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ANTIOXIDANT AND WOUND HEALING ACTIVITIES OF *LANNEA COROMANDELICA* BARK EXTRACT IN A MOUSE MODEL

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Abstract

Lannea coromandelica, a traditional medicinal herb, has provoked the interest of researchers due to its possible therapeutic characteristics. The antioxidant and wound healing capabilities of *Lannea coromandelica* bark extract are investigated in this study to determine its therapeutic potential application in wound healing. *Lannea coromandelica* bark was gathered, authenticated, and processed into a hydroalcoholic extract. The radical scavenging activities of DPPH (1,1-diphenyl-2-picrylhydrazyl) and ABTS (2,2'-azino-bis 3-ethylbenzthiazoline-6-sulfonic acid) were measured. In vivo models were used to assess wound healing activities, including tissue regeneration and growth factor regulation. *Lannea coromandelica* bark extract had substantial antioxidant activity in both DPPH and ABTS experiments, indicating effective free radical scavenging activity. The extract increased tissue regeneration, expedited wound closure, and altered critical growth factors involved in the wound healing process in mouse skin wound healing experiments. The findings highlight *Lannea coromandelica* bark extract's potential as a natural source of antioxidants and a wound healing agent. Because of its dual actions, the extract is a prospective therapeutic candidate for oxidative stress control and wound treatment.

Keywords: *Lannea Coromandelica,* Antioxidant, Wound Healing, Polyphenols, Flavonoids, Growth Factors, Angiogenesis.

INTRODUCTION

Antioxidants are necessary for scavenging harmful free radicals and reactive oxygen species in order to prevent oxidative cell damage(Rao, Kalva, Yerramilli, & Mamidi, 2011; Varshan & Prathap, 2022). Numerous chronic diseases, including cancer, cardiovascular ailments, and neurological diseases, have been linked to oxidative stress (Khansari, Shakiba, & Mahmoudi, 2009; Kumaresan et al., 2022). In order to treat and prevent these illnesses, the hunt for strong antioxidants from natural sources has become increasingly important.

In addition, the process of healing a wound is a complex biological one that entails a series of intricate cellular and molecular activities with the goal of regaining tissue integrity and function(Eming, Martin, & Tomic-Canic, 2014; Prathap & Jayaraman, 2022b). (Menke, Ward, Witten, Bonchev, & Diegelmann, 2007). By accelerating tissue regeneration, lowering inflammation, and encouraging the creation of granulation tissue and (Prathap & Jayaraman, 2022a; Serra et al., 2017).

The bark extract of *Lannea coromandelica* has demonstrated potential for anti-oxidant and wound-healing properties. According to research, it contains a variety of bioactive substances that boost its antioxidant capacity, including polyphenols, flavonoids, and tannins(Hernández-Rodríguez, Baquero, & Larrota, 2019).

These bioactive components have the ability to scavenge free radicals, effectively reducing oxidative stress and guarding against oxidative cell damage(Inze & Van Montagu, 1995; Mohanraj, Varshini, & Somasundaram, 2021).

Additionally, preclinical research has shown that *Lannea coromandelica* bark extract has the ability to treat wounds. The extract significantly affects wound contraction, collagen deposition, and re-epithelialization. It has been linked to the elevation of growth factors, which promote angiogenesis and improve tissue regeneration.

In the end, this study intends to add to the expanding body of research that suggests *Lannea coromandelica* bark extract may be an effective home treatment for conditions linked to oxidative stress and wound healing. New phytotherapies with safe and efficient therapeutic choices to support overall health and wellbeing may be developed with further confirmation through clinical trials and mechanistic investigations.

MATERIALS AND METHODS

Plant Material Collection and Authentication: The bark of *L. coromandelica* was obtained from Saveetha Dental College and subsequently identified by a laboratory assistant.

Hydroalcoholic Extract Preparation: The obtained bark was properly cleaned to eliminate contaminants and air-dried in the shade. The dried bark was ground into a coarse powder. A hydroalcoholic extract was created by macerating the powdered bark in a 1:1 combination of ethanol and water. Intermittent shaking was applied to the mixture. Following maceration, the extract was filtered using appropriate filter paper (Quintão, Tavares, Vieira-Filho, Souza, & Santos, 2013).

Concentration and Storage: The filtrate was concentrated using a rotating evaporator at a regulated temperature under reduced pressure. The concentrated extract was then transferred to a sterile container and stored at the temperature suggested by the manufacturer, away from direct sunlight.

Chemical Analysis: Using conventional techniques, preliminary phytochemical screening was performed to detect the presence of several secondary metabolites such as polyphenols, flavonoids, tannins, alkaloids, and terpenoids(Moncayo, Cornejo, Castillo, & Valdez, 2021).

Selection and Care of the Animals: The laboratory mice's wound-healing mechanisms resemble those of humans; they were chosen as the study's animal model. To reduce stress and maintain consistency in the experimental settings, the mice were given a set amount of time to get used to the lab setting. The mice were fasted for a brief period prior to the experiment's start in order to prevent any potential interference from food digestion while under anesthesia.

Anesthesia and Wound Induction: The mice were given a combination of ketamine and xylazine at doses of 70 mg/kg and 10 mg/kg body weight on the day of the experiment to maintain an anesthetized condition. This anesthetic combination ensures that the animals experience the wound infliction procedure with the least amount of pain by providing appropriate drowsiness and analgesia.

Infliction of Wounds: Each mouse's skin was then given a uniform wound. To ensure uniformity in the size and placement of the cut across all animals, the wound was often

made on the back or dorsal area. Depending on the desired wound size and depth, a scalpel or a punch biopsy tool are two common ways to create a wound.

Application of *Lannea Coromandelica* Bark Extract: The *Lannea coromandelica* bark extract was topically applied to the wound site after the wound was caused. To ensure the extract adhered properly to the wound region, it was prepared in an appropriate carrier or vehicle. To evaluate the extract's long-lasting effects on the wound-healing process, the application was carried out every day for seven straight days.

Observation and Wound Evaluation: The wounds were continuously monitored during the study period for any indications of infection, irritation, or negative reactions to the extract. To statistically evaluate the healing process, variables like wound size, wound closure rate, and tissue regeneration were assessed and recorded.

Sacrifice and Tissue Collection: The mice were euthanized in accordance with ethical standards on the eighth day of the experiment. The objective of this procedure was to gather skin tissue for future examination. A gentle approach to euthanasia was used to lessen the animals' suffering. The healed wound site's surrounding skin tissue was carefully removed and gathered.

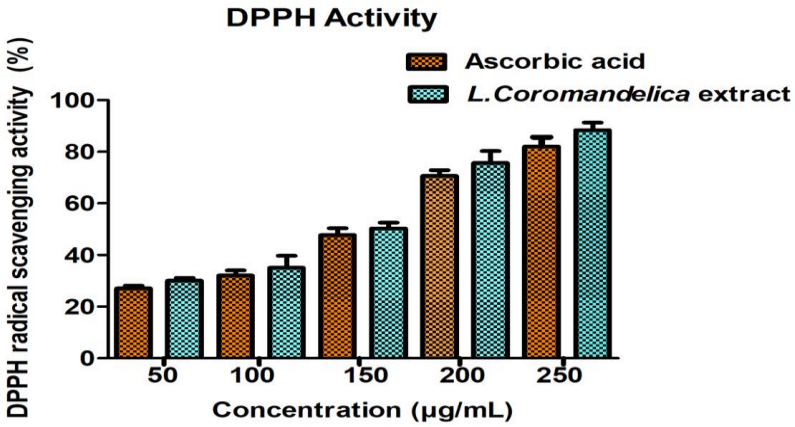
The DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity of *Lannea coromandelica* bark extract was measured using a spectrophotometric technique. The extract was produced in various quantities and combined with a DPPH solution. The reaction mixture was incubated in the dark, and the decrease in absorbance at a given wavelength was determined. As a positive control, ascorbic acid was employed.

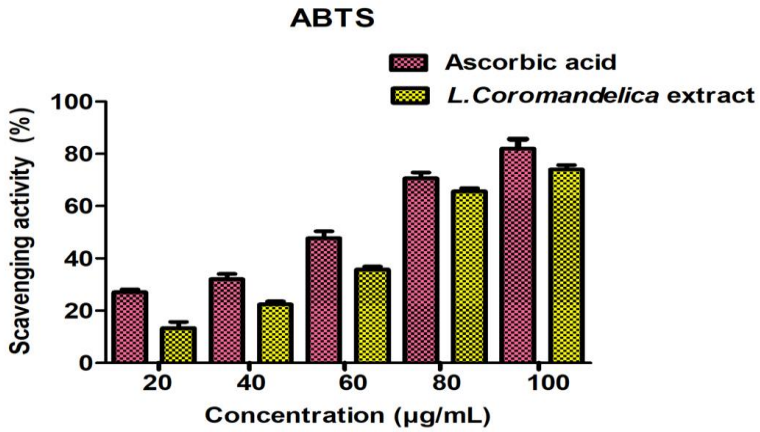
ABTS Radical Scavenging Assay: A modified technique was used to test the extract's ABTS (2,2'-azino-bis (3-ethylbenzthiazoline-6-sulfonic acid) radical scavenging activity. In the dark, an ABTS solution was combined with potassium persulfate and left to react. The resultant ABTS radical cation solution was diluted, then extract at various concentrations was added. After incubation, the absorbance at a specified wavelength was measured. Trolox was utilized as a standard of comparison. A similar formula to that used for the DPPH assay was used to quantify the percentage of ABTS scavenging activity.

Tissue Fixation and Histopathological Examination: To retain the tissue's cellular and morphological characteristics, the collected skin tissue was subsequently fixed in a 10% formaldehyde solution. A common technique to stop tissue deterioration and preserve structural integrity is formaldehyde fixation. The tissue samples were processed for histological analysis after an appropriate fixation period.

Histopathological Analysis: Hematoxylin and eosin (H&E) or other particular stains were used to analyze the preserved tissue samples that had been embedded in paraffin blocks and thinly sectioned. These stained sections were subjected to histopathological analysis, which included microscopic inspection. Inflammatory cells, collagen deposition, re-epithelialization, angiogenesis, and other tissue remodeling processes could all be seen and evaluated, which helped researchers better understand how wounds heal.

RESULTS

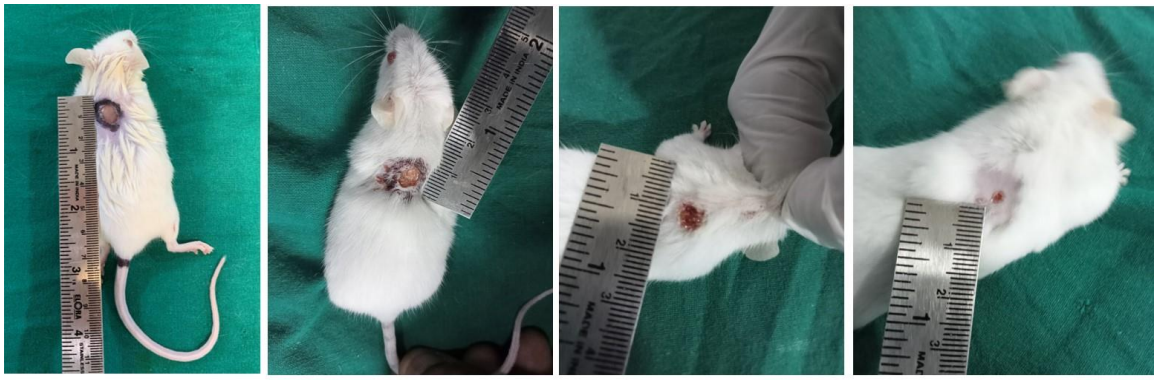




An examination of the antioxidant capacity of *Lannea coromandelica* bark extract found considerable free radical scavenging activity. In both DPPH (1,1-diphenyl-2-picrylhydrazyl) and ABTS (2,2'-azino-bis (3-ethylbenzthiazoline-6-sulfonic acid) tests, the extract displayed significant antioxidant properties. The presence of polyphenols, flavonoids, and tannins in the extract can be linked to the observed radical-scavenging impact(Lodovici et al., 2001). These bioactive chemicals are well-known for their capacity to donate hydrogen atoms and neutralize reactive oxygen species (ROS), resulting in a beneficial antioxidant effect(Parcheta et al., 2021).

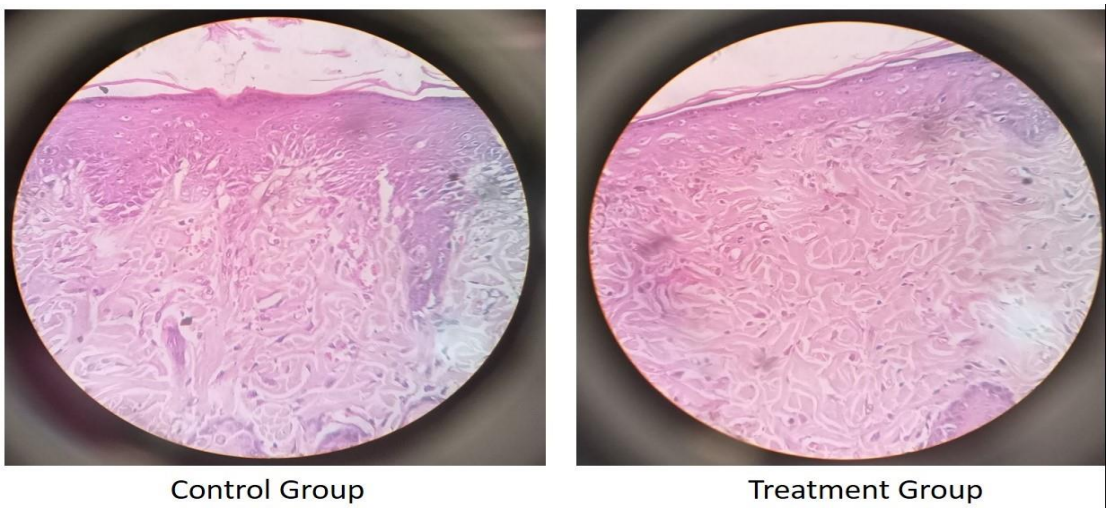
The *Lannea coromandelica* bark extract wound healing trial produced encouraging results, with notable increases in wound size and tissue regeneration when compared to the control condition. In comparison to the untreated wounds in the control group after 7 days of treatment, the extract-treated lesions showed noticeably reduced diameters. This suggests that the extract was involved in speeding the healing of the wound.

All groups, including the control group, displayed a gradually declining wound area throughout the course of the 7-day treatment period. This implies that all of the cases involved normal wound healing processes. However, *Lannea coromandelica* bark extract treatment resulted in a more prominent and quicker reduction in wound size, indicating positive benefits for wound closure.



Day 1 Day 3 Day 5 Day 7

Additionally, histological evaluations of the treated group's wound edge revealed a zone of re-epithelialization. Re-epithelialization, when new epithelial cells move and multiply to cover the wound surface, is a crucial stage in wound healing. A re-epithelialization zone may have formed as a result of the *Lannea coromandelica* bark extract treatment, hastening the healing of the wound.



Control Group Treatment Group

Another essential component of wound healing is angiogenesis, the growth of new blood vessels. The treated group's tissue samples underwent histological analysis, which revealed the presence of new blood vessels, which are crucial for providing oxygen and nutrients to the mending tissue. The development of new blood vessels suggests that the *Lannea coromandelica* bark extract therapy aided in angiogenesis, speeding up the healing of the wound.

DISCUSSION

The extensive assessment of the literature on *Lannea coromandelica* bark extract's antioxidant and wound-healing properties reveals promising findings that underscore its therapeutic potential(Chockalingam, Sasanka, Babu K, Ramanathan, & Ganapathy, 2020; Manginstar, Tallei, Niode, Salaki, & Hessel, 2024) . The extract's robust antioxidant activities, attributed to the presence of various bioactive compounds such as polyphenols, flavonoids, and tannins, hold significant implications for medical applications. Firstly, the extract's potent antioxidant capabilities are crucial in combating oxidative stress-related diseases (Engwa, 2018) . Oxidative stress, characterized by an imbalance between the production of free radicals and the body's

ability to neutralize them, is implicated in numerous health conditions including cardiovascular diseases, neurodegenerative disorders, and cancer. The ability of *Lannea coromandelica* bark extract to scavenge free radicals and reactive oxygen species serves as a defense mechanism against oxidative damage, thereby potentially mitigating the onset and progression of such diseases. Moreover, its antioxidant properties may contribute to overall health promotion and disease prevention, highlighting its potential as a natural medication for maintaining well-being. Secondly, the extract's capacity to accelerate tissue regeneration and facilitate wound healing presents a promising avenue for therapeutic intervention. Chronic wounds pose significant challenges due to their prolonged healing process and associated complications. By promoting tissue regeneration, *Lannea coromandelica* bark extract offers a potential solution to expedite wound closure and alleviate the burden of chronic wounds. This capability is particularly significant in clinical settings where efficient wound management is paramount for patient recovery and quality of life. However, despite the promising findings, further research is warranted to elucidate the precise mechanisms underlying the extract's antioxidant and wound-healing properties. A deeper understanding of these mechanisms is essential for optimizing therapeutic strategies and developing targeted interventions. Additionally, investigations into the safety profile, optimal dosage, and potential interactions of the extract are imperative to ensure its efficacy and safety in clinical settings. In conclusion, the literature review provides compelling evidence supporting the therapeutic potential of *Lannea coromandelica* bark extract. Its strong antioxidant activities and ability to promote wound healing hold promise for addressing oxidative stress-related diseases and chronic wounds. Nevertheless, continued research efforts are necessary to unravel its mechanisms of action and optimize its clinical utility, paving the way for the development of novel therapeutic approaches grounded in natural medicine.

LIMITATIONS

The study focused on antioxidant activity in *Lannea coromandelica* bark, however more research is needed to apply findings to in vivo and therapeutic contexts. The extract was a single hydroalcoholic extract, and the precise molecular processes underlying these activities had not been adequately studied. The complexity of the animal model, as well as dosing and toxicity considerations, were all taken into account. Direct therapeutic significance requires clinical translation, and interactions with other drugs are still being investigated. Long-term effects, such as increased antioxidant protection and the molecular mechanisms behind wound healing, are still being investigated.

FUTURE SCOPE

Mechanistic Elucidation: Future research should focus on unraveling the precise molecular mechanisms underlying the antioxidant and wound-healing properties of *Lannea coromandelica* bark extract to provide insights into its therapeutic efficacy and optimize its clinical applications.

Synergistic Formulations: Investigating the potential synergistic effects of *Lannea coromandelica* bark extract with other natural compounds or pharmaceutical agents could lead to the development of novel formulations with enhanced antioxidant and wound-healing properties.

Formulation Development: Efforts should be directed towards the development of standardized formulations of *Lannea coromandelica* bark extract, including topical preparations, ointments, or hydrogels, to facilitate its easy and effective application in clinical settings.

Interactions and Compatibility: Further studies are needed to assess the interactions and compatibility of *Lannea coromandelica* bark extract with other medications or medical devices to ensure its safety and efficacy when used concurrently with conventional treatments.

Clinical trials: Conducting well-designed clinical trials to evaluate the efficacy, safety, and optimal dosage of *Lannea coromandelica* bark extract in treating oxidative stress-related diseases and promoting wound healing will be crucial for translating preclinical findings into clinical practice and validating its therapeutic potential.

CONCLUSION

In conclusion, the evidence from this thorough analysis supports *Lannea coromandelica* bark extract's antioxidant and wound-healing properties. The extract's potential goes beyond conventional medicine and calls for more clinical research as a potent and promising natural cure. Ultimately, the further study of *Lannea coromandelica* bark extract may open the door for the creation of innovative phytotherapies, providing secure and efficient therapeutic alternatives for wound care and illnesses associated with oxidative stress.

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Conflict of Interest:

The author reported the conflict of interest while performing this study to be nil

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