Potential of Bali Stingless Bee (Trigona Spp) Propolis for Wound Healing

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Abstract A wound constitutes damage to the skin or underlying tissues caused by trauma. The wound-healing process is dynamic and intricate, involving numerous cellular activities and interactions. Stingless bee propolis contains various bioactive substances with potential wound-healing properties. This study aims to evaluate the wound-healing potential of propolis from Bali stingless bees. Utilizing a descriptive-analytical design, the research analyzed the phytochemical content of Bali Stingless Bee (Trigona laeviceps species) propolis collected from two regions in Bali: Gianyar and Karangasem. Conducted in March 2023, the qualitative analysis revealed that the propolis of both areas contains flavonoids, phenols, tannins, steroids, and triterpenoids. Quantitative analysis showed that the total flavonoid content was 118.60 mg QE/100 g (Gianyar) and 59.24 mg QE/100 g (Karangasem); total tannins were 935.95 mg TAE/100 g (Gianyar) and 1029.79 mg TAE/100 g (Karangasem); total phenols were 1173.03 mg GAE/100 g (Gianyar) and 1423.19 mg GAE/100 g (Karangasem); and IC50 values were 1243.36 ppm (Gianyar) and 402.53 ppm (Karangasem). The findings indicate that Bali Stingless Bee propolis from the Gianyar and Karangasem regions holds significant wound-healing potential. Further research is required to substantiate these findings and explore the mechanisms underlying the wound-healing properties of Bali Stingless Bee propolis.

***Index Terms*— propolis, stingless bee, wound**

I. INTRODUCTION

A wound is defined as cellular, anatomical, and/or functional damage or disruption to living tissue[1]. Wounds form when the skin, mucosal surfaces, or organ tissues are compromised, disrupting their integrity. This can occur due to trauma, including cuts, abrasions, punctures, or surgical procedures. Wounds may arise during the dressing process, occur suddenly due to trauma, or be intentionally inflicted during surgical procedures[2].

Wound healing is a complex, dynamic process that aims to restore the normal function and structural integrity of damaged tissue. It involves a sequence of coordinated biological events designed to repair injuries and rejuvenate affected areas [3]. It involves a complex series of physiological events crucial for maintaining skin integrity following trauma, whether from an accident or surgery. Normal wound healing involves three overlapping phases: hemostasis/inflammation, proliferation, and remodeling. These phases work together to repair and regenerate damaged tissue, starting with stopping bleeding and inflammation, followed by tissue synthesis and finally, tissue refinement for restored function [4,5].

Various factors can influence the healing process, potentially resulting in delayed wound healing, increased patient morbidity and mortality, and suboptimal cosmetic outcomes[2]. A critical transition in the wound healing process is the shift from the inflammatory phase to the proliferative phase [6]. A prolonged inflammatory response with elevated levels of cytokines and inflammatory mediators can lead to a severe condition known as Systemic Inflammatory Response Syndrome (SIRS), which can further develop into Multiple Organ Dysfunction Syndrome (MODS) [7].

The use of natural ingredients for wound healing has been extensively studied within the context of Complementary and Alternative Medicine (CAM).

Propolis, a natural product, is recognized for its wound-healing properties[8]. Propolis is a resinous mixture collected by bees from tree buds, sap, and other plant sources. Its chemical composition varies depending on geographical location, collection time, light exposure, altitude, and food availability in the area of production [9].

Propolis is believed to offer various medicinal benefits, including antiseptic, antibacterial, anti-inflammatory, antioxidant, and immunomodulatory properties. It is generally well-tolerated by the body, rarely causing allergic reactions or toxicity. Additionally, propolis enhances the proliferation and growth capacity of skin cells [10].

II. METHOD

This study is a quantitative research employing a descriptive-analytical design. It analyzes the phytochemical content of Bali Stingless Bee (Trigona laeviceps species) Propolis from two regions in Bali, namely Gianyar and Karangasem. The phytochemical analyses conducted both qualitatively and quantitatively, were performed in the Integrated Mathematics and Natural Sciences (MIPA) laboratory of the Faculty of MIPA at Udayana University in March 2023.

The data collected is primary and analyzed descriptively. The qualitatively tested phytochemical contents of propolis include flavonoids, phenols, tannins, saponins, steroids, triterpenoids, and alkaloids. The quantitatively tested phytochemical contents include flavonoids, tannins, phenols, and IC50 values.

Total flavonoids were determined using quercetin equivalents and expressed as mg quercetin per 100 g of sample (mg QE/100 g). Total tannins were measured using tannic acid standards and expressed in mg tannic acid per 100 g (mg TAE/100 g). Total phenols were determined using the Folin-Ciocalteu method and expressed as mg gallic acid per 100 g (mg GAE/100 g). Antioxidant activity, as indicated by IC50, was determined using 1,1-diphenyl-2-picrylhydrazyl (DPPH) and expressed in ppm.

III. RESULT

The results of this research can be explained as follows:

TABLE 1
QUALITATIVE PROPOLIS PHYTOCHEMICAL TEST RESULTS IN GIANYAR AND KARANGASEM REGIONS

No	Parameter	Hasil
1	Flavonoid	positive
2	Fenol	positive
3	Tanin	positive
4	Saponin	negative
5	Steroid	positive
6	Triterpenoids	positive
7	Alkaloid	negative

TABLE 2
QUANTITATIVE PROPOLIS PHYTOCHEMICAL TEST RESULTS

No	Parameter	Results		Unit
		Gianyar area	Karangasem area	
1	Total Flavonoid	118,60	59,24	mg QE/100 g
2	Total Tanin	935,95	1029,79	mg TAE/100g
3	Total Fenol	1173,03	1423,19	mg GAE/100g
4	IC50	1243,36	402,53	ppm

Table 1 demonstrates that the qualitative phytochemical analysis of Bali Stingless Bee propolis reveals the presence of flavonoids, phenols, tannins, steroids, and triterpenoids. Table 2 presents the quantitative phytochemical results, indicating that the total flavonoid content in propolis from the Gianyar area is higher compared to that from the Karangasem area. Conversely, the total tannin and phenol contents are greater in Karangasem propolis than in Gianyar propolis. Additionally, the IC50 antioxidant activity in Karangasem propolis is lower than in Gianyar propolis.

Flavonoids constitute a significant group of natural compounds, classified as plant secondary metabolites characterized by their polyphenolic structure. They are commonly found in fruits, vegetables, and certain beverages and are recognized for a myriad of health benefits. These include their roles as antioxidants, which help combat oxidative stress, anti-inflammatory agents that mitigate inflammation, antimutagenic agents that protect against genetic mutations, and anticarcinogenic agents that aid in preventing cancer. Moreover, flavonoids are known to modulate critical enzymatic functions within cells, further contributing to their therapeutic potential[11,12].

Propolis, a natural substance, exhibits a comprehensive wound-healing mechanism that involves five primary aspects: antibacterial action to combat microbial infections, anti-inflammatory properties to reduce inflammation, antioxidant capabilities to neutralize free radicals, immune modulation to enhance immune responses, and regulation of mast cells to mitigate allergic reactions. The anti-inflammatory effects of propolis are particularly attributed to its rich content of flavonoids, which include compounds such as carnitine and galangin, along with phenolic substances like caffeic acid, ferulic acid, and caffeic phenethyl ester[13].

Flavonoids mitigate damage caused by free radicals by directly neutralizing them. They achieve stability by reacting with reactive oxygen species (ROS), rendering the radicals inactive due to the high reactivity of the hydroxyl groups in flavonoids[11]. Numerous in vivo studies have demonstrated that propolis enhances wound healing and reduces the local inflammatory response at wound sites[13].

Tannins are polyphenolic compounds characterized by a benzene ring bonded to a hydroxyl group. Tannins from the Basellaceae family function as astringents, causing the constriction of skin pores, cessation of minor bleeding, enhancement of wound contraction, and promotion of wound closure. Moreover, tannins demonstrate antimicrobial and antioxidant attributes, thereby safeguarding the wound site against oxidative stress and preventing the proliferation of harmful bacteria in its vicinity. These properties contribute to their role in promoting healing and maintaining the integrity of the injured area [14].

Phenol, or hydroxybenzene, is a phytochemical compound with a hydroxyl group attached to an aromatic carbocyclic core. Polyphenols from the Basellaceae family act as antioxidants by inhibiting lipid peroxidation, thereby preventing or slowing cellular necrosis and enhancing vascularization at the wound site[14].

The IC50 antioxidant activity of Bali Stingless Bee propolis from both the Gianyar and Karangasem regions is classified as very weak (>200 ppm). The phenolic and flavonoid compounds in propolis act as antioxidants, each with specific mechanisms for neutralizing free radicals[15]. Tissue repair is essential for maintaining the structure and function of the body. Free radicals, which can damage healthy tissue cells, may delay tissue repair processes. Antioxidants are effective in mitigating tissue damage, reducing oxidative stress, and maintaining optimal levels of free radicals[16].

Minor trauma typically impacts the superficial layers of the skin, whereas severe trauma can lead to more extensive damage, including ruptures and fractures affecting deeper structures such as muscles, tendons, and nerves. Given its role as the body's primary barrier against pathogens, the skin becomes susceptible to bacterial invasion following injury, thereby increasing the risk of wound infections. These infections can complicate the healing process and necessitate timely intervention to mitigate further complications [13]. Propolis aids wound healing across all phases, influenced by the duration of the wound's presence. Its immunomodulatory, antimicrobial, antioxidant, analgesic, and anti-inflammatory properties contribute to accelerated wound healing [17].

Biofilm formation poses a significant obstacle to effective wound healing as it interferes with critical phases of the healing process. These microbial communities adhering to wound surfaces can impede timely closure and resolution of wounds, leading to prolonged inflammation and potentially complicating overall healing outcomes. Addressing biofilm presence is crucial for optimizing wound care protocols and ensuring successful recovery. Propolis is regarded as a suitable biomaterial for treating biofilms in wounds[9]. It uniquely promotes the healing of traumatic and surgical wounds by enhancing skin regeneration and stimulating the growth of granulation tissue [13].

IV. CONCLUSION

The research findings indicate that Bali Stingless Bee propolis from the Gianyar and Karangasem regions possesses significant wound-healing potential. Additional staged research is necessary to further substantiate and elucidate the wound-healing properties of Bali Stingless Bee propolis.

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