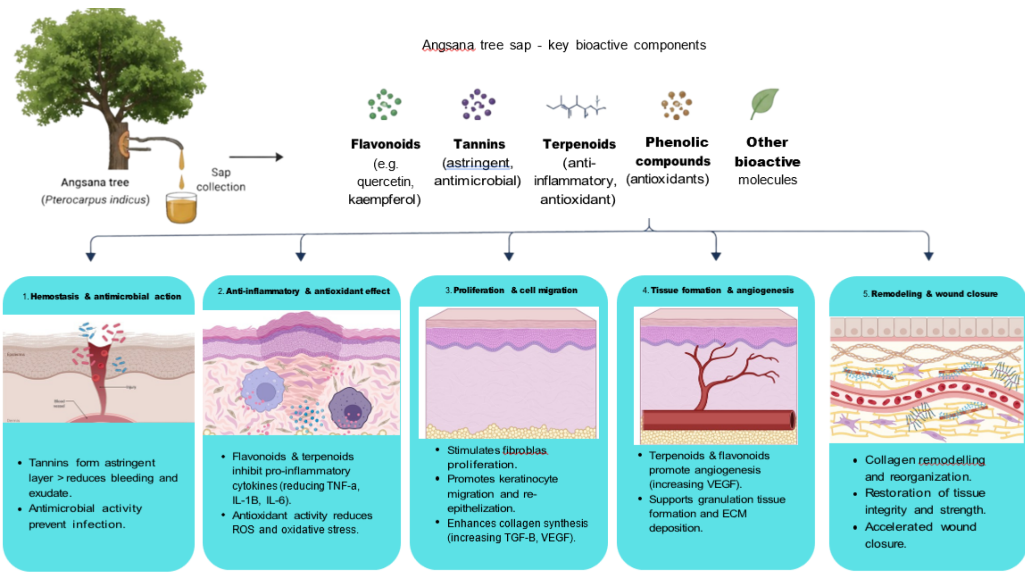

Figure 3. Angsana tree sap bioactive compounds and their roles in promoting wound healing stages. Source: Developed by the author based on Pranata et al.[2] and Eryani et al.[1]

Although angsana-derived compounds have demonstrated various biological activities, reports of inhibitory effects on cell proliferation highlight the need for further investigation regarding dose-dependent effects, safety, and potential cytotoxicity before clinical application.[18]
Moreover, the growing concern of antimicrobial resistance further supports the exploration of plant-based antiseptics. chemical compounds often exhibit multi-target mechanisms of action, reducing the likelihood of resistance development compared to conventional antimicrobials. Evidence from broader literature indicates that natural products can effectively inhibit resistant pathogens while simultaneously promoting wound healing processes.[22,23]

Military Relevance

From a translational perspective, angsana sap presents significant advantages in tropical and battlefield settings. Its widespread availability in Southeast Asia, ease of access, and minimal processing requirements make it a practical and sustainable option for initial wound management in resource-limited environments.[21]
Although angsana sap is locally available, its direct field application requires caution because sterility, concentration, stability, and safety have not been standardized. This aligns with the increasing need for context-appropriate medical interventions in military medicine.
Overall, this review demonstrates that while angsana sap possesses significant antimicrobial and wound healing potential comparable to povidone-iodine in experimental settings, its clinical application remains limited by insufficient evidence. Therefore, angsana should be considered as a complementary or alternative antiseptic in resource-limited and battlefield environments rather than a direct replacement for conventional antiseptics. Future research focusing on clinical trials and standardization is essential to establish its role in modern wound care practice.

Limitations of the Review

This review has several limitations that should be acknowledged. First, the available evidence regarding the wound-healing potential of *Pterocarpus indicus* (angsana) sap remains limited. Most published studies have been conducted in vitro or in animal models, while robust clinical evidence in humans is still lacking. Furthermore, no studies have specifically evaluated the effectiveness and safety of angsana sap in military populations or battlefield settings, where wound characteristics, environmental exposure, delayed evacuation, and limited medical resources may substantially differ from civilian conditions.
Second, there is currently no standardized protocol regarding the preparation and application of angsana sap for wound management. Variability in extraction methods, sap preparation, phytochemical composition, concentration, dosage, frequency of application, storage conditions, and sterilization procedures may influence therapeutic outcomes and limit comparability across studies.
Third, the safety profile of angsana sap has not been comprehensively established. Although existing studies suggest promising antimicrobial, anti-inflammatory, and wound-healing activities, available evidence regarding local tissue tolerance, cytotoxicity, microbial contamination risk, skin irritation, hypersensitivity reactions, allergic responses, and long-term safety remains insufficient. These limitations should be carefully considered before recommending angsana sap for routine clinical use.
Finally, variability in extraction methods, dosage, and application techniques further complicates standardization and interpretation of existing findings. In contrast, povidone-iodine benefits from extensive clinical validation, standardized formulations, and established guidelines, ensuring consistent outcomes across diverse healthcare settings. Therefore, further preclinical investigations and well-designed human clinical trials are needed to establish efficacy, safety, and standardized protocols before angsana sap can be integrated into evidence-based wound management, particularly in military medicine.
In addition, this review is narrative in nature and therefore may be subject to selection bias and heterogeneity among included studies. The available evidence is highly variable in terms of study design, outcome measures, and intervention protocols, limiting direct comparisons between studies. Consequently, conclusions regarding the clinical effectiveness of angsana sap should be interpreted with caution until supported by well-designed human clinical trials, particularly in military and battlefield settings.

Conclusion

This review highlights the potential of Pterocarpus indicus (angsana) sap as a natural wound-care agent compared with 10% povidone-iodine, particularly in tropical and military medicine contexts. Angsana sap contains bioactive compounds, including flavonoids, tannins, and terpenoids, which have been associated with antimicrobial, anti-inflammatory, antioxidant, and tissue-repair activities.[24] Experimental evidence suggests that angsana sap may support wound closure and re-epithelialization, with some findings showing comparable preclinical outcomes to povidone-iodine.[25]
Nevertheless, povidone-iodine remains a widely used and clinically established antiseptic because of its broad-spectrum antimicrobial activity, standardized formulation, and extensive clinical validation. Although angsana sap may offer practical advantages

in resource-limited, tropical, or battlefield settings, its direct clinical application remains limited by insufficient human studies, lack of standardized formulation, uncertain dosing, and potential concerns regarding sterility and safety. Current evidence remains predominantly preclinical, and further well-designed clinical trials are required to establish its safety, optimal formulation, and effectiveness in human populations.

In conclusion, angsana sap cannot yet replace povidone-iodine as a clinically established antiseptic, but it represents a promising adjunctive therapy and a potential "bridge-to-care" option in resource-limited settings. Future research should focus on clinical validation and standardization to support its integration into modern wound care practice, particularly in tropical and military medicine.

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Author Contributions

The author serves as the guarantor of the manuscript. TSR designed the study, conducted data collection and analysis, interpreted the results, and prepared the manuscript. TSR has approved the final version and assumes full responsibility for the accuracy and integrity of the work.

Conflict of Interest

No conflict of interest.

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