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# Evaluation of the Effectiveness of Banggai Yam (*Dioscorea alata* L.) Extract Cream for Healing Diabetic Wounds

**Anggun Eka Pringgadani[1], Nurhikma Awaluddin[2*], Ghina Ramadhani[3], Eka Sari Ridwan[4]**
[1-4] *Bachelor of Pharmacy study program , Faculty of Pharmacy, Megarezky University , Makassar, Indonesia*
**Corresponding author: hykma.awaluddin@unimerz.ac.id*

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**ABSTRACT**

Diabetic wounds are a common complication of diabetes mellitus, typically characterized by impaired or delayed healing. Banggai yam (*Dioscorea alata* L.*)* contains bioactive compounds such as flavonoids, saponins, tannins, and phenolics, which possess potential wound-healing properties. This study aimed to evaluate the effectiveness of Banggai yam extract cream on diabetic wound healing in rats. Banggai yam extract was formulated into cream preparations at concentrations of 5%, 10%, and 15% (w/w). Fifteen adult male Wistar rats (Rattus norvegicus) were randomly divided into five groups: a negative control, a positive control, and three treatment groups. Wounds with a diameter of 1 cm were created on the dorsal area and treated twice daily for 12 days. Wound length was measured using a digital caliper and analyzed using One-Way ANOVA. The 15% concentration cream demonstrated the most significant wound-healing activity, achieving a wound closure percentage of 90.00 ± 8.72% by day 12. Statistical analysis showed significant differences among groups ($p < 0.05$).

## INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia, resulting from either insufficient insulin production or reduced insulin sensitivity. Persistent hyperglycemia can lead to various complications, including diabetic ulcers that are challenging to heal due to impaired tissue repair. Data from the International Diabetes Federation (IDF) indicates a continual rise in diabetes cases globally, with Indonesia ranking fifth in the highest number of sufferers (Azizah et al., 2022)

One of the serious complications of diabetes mellitus is diabetic ulcers, which can lead to severe infections and even amputation. Data shows that more than one million people with diabetes experience amputations each year. Therefore, developing alternative therapies based on natural ingredients to accelerate wound healing is crucial (Dharmayanti et al., 2024) .

Wounds are divided into three stages based on their depth and extent: superficial wounds, which occur in the epidermis. Partial-thickness wounds involve partial skin loss without exposure of muscle tissue. Full-thickness wounds, which involve complete skin loss but allow muscle recognition (Awaluddin et al., 2020) .

Diabetic wounds occur due to infections caused by hyperglycemia, which trigger bacterial overgrowth. Furthermore, a weakened immune system results in a prolonged inflammatory phase in wounds. Improper treatment of diabetic wounds (ulcers) can also worsen the wound condition, increasing the risk of further complications (Primadani & Safitri, 2021) .

Indonesia is home to abundant biodiversity, including the Banggai yam (*Dioscorea alata* L.), a native tuber from Central Sulawesi that contains high levels of flavonoids, phenols, and saponins.

These bioactive compounds exhibit antioxidant, anti-inflammatory, and antidiabetic properties, which synergistically promote wound healing. This study aimed to assess the effectiveness of a cream containing Banggai yam extract in accelerating diabetic wound healing in male white rats and to determine the optimal concentration for maximum therapeutic effect.

Banggai yam is known to contain high levels of natural antioxidants from this group of compounds. Natural antioxidant compounds in plants usually consist of the phenolic group, including flavonoids and polyphenols, derivatives of polyfunctional organic acids, which are relatively polar and function as active antioxidants. The antioxidant function of flavonoids includes free radical scavenging (Magfirah et al., 2021) . The extract of *Dioscorea alata* L. demonstrates anti-inflammatory properties by reducing the expression of pro-inflammatory cytokines such as TNF-α and IFN-γ in vitro (Makiyah et al., 2022) .

The application of herbal plants in traditional medicine has been recognized and embraced for a long time across both developed and developing nations. Over the past twenty years, there has been a marked rise in global interest toward traditional medicinal practices. The World Health Organization (WHO) reports that about 65% of people in developed countries rely on traditional therapies and natural remedies. The growing popularity of the " *back to nature" concept* has also driven the increased use of traditional medicines that contribute to health, while also encouraging more research and scientific studies in this field (Rahmasiah et al., 2024) .

This study aimed to assess the effectiveness of a cream containing Banggai yam extract in accelerating the healing of diabetic wounds in male white rats and to determine the optimal concentration for maximum therapeutic effect. By leveraging the potential of Banggai yam, it is hoped that a safe and effective topical preparation can be developed to support diabetic wound therapy.

## METHOD

### Tools and Ingredients

The tools and ingredients used in this study include laboratory equipment such as glucometers, glucose test strips, calipers, rotary evaporators, analytical scales, maceration vessels, hotplates, ovens, porcelain dishes, test tubes, and surgical instruments. The ingredients used include Banggai yam extract *(Dioscorea alata L.)* , male white rats *(Rattus norvegicus)* as test animals, alloxan monohydrate, 96% ethanol, glycerin, stearic acid, cetyl alcohol, triethanolamine, methyl paraben, and additional materials such as hair removal cream and alcohol swabs.

### Determination

The identification of Banggai yam *(Dioscorea alata L.)* was conducted at the Batu Herbal Medica UPT Laboratory to verify the authenticity of the plant species.

### Extraction Process

The extraction of Banggai yam *(Dioscorea alata L.)* was carried out using the reflux technique with 96% ethanol as the solvent and a 500-gram sample. The mixture underwent reflux for two hours at a temperature range of 78–90°C. Once cooled, the solution was filtered through a sieve to maximize the filtrate yield. The collected filtrate was then concentrated using a rotary evaporator to produce a thick extract of Banggai yam *(Dioscorea alata L.).*

### Phytochemical Screening

#### Flavonoid

Dissolve 100 mg of the extract in ethanol, filter, add concentrated HCl and magnesium powder, and heat. A positive reaction is indicated by a red-orange to red color.

#### Saponin

A total of 200 mg of the extract was boiled in distilled water, then filtered and shaken vigorously. The formation of foam indicated a positive result.

#### Tannin

A total of 200 mg of the extract was dissolved in distilled water, filtered, and 0.1% $FeCl_3$ was added. A brownish-green or blackish-blue color indicates a positive result.

#### Phenolic

A total of 500 mg of extract was mixed with 96% ethanol and 1% $FeCl_3$. A positive reaction is indicated by a color change to green, blue, or red.

## Cream Preparation Formulation

Banggai yam extract cream is made in concentrations of 5%, 10%, and 15%. The cream base contains stearic acid, cetyl alcohol, TEA, glycerin, methyl paraben, and distilled water. The cream base was prepared following the formulation detailed in Table 1. All necessary ingredients were carefully measured and separated into two phases: the oil phase and the water phase. The oil phase, which included stearic acid and cetyl alcohol, was prepared accordingly, was placed in a porcelain cup, covered with a watch glass, and heated to 70°C. Meanwhile, the water phase, containing glycerin, triethanolamine, methyl paraben, and distilled water, was heated in a beaker at the same temperature. The heated oil phase was then poured into a sterile warm mortar, combined with the water phase, and ground continuously until the mixture cooled and formed a uniform cream base.

**Table 1. Formulation of Banggai Uwi Extract Cream *(Dioscorea alata L.).***

| Material | Function | Concentration (%) (w/w) | | | | |
|---|---|---|---|---|---|---|
| | | F1 | F2 | F3 | - | + |
| Banggai yam extract | Active Ingredients | 5 | 10 | 15 | 0 | Epithelial Cream |
| Stearic acid | Emulsifier | 6 | 6 | 6 | 6 | |
| Cetyl alcohol | Thickener | 2 | 2 | 2 | 2 | |
| Triethanolamine | pH regulator | 2 | 2 | 2 | 2 | |
| Glycerin | Moisturizer | 5 | 5 | 5 | 5 | |
| Methyl paraben | Preservative | 0.2 | 0.2 | 0.2 | 0.2 | |
| Aquadest ad | Solvent | 100 | 100 | 100 | 100 | |

**Table 2. Yield of Banggai Uwi Extract *(Dioscorea alata L.)***

| Extraction Method | Types of Solvents | Amount of Solvent | Uwi Banggai weight (*Dioscorea alata* L.) | Weight of thick extract (grams) | Yield % Value |
|---|---|---|---|---|---|
| Reflux | Ethanol 96% | 5 | 500 | 50 | 10% |

## Evaluation of Cream Preparations

### Organoleptic Test

This is done by using the five senses to see the color of the extract, smell the smell, taste and consistency of the extract made.

### Homogeneity Test

The test is performed visually by applying the cream to a watch glass and observing it. If the color is even and there are no grains in the cream preparation, it is considered homogeneous.

### pH Value Test

It is an important parameter because a stable pH value of the cream indicates that the distribution process of the ingredients in the preparation is even.

### Viscosity Test

Viscosity testing is performed to measure the thickness of a preparation. Viscosity is the property of a material's resistance to flow. The physical instrument commonly used to measure viscosity is a viscometer. Cream is placed into the viscometer at 30 rpm and the results are observed. A good viscosity value for a cream preparation is 2,000–50,000 cps.

### Spread Power Test

A spreadability test is performed to ensure even distribution of the cream when applied to the skin. The greater the spreadability of a cream, the more effective the contact between the active ingredients and the skin's absorptive cells. An ideal cream formulation typically exhibits a spreadability range of 5 to 7 cm.

### Adhesion Test

The adhesion test is conducted to evaluate the duration the cream remains attached to the skin upon application. This property is crucial for ensuring that the cream maintains contact with the wound area long enough to deliver its therapeutic effects effectively. A good adhesion test for cream is between 2–300 seconds.

### Physical Stability Test

The physical stability test of the preparation was conducted using a cycling test. The sample was stored at 4°C for 24 hours and then at 40°C in an oven for 24 hours (1 cycle). The test was conducted in 3 cycles and physical changes were observed, including homogeneity, pH, spreadability, adhesion, and viscosity.

**Table 3. Screening Results Phytochemicals Extract Uwi Banggai *(Dioscorea alata L.)***

| Compound examination | Solvent Reagent | Observation result | | |
|---|---|---|---|---|
| | | Observation | Color | Note |
| Flavonoid | Concentrated HCl, magnesium powder | A red solution is formed | Red | + |
| Saponin | Aquadest | Formation of foam | Yellow orange | + |
| Tannin | Aquadest, $FeCl_3$ 0.1% | Formation of a brownish green solution | Brownish green | + |
| Phenolic | Ethanol 96%, $FeCl_3$ 1% | Formation of a dark blue solution | Blue | + |

**Table 4. Test Results Organoleptic**

| Formula | Before the Cycling Test | | | After the Cycling Test | | |
|---|---|---|---|---|---|---|
| | Texture | Color | Smell | Texture | Color | Smell |
| K(-) | Semi-Solid | White | Odorless | Semi-Solid | White | Odorless |
| F1 | Semi-Solid | Cream | The distinctive smell of Banggai Uwi extract | Semi-Solid | Cream | The distinctive smell of Banggai Uwi extract |
| F2 | Semi-Solid | Light brown | The distinctive smell of Banggai Uwi extract | Semi-Solid | Light brown | The distinctive smell of Banggai Uwi extract |
| F3 | Semi-Solid | Light brown | The distinctive smell of Banggai Uwi extract | Semi-Solid | Light brown | The distinctive smell of Banggai Uwi extract |

### Experimental Animal Treatment

A total of 15 adult male white rats (*Rattus norvegicus*), aged 2–3 months and weighing 180–250 g, were randomly assigned into five groups, with each group comprising three rats. The rats were maintained in clean, dry cages with good ventilation and were provided with standard feed and water ad libitum. The room temperature was maintained at approximately 22–25°C, with a 12-hour light and 12-hour dark cycle. Group I functioned as the negative control, Group II as the positive control (treated with epithelial cream), while Groups III, IV, and V received topical applications of Banggai yam (*Dioscorea alata* L.) extract cream at concentrations of 5%, 10%, and 15%, respectively. Incisional wounds were created on each rat, and the respective treatments were applied topically twice daily for a duration of 12 days.

### Alloxan Induction

Fifteen male white rats (Rattus norvegicus) were divided into five groups: control, formula 0 (cream base), F1 (5%), F2 (10%), and F3 (15%). Before induction, the rats were fasted for 12–16 hours, then induced with alloxan 150 mg/kgBW intraperitoneally . After three days, the fasting blood glucose levels of the rats were measured using a hemoglucometer. Rats with blood glucose levels equal to or greater than 200 mg/dL were classified as diabetic and selected for use in the experimental study (Wahyuni et al., 2024; Wijianto et al., 2024).

### Wound Making

Wounds were created after the rats had developed hyperglycemia. The wound-making procedure began with removing the fur on the upper dorsal area using hair removal cream. The rats were then anesthetized using inhalation ether anesthesia by dripping 2 mL of ether onto cotton placed inside an anesthesia chamber until the rats lost consciousness (Awaluddin et al., 2020a). After anesthesia was achieved, a wound with a diameter of 1 cm was created on the shaved dorsal area using a sterile surgical scalpel.

## Administration of Banggai Yam Extract Cream Preparation *(Dioscorea alata L.)*

Each group of test animals that had been injured was immediately treated according to their respective groups. The cream was applied thinly and evenly at a dose of 0.5 g to the wound area twice daily. The wounds, measuring 1 cm in diameter, were created on the dorsal area of the rats and were subsequently covered with sterile gauze and plaster to prevent contamination.

## Observation of Wound Closure Percentage

Observations were made by measuring the wound length on days 1, 3, 6, 9, and 12 in each group. Wound measurements were performed using a digital caliper. To minimize observational bias, all measurements were conducted objectively using the same measuring instrument for all groups throughout the study. The percentage of wound closure was calculated using the formula:

$$PL\ (\%) = \frac{P0-Pn}{P0} x\ 100\%$$

Information :
PL (% : percentage of wound closure
P0 : initial wound length (cm)
Pn : length of wound on the day of observation
(Putri et al., 2022) .

## RESULTS AND DISCUSSION

Banggai yam extract is obtained through reflux extraction. This Banggai yam plant has antimicrobial properties that facilitate wound healing and prevent infection (Sundkar et al., 2024) . Furthermore, Banggai yam offers other benefits, such as being a powerful free radical scavenger, protecting against cardiovascular disease, and reducing the risk of osteoporosis. Banggai yam also contains compounds such as flavonoids, saponins, tannins, and phenolics.

Flavonoids contained in Banggai yam extract act as anti-inflammatory agents by inhibiting inflammatory mediators such as TNF-α, IL-1β, and prostaglandins. Flavonoids also suppress cyclooxygenase (COX) activity, thereby reducing inflammation and accelerating diabetic wound healing.

In addition, saponins contribute to wound healing by stimulating fibroblast proliferation, collagen synthesis, and angiogenesis during the proliferative phase. This mechanism accelerates granulation tissue formation and wound closure.

Phenolic compounds possess antioxidant activity by scavenging free radicals and reducing oxidative stress. Under diabetic conditions, oxidative stress can delay tissue repair; therefore, phenolic compounds help protect cells from oxidative damage and support tissue regeneration (Kaur et al., 2021).

Based on Table 2. The results of the thick extract of Banggai yam *(Dioscorea alata L.)* after evaporation using a rotary evaporator obtained 50 grams of thick extract. The yield calculation results were 10%. This result meets the requirements of the Indonesian Herbal Pharmacopoeia, namely a yield of not less than 7.2% (Djoko et al., 2020) .

Based on Table 3, the results of phytochemical tests on Banggai yam extract indicate the presence of flavonoids, saponins, tannins, and phenolics. The presence of these compounds is indicated by a red color change for flavonoids, a brownish-green color for tannins, and the formation of a foamy precipitate as a result of a positive reaction with certain reagents (Rizqon et al., 2023). A dark blue color change for phenolics (Widiawati & Lailatul Qodri, 2023).

## Evaluation of Physical Properties of Cream

### Organoleptic Test

Based on Table 4. Results of organoleptic Observations indicated that all cream formulations possessed a semi-solid texture, were non-sticky upon application, and remained stable after the cycling test. All preparations showed homogeneous results with no granules present. The colored negative control formula (K-) is a cream without odor, but formulations F1 (5%), F2 (10%), and F3 (15%) exhibit a youthful chocolate hue and a characteristic perfume of yam extract.

### Homogeneity

Based on Table 5. It shows that all F1, F2, and F3 cream preparations showed homogeneous results with no granules in the cream preparation, whereas if the cream preparation was not homogeneous, it was said that the cream preparation was not good. A homogeneous preparation is characterized by all

particles being evenly dispersed and there being no clumping when observed (Artanti & Azzahra, 2022) .

**Table 5. Test Results Homogeneity**

| Formula | Before the cycling test | After the cycling test |
|---|---|---|
| K(-) | Homogeneous | Homogeneous |
| F1 | Homogeneous | Homogeneous |
| F2 | Homogeneous | Homogeneous |
| F3 | Homogeneous | Homogeneous |

## pH test

Based on table 6. Shows the results of the pH of all preparations before and after the cycling test remained within the safe range (4.5–8), ensuring they do not cause skin irritation. Although there was a decline in viscosity after the cycling test, the values remained within the standard range of 2,000–50,000 cPs. This decline is likely caused by a reduction in the binding capacity of the thickener due to high-temperature exposure and prolonged storage. The decrease in pH in some formulas is thought to be due to degradation of compounds in the cream base, while the increase in F3 may be caused by an oxidation reaction (Zam Zam & Musdalifah, 2022) .

**Table 6. pH Test Results**

| Formula | pH Value Test | |
|---|---|---|
| | Before the cycling test | After the cycling test |
| K(-) | 7.23 | 6.62 |
| F1 | 6.95 | 6.27 |
| F2 | 6.49 | 6.54 |
| F3 | 6.62 | 6.64 |

## Viscosity

Based on table 7. Shows the results of the value viscosity beginning in range standard (2,000–50,000 cPs), namely K(–) with value 9,060 cPs , F1 with value of 6,890 cPs , F2 with value of 7,819 cPs , and F3 with value of 8,320 cPs . After cycling test , occurred decline viscosity : K( –) becomes 2,220 cPs , F1 becomes 3,700 cPs , F2 becomes 4,520 cPs , and F3 becomes 2,279 cPs. Decline This allegedly caused by a decrease material binding capacity thickener consequence exposure temperature height and long storage time , which causes consistency stock become more liquid.

**Table 7. Test Results Viscosity**

| Formula | Before the Cycling Test | After the Cycling Test |
|---|---|---|
| K(-) | 9060 | 2220 |
| F1 | 6890 | 3700 |
| F2 | 7819 | 4520 |
| F3 | 8320 | 2279 |

## Spread Power Test

Based on table 8. Shows the power spread beginning in range 5.9–6.0 cm, and decreasing to 5.4–5.5 cm after *cycling test* . An average decrease of 0.5 cm occurred in a way consistent across all formulas, including K( –), F1, F2, and F3. Decline Power spread caused by changes temperature during storage that affects viscosity cream (Lumentut et al., 2020) .

Based on Table 9. Shows the power good adhesion and still is at in the appropriate range , namely 2–300 seconds . Before *cycling test* , power sticky K( –) is 6.97 seconds, F 1 6.95 seconds , F2 2.47 seconds , F3 2.70 seconds . After *cycling test* , occurred A little decrease in K( –) to 4.09 seconds , F1 2.47 seconds , F2 2.63 seconds , and F3 2.49 seconds .Decline Power sticky caused by changes structure stock consequence influence temperature and time storage (Tari & Indriani, 2023).

**Table 8. Results of Spreadability Test**

| Formula | Before the Cycling Test | After the Cycling Test |
|---|---|---|
| K(-) | 6.0 cm | 5.5 cm |
| F1 | 5.9 cm | 5.4 cm |
| F2 | 6.0 cm | 5.5 cm |
| F3 | 5.9 cm | 5.4 cm |

**Table 9. Adhesion Test Results**

| Formula | Before the Cycling Test | After the Cycling Test |
|---|---|---|
| K(-) | 06.97 seconds | 04.09 seconds |
| F1 | 06.95 seconds | 02.47 seconds |
| F2 | 02.47 seconds | 02.63 seconds |
| F3 | 02.70 seconds | 02.49 seconds |

## Observation of Blood Glucose Levels in Test Animals

Based on Table 10, all experimental animals showed hyperglycemic conditions after alloxan induction, with blood glucose levels exceeding 200 mg/dL. The blood glucose levels are presented as Mean ± SD to improve statistical clarity and scientific readability. The results

**Table 10 Blood Glucose Levels of Test Animals (Mean ± SD)**

| Group | GDP (mg/dL) | Blood Glucose Levels of Test Animals | | | | |
|---|---|---|---|---|---|---|
| | | Day 1 | Day 3 | Day 5 | Day 16 | Day 20 |
| K(-) | 93.33 ± 14.01 | 126.33 ± 13.65 | 287.00 ± 19.55 | 415.00 ± 0.00 | 426.33 ± 78.82 | 382.00 ± 53.91 |
| F1 | 105.67 ± 6.43 | 93.00 ± 20.98 | 319.00 ± 89.45 | 312.00 ± 57.28 | 448.33 ± 64.16 | 483.33 ± 93.09 |
| F2 | 86.67 ± 10.50 | 111.33 ± 14.01 | 305.00 ± 0.00 | 421.50 ± 28.99 | 547.67 ± 53.88 | 540.00 ± 0.00 |
| F3 | 111.00 ± 11.27 | 138.00 ± 13.11 | 331.00 ± 83.44 | 358.00 ± 79.20 | 498.00 ± 33.24 | 525.50 ± 76.37 |
| K(+) | 105.00 ± 9.54 | 121.33 ± 12.42 | 352.00 ± 42.43 | 362.50 ± 16.26 | 462.33 ± 93.34 | 535.00 ± 0.00 |

**Table 11. Average Wound Length in Diabetics Rats (Mean ± SD)**

| Group | (Mean ± SD) | Wound Length in Diabetic Rats | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 3 | 6 | 9 | 12 |
| K(-) | Mean ± SD | 1.0±0.00 | 1.0±0.00 | 0.82±0.04 | 0.65±0.04 | 0.57±0.08 |
| F1 | Mean ± SD | 1.0±0.00 | 0.83±0.06 | 0.76±0.06 | 0.46±0.09 | 0.38±0.09 |
| F2 | Mean ± SD | 1.0±0.00 | 0.84 ± 0.04 | 0.77±0.06 | 0.68±0.02 | 0.21±0.02 |
| F3 | Mean ± SD | 1.0±0.00 | 0.71 ± 0.06 | 0.58±0.08 | 0.49±0.06 | 0.10±0.00 |
| K(+) | Mean ± SD | 1.0±0.00 | 0.72 ± 0.05 | 0.53±0.09 | 0.26±0.25 | 0.00±0.00 |

($H_0$) ($H_1$)

**Figure 1.** Observation of Rat Wounds Treated with 15% Banggai Yam (*Dioscorea alata* L.) Extract Concentration

confirmed that the diabetic animal model was successfully established and suitable for wound healing evaluation. This condition indicates that the diabetic animal model has been successfully established for wound healing studies.

Based on Table 11, the results of wound length observations were recorded on days 1, 3, 6, 9, and 12. In general, all groups showed a decrease in wound length over time. Based on the results presented as mean ± SD, all treatment groups demonstrated a progressive reduction in wound length during the observation period. The F3 group showed the greatest reduction in wound length compared to the other treatment groups. On day 12, the F3 group exhibited a remaining wound length of 0.10 ± 0.09 cm, which was comparable to the positive control group. Statistical analysis using One-Way ANOVA showed significant differences between groups ($p < 0.05$).

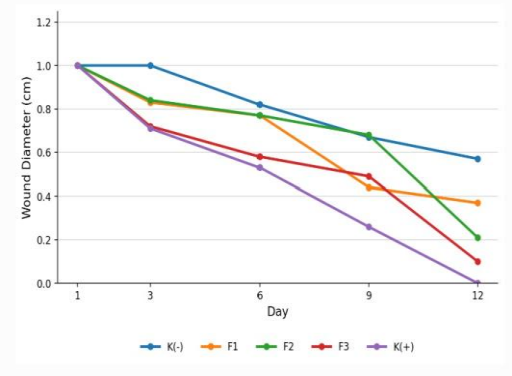


**Figure 2. Graph of Decreased Wound Diameter in Diabetic Rats**

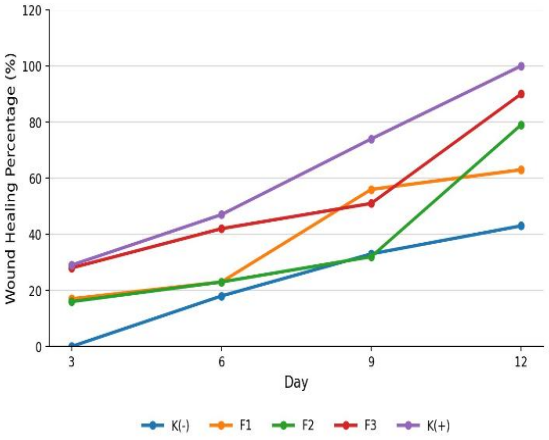


**Figure 3. Graph of Percentage of wound Healing in Diabetic Rats**

**Table 12. Percentage of Wound Healing in Diabetic Rats (Mean ± SD)**

| Group | Day 3 | Day 6 | Day 9 | Day 12 |
|---|---|---|---|---|
| K(-) | 0±0.00% | 17.67±3.51% | 34.67±4.04% | 43.33±7.51% |
| F1 | 16.67±5.77% | 24.00±5.29% | 54.00±8.89% | 61.67±8.50% |
| F2 | 15.67±4.04% | 23.33±5.77% | 32.33±2.08% | 79.00±2.00% |
| F3 | 28.67±6.11% | 41.67±7.64 | 51.00±6.24% | 90.00±8.72% |
| K(+) | 27.67±4.51 | 46.67±9.29 | 74.00±25.30% | 100 ± 0.00% |

The most significant decrease was observed in F2 and F3 compared to F1, indicating the effectiveness of Banggai yam extract in accelerating wound healing. The wound healing mechanism involves several complex phases, namely hemostasis, inflammation, proliferation, and maturation. The hemostatic phase occurs immediately after wound formation in the rats. Furthermore, the inflammatory phase is an important stage in the wound healing process and normally occurs from day 0 to day 3, during which inflammatory responses help initiate tissue repair (Sadsyam et al., 2025).

Based on Table 12, the percentage of wound closure was calculated based on the reduction in the initial and final wound length. The percentage of wound healing increased progressively in all groups during the observation period. On day 12, the F3 group showed the highest percentage of wound closure among the treatment groups, reaching 90.00 ± 8.72%, while the positive control group achieved complete wound closure (100%). Statistical analysis indicated significant differences among groups ($p < 0.05$), particularly between the F3 group and the negative control group (Lestari et al., 2025).

In general, the F3 group showed the highest percentage of wound closure, followed by F2 and F1. Statistical tests also demonstrated significant differences between groups, especially between the F2 and F3 groups compared to the K(-) and F1 groups, confirming the potential of Banggai yam extract in accelerating the healing process of diabetic wounds.

## CONCLUSION

This study demonstrates that Banggai yam (*Dioscorea alata* L.) extract cream maintains stable physical characteristics and meets the quality standards for topical preparations. The cream formulation containing a 15% concentration was found to be the most effective in accelerating diabetic wound healing. These findings support the potential of Banggai yam extract as a topical wound-healing agent for diabetic patients.

## STUDY LIMITATION

This study has several limitations, including a small sample size, a short observation period, and the absence of histopathological examination to further evaluate tissu regeneration and wound healing mechanisms. In addition, total phenolic content analysis and standardization of bioactive compounds in Banggai yam extract were not performed, which may affect the consistency and characterization of the extract used in this study

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## AUTHOR CONTRIBUTION

All authors contributed equally to this research.

## CONFLICT OF INTEREST

There is no conflict of interest in conducting this research.

## ETHICAL CONSIDERATIONS

This research has been approved by the Makassar Health Polytechnic Research Ethics Committee with number 1044/M/KEPK-PTKMS/V/2025. al procedures complied with ARRIVE guidelines and humane animal treatment principles. The experimental animals were handled carefully to minimize pain and stress throughout the study period.

## BIBLIOGRAPHY

Artanti, E. D., & Azzahra, F. (2022). Formulasi Dan Uji Sifat Fisikokimia Sediaan Krim Ekstrak Daun Katuk (Sauropus Androgynous (L.) Merr.) Dengan Variasi Konsentrasi Asam Stearat. *Pharmaceutical Journal of UNAJA*, *1*(2), 61–69.

Awaluddin, N., Farid, N., & Bachri, N. (2020a). Uji Efektivitas Gel Ekstrak Etanol Daun Binahong (Anredera cordifolia) sebagai Penyembuhan Luka Insisi pada Tikus Wistar Jantan. *Jurnal Kesehatan*, *13*(2), 158. https://doi.org/10.24252/kesehatan.v13i2.16435

Awaluddin, N., Farid, N., & Bachri, N. (2020b). Uji Efektivitas Gel Ekstrak Etanol Daun BINAHONG (Anredera cordifolia) Sebagai Penyembuhan Luka Insisi Pada Tikus Wistar Jantan. *Jurnal Kesehatan*, *13*(2), 158. https://doi.org/10.24252/kesehatan.v13i2.16435

Azizah, U. N., Wurjanto, M. A., Kusariana, N., & Susanto, H. S. (2022). Hubungan Kualitas Tidur dengan Kontrol Glikemik pada Penderita Diabetes Melitus : Systematic Review. *Jurnal Epidemiologi Kesehatan Komunitas*, *7*(1), 411–422. https://doi.org/10.14710/jekk.v7i1.13310

Dharmayanti, N. P. D., Darmini, A. A. A. Y., & Dharmapatni, N. W. K. (2024). Tingkat Pengetahuan Penderita Diabetes Melitus Tentang Pencegahan Ulkus Diabetik Melalui Penyuluhan. *Jurnal Abdimas ITEKES Bali*, *3*(2), 70–74. https://doi.org/10.37294/jai.v3i2.511

Djoko, W., Taurhesia, S., Djamil, R., & Simanjuntak, P. dkk. (2020). Standardisasi Ekstrak Etanol Herba Pegagan (Centella asiatica). *Sainstech Farma*, *13*(2), 118–123.

Kaur, B., Khatun, S., & Suttee, A. (2021). Current Highlights on Biochemical and Pharmacological Profile of Dioscorea Alata : a Review. *Plant Archives*, *21*(Suppliment-1), 552–559. https://doi.org/10.51470/plantarchives.2021.v21.s1.085

Lestari, N. W., Wijianto, D. W., & Wahyuni, A. S. (2025). Potential For Diabetic Wound Healing With Hydrogel Patch Of Neem Leaf Extract (Azadirachta indica). *International Journal of Applied Pharmaceutics*, *17*(2), 250–258. https://doi.org/10.22159/ijap.2025v17i2.53310

Lumentut, N., Edi, H. J., & Rumondor, E. M. (2020). Formulasi dan Uji Stabilitas Fisik Sediaan Krim Ekstrak Etanol Kulit Buah Pisang Goroho (Musa acuminafe L.) Konsentrasi 12.5% Sebagai Tabir Surya. *Jurnal MIPA*, *9*(2), 42. https://doi.org/10.35799/jmuo.9.2.2020.28248

Magfirah, Ikhwan, N., & Patala, R. (2021). Penetapan Kadar Metabolit Sekunder Dan Uji Antioksidan Formula Soy-Yamghurt Campuran Sari Kedelai-Ubi Banggai. *Farmakologika Jurnal Farmasi*, *XVIII*(2).

Makiyah, S. N. N., Kita, M., Setyawati, I., & Tasminatun, S. (2022). Dioscorea alata L. Tubers Improve Diabetes through Anti-hyperglycemia, Anti-inflammation, Ameliorate Insulin Resistance and Mitochondrial Dysfunction. *Indonesian Biomedical Journal*, *14*(4), 365–375. https://doi.org/10.18585/INABJ.V14I4.1966

Primadani, A. F., & Safitri, D. N. P. (2021). Proses Penyembuhan Luka Kaki Diabetik Dengan Perawatan Luka Metode Moist Wound Healing. *Ners Muda*, *2*(1), 9. https://doi.org/10.26714/nm.v2i1.6255

Putri, G. N. F. M., Idacahyati, K., & Zain, D. N. (2022). Uji Aktivitas Sediaan Serum kombinasi Minyak Atsiri Daun Kirinyuh (Chromolaena odorata L.) dengan Curcumin terhadap Penyembuhan Luka Diabetes. *Prosiding Seminar Nasional Diseminasi Hasil Penelitian Program Studi S1 Farmasi*, *2*(1), 433–442.

Rahmasiah, Hadiq, S., & Sirajuddin, W. (2024). 1 , 2 , 3. *Jurnal Farmasi IKIFA*, *3*(2), 83–94.

Rizqon, M. Z., Wirasti, W., Waznah, U., & Vandian Nur, A. (2023). Uji Aktivitas Antioksidan Dan Penghambatan Enzim Xantin Oksidase Ekstrak Etanol Uwi Ungu (Discorea alata L.) Dengan Metode In Vitro. *Jurnal Ilmiah JOPHUS : Journal Of Pharmacy UMUS*, *4*(02), 69–76. https://doi.org/10.46772/jophus.v4i02.822

Sadsyam, S., Awaluddin, N., & Suharniayanti, S. (2025). Potensi Ekstrak Etanol Buah Kelor (*Moringa oleifera* L.) Sebagai Bahan Aktif Sediaan Gel Terhadap Penyembuhan Luka Diabetes Pada Tikus Putih Jantan. *Pharmacology And Pharmacy Scientific Journals*, *4*(1), 27–39. https://doi.org/10.51577/papsjournals.v4i1.692

Sundkar, S. U., Wankhede, S., Sen, A. K., & Vinod, S. (2024). *Pharmacological Properties and Therapeutic Applications of Dioscorea alata*. *3048*. https://doi.org/10.69613/gb1wm966

Tari, M., & Indriani, O. (2023). Formulasi Dan Uji Stabilitas Fisik Sediaan Krim Ekstrak Sembung Rambat (Mikania micrantha Kunth). *Babul Ilmi Jurnal Ilmiah Multi Science Kesehatan*, *15*(1), 192–211. https://doi.org/10.36729/bi.v15i1.1074

Wahyuni, A. S., Rahmawati, F. A. F., Wijianto, D. W., & Umniyyah, R. A. (2024). Effectiveness And Safety Of Use Of Biguanide And Sulfonylurea Drugs With Histopathological Analysis And Parameters Of The Kidney, Liver And Pancreas In Alloxan-Induced Rats. *Int J App Pharm*, *16*(spl5), 108–113. https://doi.org/10.22159/ijap.2024v16s5.52469

Widiawati, W., & Lailatul Qodri, U. (2023). Analisis Fitokimia Dan Penentuan Kadar Fenolik Total Pada Ekstrak Etanol Tebu Merah Dan Tebu Hijau (Saccharum officinarum L.). *Jurnal Farmasi Tinctura*, *4*(2), 91–102. https://doi.org/10.35316/tinctura.v4i2.3175

Wijianto, D. W., Wahyuni, A. S., Iswanto, D., & Listiadewi, A. (2024). Evaluation of the Effectiveness of Metformin and Black Rice Ethanol Extract Combination in Reducing Blood Glucose Levels and Protecting Kidney, Liver, and Pancreatic Cells. *Tropical Journal of Natural Product Research*, *8*(6), 7410–7415. https://doi.org/10.26538/tjnpr/v8i6.11

Zam Zam, A. N., & Musdalifah, M. (2022). Formulasi dan Evaluasi Kestabilan Fisik Krim Ekstrak Biji Lada Hitam (Piper nigrum L.) Menggunakan Variasi Emulgator. *Journal Syifa Sciences and Clinical Research*, *4*(2), 304–313. https://doi.org/10.37311/jsscr.v4i2.14146