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Effectiveness Of Hydrogel Of Green Grasshopper Leaf Extract (*Cyclea Barbata*) And Breadfruit Leaf (*Artocarpus Altilis*) Against Burns In Rabbits (Oryctolagus Cuniculus)

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Abstract

This study aimed to evaluate the effectiveness of a hydrogel formulation combining green grasshopper leaf extract (*Cyclea barbata*) and breadfruit leaf extract (*Artocarpus altilis*) in accelerating burn wound healing in rabbits (*Oryctolagus cuniculus*). The study used a completely randomized design with five treatments and five replications. Burn wounds were created on the rabbits' dorsal area and treated with various hydrogel formulations, including a negative control and a positive control using Bioplacenton. The observed parameters included changes in wound diameter, clinical signs of inflammation such as redness, swelling, and exudate, and the duration of healing. The results showed that the combined hydrogel of green grasshopper leaf extract and breadfruit leaf extract accelerated burn wound healing compared with the negative control, with the best result observed in treatment P1, which achieved complete healing on day 11 and produced a response close to that of the positive control. No local adverse effects such as excessive erythema, edema, or purulent exudate were observed in any treatment group. These findings indicate that the hydrogel combination of *Cyclea barbata* and *Artocarpus altilis* extracts has potential as a safe, effective, and economical veterinary herbal preparation for burn treatment in rabbits and other livestock.

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Keywords: green grasshopper leaf extract; breadfruit leaf extract; hydrogel; burns

INTRODUCTION

Burns are a form of tissue injury that can be classified based on the depth of skin damage to degree I (*superficial burns*), degree II (*partial thickness burns*), and degree III (*full thickness burns*). The severity of the burn is determined by the depth of the affected tissue, so the deeper the damage that occurs, the more complex the biological response and healing process required. The healing process of burns takes place through a series of phases that are mutually continuous, namely the phases of hemostasis, inflammation, proliferation, and tissue remodeling, which aim to repair the structure and function of damaged tissues. In higher-degree burns, the healing process generally takes longer, accompanied by a greater risk of complications such as infection, excessive scar tissue formation, and impaired tissue function. This condition makes burns one of the serious health problems if not handled appropriately and adequately. On the other hand, Indonesia has a very high biodiversity, including various medicinal plants that have the potential to be therapeutic agents, but their use and scientific exploration in the treatment of burns is still not optimal (Djamil *et al*., 2026).

Wound healing is a complex biological process that involves stages of hemostasis, inflammation, proliferation, and tissue remodeling to restore damaged skin structure and function. This process can be accelerated through the use of therapeutic agents that are able to stimulate cell proliferation, angiogenesis, and collagen synthesis so that the formation of new tissues takes place more effectively. One of the approaches that is widely developed in wound therapy is the use of biomaterials and bioactive compounds that are able to support tissue regeneration and reduce the risk of infection in the wound area (Li *et al*., 2023).

In animal health practice, the treatment of burns in livestock generally still relies heavily on chemical preparations or synthetic drugs such as antiseptics and topical ointments, whose long-term use has the potential to cause side effects and requires relatively high costs. On the other hand, Indonesia has a rich biodiversity with various medicinal plants that have the potential to be developed as safer, more economical, and easier to obtain alternative burn therapy, especially for farmers in rural areas. The development of topical preparations based on natural ingredients is one of the interesting approaches because it can combine protective, anti-inflammatory, and regenerative effects in one formulation that is practically used in the field (Hakim *et al*., 2010), the plants that can be used are green grasshopper leaves and breadfruit leaves.

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Green grasshopper leaves are known to have bioactive compounds such as flavonoids in this compound containing flavonoids with subgroups or derivatives of flavonoids, namely *Kuersetin* which functions as an anti-inflammatory, and helps regulate blood sugar (Akmalia *et al*., 2025). Meanwhile, breadfruit leaves contain various bioactive compounds that are efficacious, one of which is flavonoids that act as anti-inflammatories. The mechanism of action of flavonoids in the healing process of burns is to inhibit the production of pro-inflammatory mediators such as cytokines and prostaglandins, so that it can speed up the healing process and reduce inflammatory reactions such as swelling. The purpose of this study was to evaluate the effectiveness of hydrogel combination of green grasshopper leaf extract (*Cyclea barbata*) and breadfruit leaves (*Artocarpus altilis*) against the healing of burns in rabbits (*Oryctolagus cuniculus*). The parameters observed included changes in wound diameter, signs of local inflammation in the form of redness, swelling, and exudate, and length of healing. The results of this study are expected to provide a scientific basis for the development of safe, effective, and economical local plant-based veterinary herbal medicine preparations for the treatment of burns.

THEORETICAL INSIGHT

1. Rabbit (Oryctolagus cuniculus)

The Hyla rabbit is one of the superior broiler rabbit strains originating from breeding in France and has since been widely developed in various countries, including Indonesia. This rabbit is known to have rapid growth, large body size, high reproductive ability, and good feed efficiency, so it is often used as a commercial broiler rabbit. In Indonesia, Hyla rabbits are imported and developed to increase the productivity of tropical rabbit livestock (Brahmantiyo *et al*., 2021).

Rabbits are known as one of the animals that have been widely cultivated for various purposes, such as meat producers, pets, or used as experimental animals in research. Rabbit cultivation is an attractive alternative because rabbits have rapid growth, high feed efficiency, and a fast reproductive cycle (gestation period 28-30 days and sexual maturity 4-5 months). These characteristics make rabbits a very productive animal that can**t** profitable in a relatively short time**.** Rabbits also have a cute and adorable appearance so many people are interested in keeping rabbits as pets. However, in addition to the advantages it possesses, the cultivation and maintenance of rabbits is greatly influenced by proper feeding management, given its unique digestive system (Nasihin, 2025).

2. Green Grasshopper Leaf (*Cyclea barbata*)

Cyclea barbata or green grasshopper is a vine that is widely used in Indonesia because its

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leaves can be processed into a thick gel that can be consumed. This plant can grow in a variety of tropical regions and is generally found in humid and shady environments. The growth of green grasshoppers is also influenced by soil conditions, where this plant can thrive both at a pH that tends to be acidic to neutral, and requires enough moisture to support optimal growth. In addition, the propagation of green grasshopper plants can be done generatively through seeds or vegetatively through stem cuttings and root shoots (Nurhidayat, 2023).

Green grasshopper leaf extract (*Cyclea barbata*) is reported to have the potential to accelerate the wound healing process through anti-inflammatory mechanisms, namely by suppressing the migration of neutrophils to the wound area so that it can reduce the inflammatory response excessively. The flavonoid compounds found in green grasshopper leaves play a role in blocking pathways *siklooksigenase* and *lipooksigenase*, thereby lowering the production of inflammatory mediators such as prostaglandins and leukotrienes. In addition, the content of other compounds such as alkaloids, tannins, pectin, and antioxidant compounds also contributes to antimicrobial activity, maintains the moisture of wound tissues, and helps the cell regeneration process. The content of these secondary metabolites makes green grasshopper potentially a natural therapeutic agent in the treatment of burns and healing of skin tissues (Dinda, 2023).

The main content of flavonoid compounds-*Kuersetin* has antioxidant, anti-inflammatory and antibiotic properties believed to be used as an agent in wound healing (Childbirth *et al*., 2014). Flavonoids are a group of polyphenol compounds that are found in many plants and have various important biological activities, especially as natural antioxidants. On *Anredera cordifolia*, flavonoids such as quercetin and kaempferol have been reported as the main bioactive components that play a role in its pharmacological activity. These flavonoid compounds work by neutralizing free radicals so that they can protect cells from oxidative damage that has the potential to worsen inflammatory processes and inhibit wound healing. In addition, flavonoids also have anti-inflammatory activity through inhibiting the production of inflammatory mediators such as prostaglandins and pro-inflammatory cytokines, so they can help reduce the inflammatory response and accelerate the process of tissue regeneration in wounds (Paradise) *et al.,* 2022).

3. Breadfruit Leaf (*Artocarpus altilis*)

Breadfruit leaves (*Artocarpus altilis*) is part of the breadfruit plant that belongs to the Moraceae family and grows widely in tropical regions, including Indonesia. In addition to being used as a food source from the fruit, breadfruit leaves have also been used for a long time in traditional medicine because they contain various bioactive compounds such as flavonoids, tannins, and saponins that have pharmacological activity. These compounds are known to have

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antioxidant and anti-inflammatory effects that play a role in protecting cells from oxidative damage and helping the tissue regeneration process, so it has the potential to support wound healing (Maulida *et al.,* 2024)**.**

Breadfruit leaves (*Artocarpus altilis*) contains a variety of bioactive compounds, especially flavonoids that play an important role in the wound healing process. Flavonoids are known to accelerate the tissue repair process through antioxidant activity that is able to suppress oxidative stress and reduce cell damage in the wound area. In addition, flavonoids also have antibacterial effects that help prevent infections and support the process of tissue regeneration. One of the flavonoid derivatives in breadfruit, namely artonin E, is reported to have biological activity as an antioxidant, antibacterial, and immunomodulator that plays a role in supporting the wound healing process. Molecularly, flavonoids are also involved in a variety of *signaling pathway* which regulates cell proliferation, inflammation, and the formation of new tissues thereby accelerating the process of skin regeneration (Fitrya et al., 2023).

4. Wounds and Healing Mechanisms

Wounds are conditions of damage or discontinuity of body tissues that can involve the epidermal layer to deeper tissues such as the dermis, subcutaneous tissues, muscles, blood vessels, and nerves due to physical, thermal, and chemical trauma. The tissue damage will trigger a complex series of biological processes in the form of hemostasis, inflammation, proliferation, and remodeling phases to repair and restore the function of injured tissues (Cioce et al., 2024).

Burns are damage to skin tissue (epidermis, dermis, or deeper tissues) caused by contact with heat sources such as water, fire, hot oil, chemicals, electricity, radiation, or flammable gases, and can be life-threatening and cause extensive tissue damage that requires complex treatment with long recovery time and great cost. Burns are a form of trauma that is dangerous to life, limbs, and tissues and organs in the body, with symptoms in the form of pain, redness, blistering, peeling, swelling, and looking burnt on the affected skin. The degree of burns is determined based on the depth of tissue damage and is classified into three levels (levels 1, 2, and 3), where the severity of burns in children is higher due to the accompanying morbidity and mortality factors (Akbar & Agustina, 2023).

MATERIALS AND METHODS

1. Research Location

The research location was carried out at the Integrated Service Unit (UPT) of the Integrated Laboratory of Nusa Cendana University, Kupang City, East Nusa Tenggara

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2. Research Materials

The tools used in this study include ovens, scales, blenders, sieves, erlenmeyer 1000 ml, 500 ml and 250 ml, filter paper, glass funnel, water filter, round pumpkin erlenmeyer, rotary evaporator, measuring cups 500 ml and 250 ml, mixing rods, spatulas, digital thermometers, round metal plates, bunsen, hair shavers, rabbit care cages, medical gloves and masks.

The materials used in this study included green grasshopper leaves (DCH), breadfruit leaves (DS), healthy rabbits weighing 1–1.2 kg, 25 male rabbits, HPMC polymer, 70% ethanol, glycerin, distilled water, aluminum foil, and plaster.

3. Research Methods

The study was conducted experimentally with a Complete Random Design, consisting of 5 treatments with 5 repetitions, namely P0 = no treatment, P1 = 30%DS : 20%DCH, P2 = 35%DS : 20%DCH, P3 = 40%DS : 10%DCH, P+ = Bioplacenton. Furthermore, wound healing parameters were observed based on wound diameter, signs of local inflammation in the form of redness, swelling, and exudate, and duration of healing. Observations were carried out for 15 days.

4. Data Analysis

Data were analyzed using ANOVA One-Way analysis to see changes in wound healing over time in the same group and compare these changes between treatment groups. All data was analyzed with IBM SPSS 25.0 Statistical Software and PUSH Tool 3.0.

RESULTS AND DISCUSSION

The administration of hydrogel in combination of green grasshopper leaf extract and breadfruit leaf had an effect on the dynamics of the reduction in burn diameter in rabbits during the observation period. In general, the entire treatment group showed a decrease in wound diameter from day to day, but the rate of wound reduction in the group that received the combination hydrogel was faster than that of the negative control. The P1 treatment showed the fastest and most consistent decrease in wound diameter, resulting in perfect wound closure on day 11, while the negative control group took longer to achieve a similar condition. The results of statistical analysis showed that the difference in wound diameter decrease and healing time between the combination hydrogel group and the negative control was real ($p < 0.05$), while the P1 response was close to the positive control of Bioplacenton.

The effect is strongly thought to come from the content of flavonoids, tannins, saponins, and phenolic compounds that work synergistically in reducing inflammation, inhibiting bacterial growth, increasing collagen formation, and accelerating the regeneration of skin tissue damaged

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by burns. Breadfruit leaves are known to contain flavonoids with derivative compounds *Artonin E*, saponins, tannins, and polyphenols that play a role in the wound healing process, while green grasshopper leaves contain flavonoids with compound derivatives *Quartetin*, saponins, tannins, and antioxidant compounds that are able to ward off free radicals and support tissue regeneration (Sari PR, et al., 2021).

Signs of inflammation are observed through the parameters of redness, swelling, and the presence of fluid (exudate). The results showed that P1 treatment showed the best effectiveness compared to P2 and P3 treatments in accelerating burn healing. This can be seen from all observation parameters, namely redness, swelling, and burn fluid discharge. In the redness parameter, the P1 group had achieved a score of 0.00 on day 9, the same as positive control and faster than P2 and P3 who had just recovered on days 11 and 13. On the swelling parameters, P1 also showed a faster decrease with complete recovery on day 9, while P2 and P3 took up to days 11 and 12. The same results were seen in the wound fluid parameters, where P1 reached a dry state on day 9, faster than P2 and P3.

The P1 prominence shows that the formulation of green grasshopper leaf extract (*Cyclea barbata*) and breadfruit leaves (*Artocarpus altilis*) in this treatment provides the most optimal conditions in supporting the burn healing process. Flavonoid content (*Artonin E* and *Quartetin*), saponins, tannins, and phenolic compounds in both plants play a role in suppressing the inflammatory response, reducing swelling, inhibiting the growth of microorganisms, and accelerating tissue regeneration (Badriyah, 2023). Burn healing in rabbits treated with hydrogel from a combination of green grasshopper leaves and breadfruit leaves showed positive progress, with P1 showing better outcomes of all treatments and close to positive control (Bioplacenton).



Figure 1. Time healing burn wound

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The results of this study show that P1 treatment accelerates wound healing compared to P2 and P3. Therefore, P1 treatment can be said to be the most effective formulation among the extract treatment group in accelerating burn healing. From this study, it is known that the higher the concentration of breadfruit leaves does not cause faster wound healing because the flavonoid content (*Artonin E*) is cytotoxic by inhibiting the proliferation of fibroblasts. Fibroblasts are needed in the proliferation phase to produce collagen. The high *Artonin E* in breadfruit is also strongly astringent which inhibits epithelial migration (Arief *et al.,* 2019).

In contrast to green grasshopper extract, it shows the opposite finding. That the higher the concentration of green grasshopper leaf extract, the faster the burn heals. This is because flavonoid compounds (*Quartettin*) are hydrogels that are able to keep wounds moist, in addition to high concentrations of green grasshopper leaf extract are able to produce the most significant number of fibroblasts and collagen fiber density for wound healing (Sari *et al.,* 2021).

The hydrogel preparation used in this study also contributes to supporting the healing process of burns, because it is able to maintain the moisture of the wound surface, provide a soothing cold sensation, and function as a physical barrier to irritants from the outside environment. Moist but protected wound conditions are reported to be more favorable for epithelial cell migration, granulation tissue formation, and collagen deposition than dry wound surfaces.

The use of a combination of green grasshopper leaf extract and breadfruit leaf in livestock and animal health has the potential to be an alternative to treating burns in livestock that is relatively easy to apply, utilizes local resources, and is more cost-effective than imported synthetic preparations.

CONCLUSIONS AND RECOMMENDATIONS

Hydrogel combination of green grasshopper leaf extract and breadfruit leaf in treatment 1 with a composition of 30%DS: 20%DCH was proven to be effective in accelerating the healing of burns in rabbits based on the parameters of reducing wound diameter, reducing local inflammatory signs, and shorter healing time compared to negative control without causing significant local side effects, so that it has the potential to be developed as a safe alternative to veterinary herbal medicine, effective, and economical for the treatment of burns in livestock.

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