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Development And In Vivo Evaluation Of A Herbal-Based Topical Formulation For Enhanced Wound Healing In A Burn Model

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Abstract

Background:

Wound healing is an essential component of clinical care, especially for burn injuries, as recovery can be delayed by prolonged inflammation and infection. Topical formulations based on herbal ingredients present a promising alternative, given their diverse therapeutic benefits and limited adverse effects. The aim of this study was to create and assess a polyherbal cream that includes glycyrrhizin, Aloe vera, and bay leaf extracts for its potential to heal wounds in a partial-thickness burn model.

Methods:

Two topical cream formulations (1% and 2.5%) were developed using standard emulsification methods. The formulations underwent physicochemical evaluations, which included tests for pH, viscosity, spreadability, washability, stability, and skin irritation. Using a standardized burn wound model, the in vivo wound healing activity was evaluated in Wistar rats. Animals were categorized into five groups (n=6): negative control, cream base (positive control), standard (2.5% silver sulfadiazine), and test groups receiving treatment with 1% and 2.5% polyherbal cream. Days 0, 7, 14, and 21 were used to measure the rates of contraction of te wound.. Acute dermal irritation was assessed as well.

Results:

Both formulations exhibited acceptable physicochemical properties, with no indications of phase separation or irritation. By day 21, the wound contraction rate for the 2.5% polyherbal cream was significantly improved (77.36 ± 0.04%) in comparison to the standard medication (68.00 ± 0.18%) and other control groups. The enhanced epithelialization and tissue regeneration observed in the test groups were supported by histological analysis. The acute irritation study revealed no adverse reactions.

Conclusion:

The polyherbal cream at a concentration of 2.5% showed considerable wound healing effects in rats with burn injuries. This is probably attributable to the combined anti-inflammatory, antimicrobial, and antioxidant effects of glycyrrhizin, Aloe vera, and bay leaf extracts. The results indicate that the polyherbal cream could serve as a safe and effective topical treatment for managing burn wounds.

Keywords: *Burn wound model, wound healing activity, partial-thickness burns, polyherbal formulation, skin regeneration, anti-inflammatory effect, wound contraction, in vivo study.*

INTRODUCTION

Topical creams, which are semi-solid emulsified systems, are designed to deliver therapeutic or cosmetic agents through the skin or mucous membranes. Due to their unique capacity to combine hydrophilic and lipophilic actives, as well as their excellent spreadability and patient acceptability, creams are among the most commonly used dosage forms in dermatology and cosmetology [(1)].

Cream emulsions are generally divided into two categories: W/O & O/W. The O/W creams, where water is the continuous phase, are generally non-greasy, washable, and appropriate for moist lesions. Conversely, W/O creams provide occlusive advantages and are more appropriate for addressing dry, chronic skin conditions by encouraging hydration and reinforcing barrier function [(2)].

In addition to improving the skin's look and visual appeal, cosmetics serve as a barrier to protect the skin from damaging elements both within and outside the body. In addition to their aesthetic benefits, they lower the chance of developing a number of dermatological disorders, which helps to preserve skin health. The skin care cosmetics nourish the health and texture of the skin while providing moisture. Polyherbal

cream, which is a semisolid formulation, is meant for topical application. The cream is formulated using a combination of herbal extracts, almond oil, and different excipients [3].

In addition to providing basic hydration, creams act as sophisticated vehicles for medications like corticosteroids, NSAIDs, antimicrobials, and phytochemicals. The ability of creams to enhance skin penetration, stability, and therapeutic outcomes has been further improved by recent technological advancements in nanocarriers such as liposomes, nanoemulsions, and phytosomes [2].

Wound:

Wounds are frequent and frequently inevitable occurrences that could compromise the cellular makeup, anatomical structure, and functional integrity of living tissue. A wound can be described as a loss or disruption of the cellular, anatomical, or functional continuity in either deep skin tissue or living tissues. Wound healing is characterized as a complex process involving the regeneration or reconstruction of damaged tissue.

Type of Wound:

Depending on the healing time, wounds can be classified in various ways as either acute or chronic

1. **Acute Wound:** An acute wound is characterized as a traumatic loss of normal structure and function to tissue that has not been injured recently. Those injuries that heal quickly
2. **Chronic Wound:** Chronic wounds are those that persist in a protracted state of chronic inflammation rather than healing according to the normal stages. It takes a long time for these wounds to heal, or they keep reopening [4].

Wound and Wound Healing Process

A wound can be described as a loss or disruption of the cellular, anatomical, or functional continuity in either deep skin tissue or living tissues. Wounds can arise from physical, chemical, thermal, viral, microbial, or immunological stress to the skin's surface. Besides adversely affecting the patient's physical and psychological well-being, wounds can incur significant costs and result in enduring scars. In broad terms, a wound refers to a physical injury that results in a break or opening in the skin [5]. The restoration of structure and function in injured tissues is the aim of wound healing, which is a dynamic physiological process consisting of multiple phases. Hemostasis, inflammation, proliferation, and remodeling are the four separate but overlapping stages of wound healing. Immediately after tissue injury occurs, hemostasis begins. Blood vessels narrow and platelets cluster to create a fibrin clot, which serves to stop the bleeding and acts as a scaffold rich in growth factors such as PDGF and TGF β, thereby starting the healing process [6].

The inflammatory phase begins within hours, characterized by the infiltration of neutrophils to eradicate pathogens and debris. On the second day, monocytes migrate into the wound and transform into macrophages. The macrophages perform two functions: they first remove leftover debris and then release cytokines and growth factors to indicate the commencement of the next phase [7, 8].

During the proliferative phase, fibroblasts move and release components of the extracellular matrix, starting with type III collagen. At the same time, endothelial cells begin angiogenesis, motivated by VEGF in low-oxygen circumstances, to create new capillaries that provide nutrients and oxygen. Myofibroblasts aid in wound contraction [9,10],while keratinocytes multiply and move to restore the epidermal barrier. Lastly, in the remodeling phase, type III collagen is gradually converted into the more robust type I collagen. The extracellular matrix undergoes reorganization, excess cells experience apoptosis, and blood vessels regress. During the course of months, the wound develops and reaches approximately 70–80% of the tensile strength of skin that has not been injured [11].

Various systemic and local factors can influence healing outcomes. Cellular responses, angiogenesis, or matrix synthesis may be hindered by factors like diabetes, malnutrition, immune deficiencies, or age-related changes. Local conditions such as infection, ischemia, or recurrent trauma further postpone repair [9]. Macrophages are crucial in the process—at first, they promote inflammation, and later, through a dynamic change in phenotype, they aid in regeneration and resolution [12].

Herbal Ingredients in Formulation

Aloe vera (Aloe barbadensis Miller) has a long-standing history of therapeutic use, particularly in dermatology and wound management, making it a commonly utilized medicinal plant. The gel found within the aloe leaf is rich in biologically active substances, such as polysaccharides (especially acemannan), glycoproteins, vitamins A, C, and E, enzymes, amino acids, and minerals including zinc and

selenium. The plant's potent anti-inflammatory, antioxidant, antimicrobial, and regenerative effects are attributed to these constituents.

Due to its ability to increase fibroblast proliferation, stimulate collagen production, and encourage re-epithelialization, Acemannan makes Aloe vera a potent treatment for burns, ulcers, and chronic wounds. Also, the gel ensures a moist environment for the wound, which is crucial for effective tissue repair and reducing scar formation [13,14].

Figure No. 1: Aloevera Extract

The fragrant leaves of the bay laurel tree are used to make bay leaf extract (Laurus nobilis L.), which is becoming more and more well-known for its use in wound and skin healing. The extract's strong antibacterial, anti-inflammatory, and antioxidant qualities are attributed to its abundance of flavonoids, tannins, phenolic acids, and essential oils like 1,8-cineole and eugenol. These phytochemicals have shown promise in lowering the microbial burden at wound sites by preventing the growth of pathogens including Pseudomonas aeruginosa and Staphylococcus aureus. Additionally, the antioxidant properties of bay leaf components aid in the neutralization of reactive oxygen species (ROS), which lowers swelling and damage to tissues while promoting the wound recovery pathway [15].

Figure No. 2: Bay leaf and extract

Due to its strong anti-inflammatory and immunomodulatory properties, glycyrrhizin, a key active ingredient in licorice root (Glycyrrhiza glabra), has shown great promise in wound care formulations. Glycyrrhizin works by suppressing inflammatory cytokines such as TNF-α and IL-6 and blocking the high-mobility group box 1 (HMGB1) protein. Controlling excessive inflammation and encouraging tissue regeneration depend on these processes. It has been demonstrated in experimental models that glycyrrhizin-loaded hydrogels speed up keratinocyte migration and wound closure, particularly in situations involving diabetic or chronic wounds. Additionally, by avoiding oxidative stress and cellular damage, its antioxidant activity promotes a healing environment [16].

Figure No. 3: Glycyrrhizin powder extract

Oil-in-water creams were created for this study in order to facilitate easy and seamless application on injured skin. Wistar rats were used to test the efficacy of various herbal preparations in accelerating wound healing, with povidone-iodine ointment acting as the benchmark for comparison.

MATERIAL AND METHOD

Materials

All materials used in the study were of high-quality pharmaceutical or analytical grade.

Active Ingredients:

The identification and purity of the plant extracts were verified and certified. They provided hydrating, antibacterial, and inflammation reducing properties when utilized as biologically active substances in the formulation.

Excipients and Inactive Ingredients:

The Siddhartha Institute of Pharmacy in Dehradun, India, provided pharmaceutical-grade stearic acid, cetyl alcohol, liquid paraffin, emulsifying wax, glycerin, methyl and propyl parabens, distilled water, and essential oil. These excipients improved the final formulation's physical stability and visual appeal in addition to emulsifying, moisturizing, and preserving it.

Every chemical and reagent utilized in the formulation and assessment processes met the quality requirements specified in the USP and/or Indian Pharmacopoeia (IP) and didn't require additional purification.

Table 1: Ingredients and Their Role in Herbal Cream Formulation

Ingredient	Role in Formulation
Stearic acid	Serves as a thickening and emulsifying ingredient, giving the cream an even texture.
Cetyl alcohol	Improves skin sensation and formulation texture by acting as an emollient and stabilizer.
Liquid paraffin	Acts as a barrier to stop loss of moisture and as a hydrating agent.
Emulsifying wax	Permits o/w emulsions to form and stabilize.
Glycerin	A humectant that keeps the skin hydrated by drawing moisture to it.
Methyl paraben	Preservative that prolongs the shelf life of products by preventing microbial development.
Propyl paraben	Used as an antibacterial preservative in conjunction with methyl paraben.
Distilled water	Serves as a diluent and solvent to produce the appropriate consistency.
Glycyrrhizin extract	Licorice root-based anti-inflammatory and calming substance.
Aloe vera extract	Has inflammation reducing, healing, and hydrating properties.

Bay leaf extract	Has antibacterial and antioxidant qualities..
Essential oil	Based on the type, they may have therapeutic effects in addition to being used for aroma.

Formulation Procedure for Herbal Cream Containing Glycyrrhizin, Aloe Vera, and Bay Leaf Extracts

In **Table No. 2,** the composition of creams is listed. The oil phase, which included liquid paraffin, cetyl alcohol, stearic acid, and emulsifying wax, was precisely weighed and cooked to about 70°C in a sterile beaker using a controlled water bath. To enable homogeneous melting and complete blending of the lipophilic components, continuous agitation was used.

Figure No. 4: F1 & F2 Heating in waterbath

Methyl paraben, propyl paraben, and glycerin were separately dissolved in a suitable amount of distilled water to create the aqueous phase. In order to guarantee compatibility with the oil phase, this combination was additionally heated to about 70°C.

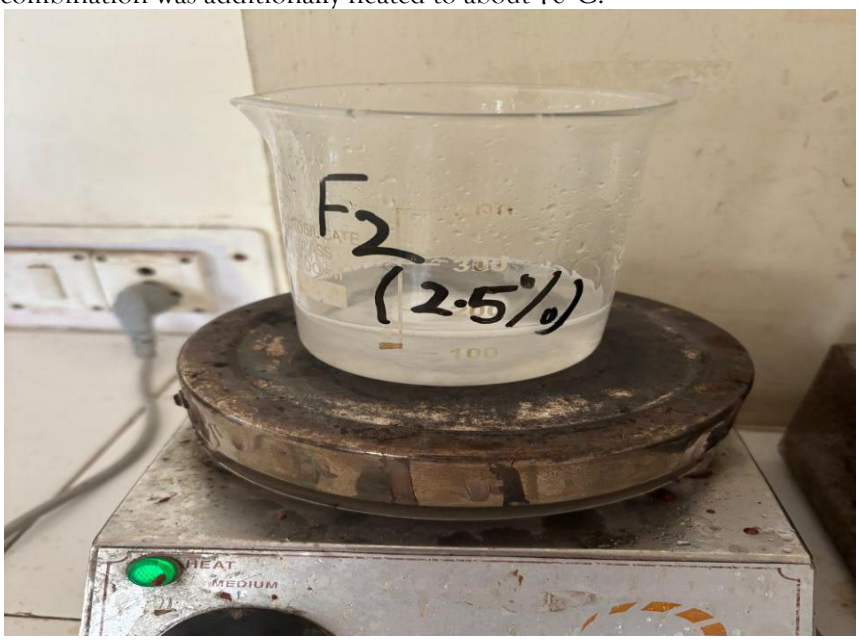

Figure No. 5: Heating & mixing of F2 through magnetic stirrer

A stable oil-in-water emulsion was formed by gradually incorporating the oil phase into the aqueous phase while maintaining constant agitation once both phases had attained the same temperature. To guarantee a uniformly smooth base cream, the system was continuously swirled.

To guarantee correct inclusion of the bioactive elements without sacrificing their stability, the determined amounts of glycyrrhizin extract, aloe vera extract, and bay leaf extract were added successively while gently

swirling the emulsion after it had cooled to about 40 to 45 °C. Then, a small amount of essential oil was added to the cream to improve its overall appearance and fragnance.

To get a consistent texture and consistency, the finished mixture was carefully mixed. For additional assessment and testing, the prepared herbal creams (F1 and F2) were moved into previously cleaned and sterile containers and kept at room temperature.

Figure No. 6: Formation of F1 & F2 formulation

Table 2: Formula Composition of Creams for 100 g (Detailed Ingredient Quantities)

Sr. No.	Ingredients	F1 (1%)	F2 (2.5%)
1.	Glycyrrhizin extract	1 g	2.5 g
2.	Aloe vera extract	5 g	5 g
3.	Bay leaf extract	1 g	2.5 g
4.	Stearic acid	5 ml	5 ml
5.	Cetyl alcohol	1.2 ml	1.2 ml
6.	Liquid paraffin	10 ml	10 ml
7.	Glycerin	3 ml	3 ml
8.	Methyl paraben	0.150 g	0.150 g
9.	Propyl paraben	0.5 g	0.5 g
10.	Emulsifying wax	2.5 g	2.5 g
11.	Distilled water	q.s.	q.s.
12.	Essential oil	q.s.	q.s.

Table 3: Ingredient Categorization by Phase and Function

Phase	Ingredients	F1 (1%)	F2 (2.5%)
Oil Phase	Stearic acid	5%	5%
	Cetyl alcohol	1.2%	1.2%
	Liquid paraffin	10%	10%
	Emulsifying wax	2.5%	2.5%
Aqueous Phase	Glycerin	3%	3%
	Methyl paraben	0.15%	0.15%
	Propyl paraben	0.5%	0.5%
	Distilled water	q.s.	q.s.
Plant Extracts	Glycyrrhizin extract	1%	2.5%
	Aloe vera extract	5%	5%
	Bay leaf extract	1%	2.5%
Additives	Essential oil	q.s.	q.s.

EVALUATION PARAMETERS

A. In-vitro evaluation parameters

1. Physical Evaluation

The physical characteristics of the created polyherbal cream were assessed to guarantee its quality, stability, and acceptability by users. In the evaluation, color, odor, consistency, physical state, and pH were all evaluated.

1.1 Color: To assess the cream's consistency and appearance, a visual inspection was conducted in the daytime. The formulation exhibited uniform coloring devoid of discoloration or phase separation.

1.2 Odor: Direct sniffing was used to assess the cream's scent. Due to the inclusion of natural plant extracts in the recipe, it had a pleasing and distinctive herbal scent.

1.3 Consistency: A tiny bit of cream was applied to the skin in order to manually evaluate the texture. The texture of the composition was uniformly smooth and spreadable, leaving no oily residue behind.

1.4 Physical State: The form of the formulation was ascertained by visual inspection. An ideal consistency for topical applications is the cream's semisolid

1.5 pH Measurement: A digital pH meter was used to determine the cream's pH. After preparing a 1% w/v dispersion of the cream in distilled water, it was left undisturbed for two hours. It was discovered that the pH was within the optimal range for skin. compatibility [(3)].

2. Spreadability

The slide-and-weight method was used to assess spreadability: two glass slides were sandwiched with 0.5 g of cream, crushed under a specified weight, and the time it took for the slides to separate was noted. Spreadability (S) was calculated by using

S = M × L / T, where M = weight, L = slide length, and T = time

3. Washability

The skin was rubbed with a tiny bit of cream, allowed to sit for a short while, and then washed with water from the faucet. One measure of washability was found to be the ease of removal [(17)].

4. Irritancy test:

Healthy individuals had a designated 1 cm^2 area on their forearm or behind their ears where the cream was applied. Periodically up to 24 hours, examinations were carried out for oedema or erythema. Non-irritability was evidenced by the lack of negative reactions.

5. Viscosity

A Brookfield viscometer (spindle No. 63) was used to measure the cream's viscosity at 25 °C and 5 rpm. Before taking the reading, the sample was given time to equilibrate.

6. Phase Separation

The cream was kept at room temperature in a wide-mouthed container to assess its physical stability, and after a day, it was visually examined for any signs of oil-water separation [(3)].

B. Pharmacological Evaluation

1. Acute Skin Irritation Test

An acute irritation test was used to evaluate the cream compositions' potential for cutaneous irritation. Each mouse (n = 6 per group) had a modest amount of cream (both 1% and 2.5% formulations) applied to the shaved skin area between their ears. The skin was checked for redness, swelling, and other indications of irritation after a day. Such reactions were absent, indicating that the formulation was non-irritating [(18)].

2. Burn Wound Model

The effectiveness of the developed polyherbal creams in healing wounds was assessed using a partial-thickness burn model. Thiopental sodium was used to anesthetize male Wistar rats. To create a consistent burn wound, a heated cylindrical metal rod (10 mm in diameter) was carefully applied to each rat's shaved dorsal area. To maintain fluid balance after injury, Ringer's lactate (1 mL/kg) was administered intraperitoneally to each animal. During the course of the trial, no extra systemic treatment medications were given. To guarantee a constant sample size and the quality of the findings, animals exhibiting symptoms of systemic sickness or extreme discomfort were morally removed from the study and replaced [(19)].

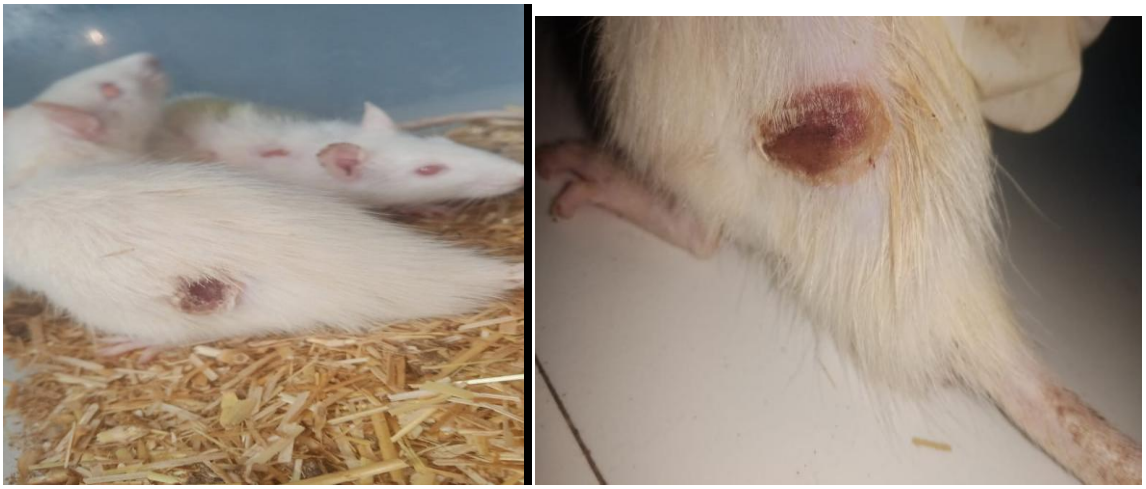

Figure No. 7: Induction of Burn Wound on Male Wistar rats for Evaluation of Wound Healing Activity

Experimental Animals

Male Wistar rats in good health weighing 100–135 g were acquired and kept in a controlled laboratory setting. Each animal was housed in a separate cage with a 12-hour light/dark cycle, a temperature of 22–24 °C, and unrestricted access to food and water. Rats were acclimated for a week before the trial began. The Institutional Animal Ethics Committee (IAEC) granted institutional approval in compliance with CPCSEA norms, and all procedures were conducted in conformity with ethical regulations..

Five groups of six animals each were randomly selected from among the animals:

- **Group I**: Untreated (negative control)
- **Group II**: Cream base only (placebo control)
- **Group III**: Treated with 1% silver sulfadiazine cream (standard group)
- **Group IV**: Treated with 1% polyherbal cream
- **Group V**: Treated with 2.5% polyherbal cream

Following the mice's burn wounds, treatment was administered for 21 days. Wound closure was removed from the mice's skin as the procedure came to an end.

GROUPING OF ANIMALS:

Table 4: Experimental Grouping and Treatment Regimen for Wound Healing Study in Rats

Name of the group (n=6)	Treatment	Dose	Route	Dose and Frequency
Negative Control	No treatment	-	-	21 days
Positive control	Cream base	-	Dermal	21 days
Standard	Silver sulfadiazine	2.5%	Dermal	21 days
Test a	F1 Cream	1 %	Dermal	21 days
Test b	F2 Cream	2.5%	Dermal	21days

Statistical Analysis

Quantitative data were presented as mean ± standard error of the mean (SEM).

RESULT AND DISCUSSION

Table 5: In-Vitro Evaluation parameters

Sr. No.	Parameter	Method Description	F1 (1% Cream)	F2 (2.5% Cream)
1	**Color**	Visual inspection under daylight	Uniform, light brown, no discoloration	Uniform, slightly darker brown
2	**Odor**	Direct smelling	Pleasant, herbal fragrance	Strong herbal aroma
3	**Consistency**	Manual application on skin	Smooth, non-greasy, good spreadability	Smooth, slightly richer feel, non-greasy
4	**Physical State**	Visual observation	Semisolid, homogeneous	Semisolid, homogeneous
5	**pH**	Digital pH meter; 1% w/v in distilled water, after 2 h	6.3 ± 0.1	6.1 ± 0.1
6	**Spreadability (g·cm/s)**	Slide-and-weight method (S = M × L / T)	13.2 ± 0.5	12.8 ± 0.4
7	**Washability**	Tap water removal after skin application	Easily washable	Easily washable
8	**Non-irritancy**	Application to forearm/ear, observed for 24 h	No erythema or oedema	No erythema or oedema
9	**Viscosity (cP)**	Brookfield viscometer, Spindle 63, 25 °C, 5 rpm	32,500 ± 200	34,200 ± 250
10	**Phase Separation**	Stored at RT in wide-mouthed container, observed at 24 h	No phase separation	No phase separation

Acute Skin Irritation Test

After 24 hours of exposure, the acute cutaneous irritation test showed no outward indications of erythema, edema, or other negative skin reactions at the application sites of the 1% or 2.5% cream formulations. Similar to untreated control areas, the skin texture and pigmentation of all treated mice (n = 6 per group) were normal. This suggests that there were no noticeable symptoms of discomfort and that both formulations were well tolerated. These findings suggest that the cream formulations are safe for topical application in the evaluated animal model and do not cause irritation.

Wound Contraction Rate

Table 2 shows the development of wound healing over a 21-day period for each treatment group. All experimental groups showed a consistent increase in wound contraction. By the seventh day, the Positive Control group's wound healing percentage (10.89 ± 0.08%) showed a small improvement, while the Negative Control group's remained low (6.76 ± 0.18%). While the Formulation (1%) and Formulation (2.5%) groups showed higher wound contraction rates of 20.56 ± 0.04% and 23.68 ± 0.11%, respectively, the Standard therapy group showed improved healing (17.76 ± 0.14%).

The healing process continued to progress on the fourteenth day. The greatest contraction was recorded by the Formulation (2.5%) group (60.68 ± 0.04%), followed by the Standard group (42.76 ± 0.04%) and Formulation (1%) (43.92 ± 0.04%). The healing percentages for the Positive Control and Negative Control groups were lower, at 20.20 ± 0.04% and 16.15 ± 0.06%, respectively.

The Formulation (2.5%) group showed the highest wound contraction (77.36 ± 0.04%) by day 21, suggesting improved healing. Following with scores of 68.00 ± 0.18% and 65.36 ± 0.04%, respectively, were the Standard and Formulation (1%) groups. At 33.20 ± 0.08% and 27.80 ± 0.11%, respectively, the Positive Control and Negative Control groups displayed comparatively lower wound healing percentages. Overall, the findings show that both polyherbal formulations considerably accelerated wound healing as compared to the uncontrolled and standard-treated groups, especially at the 2.5% concentration.

$$\text{Wound Closure (\%)} = \left(\frac{\text{Initial Wound Area} - \text{Wound Area on Day X}}{\text{Initial Wound Area}}\right) \mathbf{X\ 100}$$

Where:
Initial Wound Area refers to the wound size measured immediately after injury (Day 0).
Wound Area on Day X is the wound size measured on a specific post-injury day (e.g., Day 7, 14, or 21).

Table 6: Percentage of Wound Healing Over 21 Days (Mean ± SEM)

Group	0 Day (mm^3)	7th Day (%)	14th Day (%)	21st Day (%)
Negative Control	250	6.76 ± 0.18	16.15 ± 0.06	27.80 ± 0.11
Positive Control	250	10.89 ± 0.08	20.20 ± 0.04	33.20 ± 0.08
Standard	250	17.76 ± 0.14	42.76 ± 0.04	68.00 ± 0.18
Formulation (1%)	250	20.56 ± 0.04	43.92 ± 0.04	65.36 ± 0.04
Formulation (2.5%)	250	23.68 ± 0.11	60.68 ± 0.04	77.36 ± 0.04

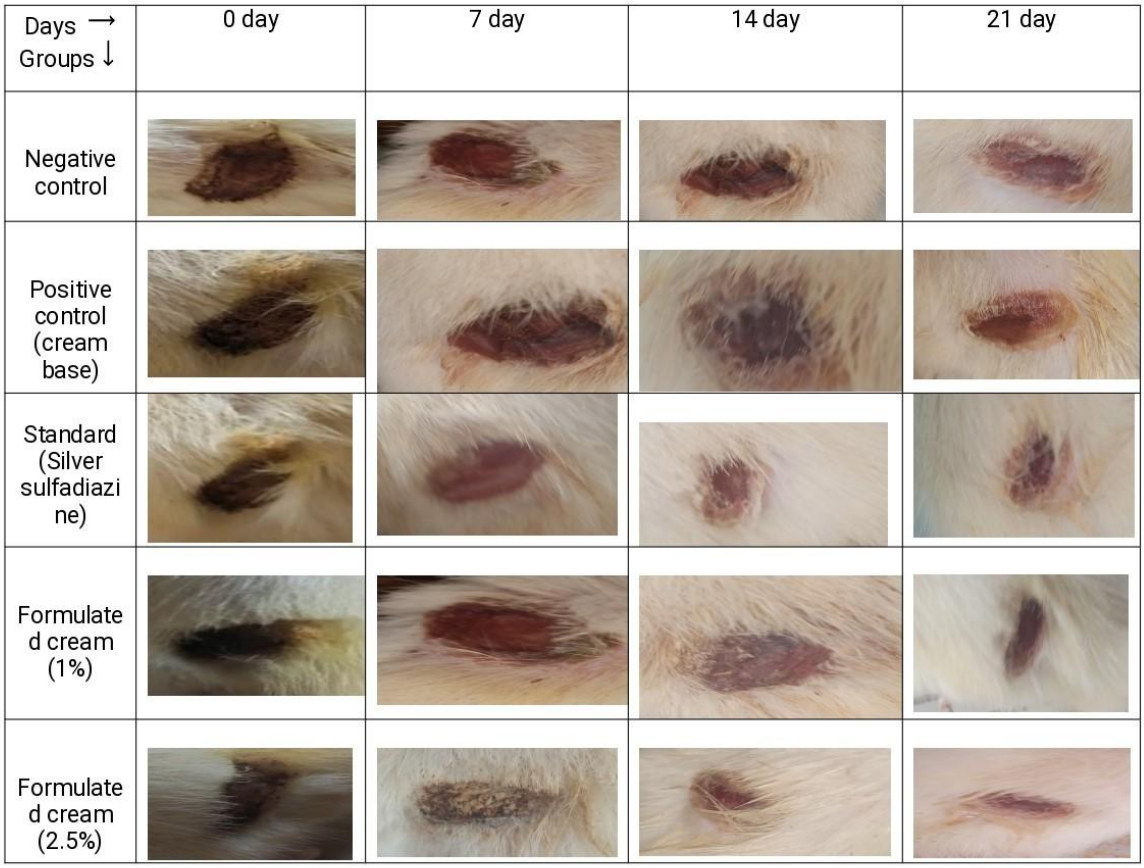

Figure No. 8: Visual Display of the Development of Wound Healing Cream in Various Treatment Groups Over a 21-Day Period

DISCUSSION

The goal of the current study was to create and assess polyherbal creams with extracts of bay leaf, aloe vera, and glycyrrhizin for their skin safety, physical characteristics, and capacity to heal wounds. A stable o/w cream base was mixed with two concentrations (1% and 2.5%) of the active plant extracts, which were then thoroughly tested both in vitro and in vivo.

Both formulations demonstrated satisfactory cosmetic qualities, such as semisolid consistency, a pleasing herbal odor, consistent color, and non-greasy spreadability, according to the physical characterization. Both user compliance and commercial acceptability depend heavily on these physical and sensory attributes. There was no chance of irritation or disturbance of the pH barrier because the creams' measured pHs (6.3 for F1 and 6.1 for F2) fell within the medically permissible range for skin application. With no indications of phase separation in ambient settings, the creams' practical usefulness was further supported by their spreadability and viscosity readings, which confirmed their good physical stability.

In Wistar rats, a partial-thickness burn wound model was used to evaluate the effectiveness of wound healing. When compared to the negative and placebo control groups, quantitative findings obtained over a 21-day period showed a statistically significant improvement in wound contraction with both polyherbal formulations. Interestingly, on every observation day, the 2.5% formulation (F2) continuously showed better healing performance. On Day 21, F2 outperformed the 1% formulation (65.36 ± 0.04%) and the standard silver sulfadiazine group (68.00 ± 0.18%) with a wound closure rate of 77.36 ± 0.04%. According to these results, the three plant extracts work in concert to efficiently stimulate tissue regeneration, most likely as a result of their combined anti-inflammatory, antioxidant, and antibacterial properties.

It has long been known that aloe vera promotes collagen synthesis and fibroblast activity, which speeds up wound healing. While bay leaf extract offers antibacterial and antioxidant properties that may help lower the risk of infection and oxidative stress at the wound site, glycyrrhizin, which is produced from licorice root, is well-known for its strong anti-inflammatory and calming effects on damaged skin. The dose-dependent effectiveness of the phytoconstituents is supported by the observed increase in wound closure rates with increasing extract concentration.

Up to 24 hours after application, neither formulation showed any symptoms of erythema, edema, or other skin toxicity, confirming the safety of both formulations in the acute dermal irritation test. This demonstrates their strong biocompatibility and supports their appropriateness for topical application. Overall, the findings show that the polyherbal cream formulations are safe for topical administration and provide notable benefits for wound healing, especially at a 2.5% concentration. These results confirm that adding traditional herbal ingredients to contemporary dermatological formulations has therapeutic promise. To facilitate the shift from preclinical to clinical use, more histological examination and clinical validation in human models are advised.

CONCLUSION

The current study effectively created and assessed two polyherbal cream formulations including extracts of bay leaf, aloe vera, and glycyrrhizin for their skin safety and capacity to heal wounds. Excellent physical properties, such as acceptable consistency, spreadability, pH, and stability, were displayed by both formulations. The synergistic effects of the mixed plant extracts were highlighted by the 2.5% formulation (F2), which performed better in promoting wound healing than both the 1% formulation (F1) and the usual silver sulfadiazine treatment.

The rapid wound contraction in the test groups was validated by in vivo tests using a burn wound model in rats. By the 21st day, the 2.5% formulation had the highest rate of wound closure. Furthermore, both compositions' safety for topical administration was validated by the acute cutaneous toxicity test's lack of irritation.

The therapeutic potential of the prepared polyherbal creams as safe and efficient substitutes for the treatment of skin wounds is strongly supported by these results. To confirm effectiveness and guarantee translational potential for human usage, further research may involve clinical trials, histopathology examination, and mechanistic investigations.

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CONFLICT OF INTEREST: There is no conflict of interest.

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