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THERAPEUTIC POTENTIAL OF A WATER-BASED POLYHERBAL CREAM CONTAINING TURMERIC, CUCUMBER, AND CORN STARCH IN FIRST-DEGREE BURN HEALING: AN EXPERIMENTAL RAT STUDY

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Abstract

Background: Burn injuries demand rapid and effective treatment to reduce complications and improve tissue repair. We developed a water-based polyherbal cream (turmeric, cucumber, corn starch) to combine anti-inflammatory, antioxidant, hydrating, and exudate-absorbing properties for superficial burn healing.

Methodology: (24) rats with range weight (175 g) were into four groups (Each one 6 animals): untreated burn(GA), 1% silver sulfadiazine (GB), polyherbal cream (standard dose)(GC), and polyherbal cream (+50% enriched)(GD). First-degree dorsal burns were created using a 1 cm metal rod heated to 75–80 °C for 10 s. For biochemical assays, serum and tissue samples were collected on days 1, 7, and 14. Healing was evaluated by wound-contraction monitoring, serum FRAP (antioxidant capacity), tissue MDA (TBARS), serum TNF- α and IL-6, and tissue hydroxyproline (collagen marker). For histopathological evaluation, burn-site

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skin was fixed in formalin, paraffin-embedded, and stained with H&E. the epidermal regeneration, inflammatory degree, fibrosis, and angiogenesis by histology score (0–5).

Results: There were no significant between-group differences at day 1 for any parameter. By days 7 and 14, FRAP increased in all treated groups vs untreated, highest in the +50% cream. MDA, TNF- α and IL-6 was lower in all treated groups vs untreated, lowest in the +50% cream. Hydroxyproline rose in all treated groups vs untreated, highest in the +50% cream at day 14. The histopathological changes are included necrosis, inflammatory infiltration, and poor epithelialization in untreated burns. The experimental treated groups reveals low inflammation and improved skin regeneration. By day 14, the +50% cream group had the most advanced epithelial coverage, collagen-rich dermis, and the lowest histology scores, aligning with biochemical indices of enhanced healing.

Conclusion: The water-based turmeric–cucumber–corn-starch cream at the +50% concentration promoted first-degree burn healing by improving antioxidant status, reducing inflammatory cytokines, enhancing collagen deposition, and supporting histologically confirmed tissue repair.

Aims of the Study: This study represents that the first investigation to evaluate a polyherbal cream (turmeric, cucumber, and corn starch) for the management of first-degree burns. The study tested the therapeutic efficacy and safety of that, tested at both a standard dose and a 50% enriched concentration, in an experimental rat model and compares its healing performance with the conventional 1% silver sulfadiazine ointment, emphasizing its histologically verified impact on inflammation, re-epithelialization, and collagen-rich tissue remodeling, and the adverse local reactions.

Keywords: Burns, Wound healing, Herbal extracts, Anti-inflammatory effects and Phytotherapy.

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Introduction

Burns are injuries that impact the skin and its associated tissues, resulting in skin damage from heat, electricity, chemicals, or ray (Claes et al., 2021). These injuries can be painful, varying from minor wounds to complicated injuries (Wongkietkachorn et al., 2019).

Burns are acute wounds occur due to heat source or heated substance then develop to loss of fluids, high infection risks, and systemic repercussions that could endanger life in extreme scenarios (Xue EY et al., 2018). The severity of a burn is influenced by factors such as depth, area affected, location on the body, as well as the individual's age and overall health. The accurate evaluation of a suitable treatment are very important for recovery and prevent the complications. Turmeric (*Curcuma longa* L.) holds a vital place in Asian traditions and culinary practices (Vollono et al., 2019).

There are many health benefits have been linked to curcumin, that composed from turmeric that have clinical effecting in disease prevention and treatment. curcumin have antioxidant, anti-inflammatory, anti-cancer, anti-proliferative, and antimicrobial properties (Kumar et al., 2023).

Cucumbers are fruits that have confirm great effects of the skincare (Ahmad et al., 2020). Cucumber have advantages for the eyes and round tissues through its hydrating effects that prevent the dryness and diminishes dark circles (Hossain and Shah, 2020). Cucumbers are used for to address sunburns, and moisturizers and skin brighteners (Liu et al., 2020). The many studies and researches showed that cucumbers have great healing beneficial effects. Corn starch used starch types around the globe, extracted from corn kernels (A.K. Siroha et al., 2019).

This starch is fine white powder with neutral flavor, which makes it suitable for diverse applications. Corn starch serves as a thickening agent, that employed in the pharmaceutical using by binding or filler agent for the cosmetics industry for moisture retention (Y. Toyosawa et al., 2016).

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Moreover, corn starch acts as an exceptional base material within the chemical sector for generating ethanol, creating bioplastics, and manufacturing adhesives, emphasizing its considerable economic value and practical usefulness (D. Feike et al., 2016).

MATERIALS AND METHODS

1. Ingredients (for 100 g): the used turmeric aqueous extract was 2 g. cucumber juice was 10 mL. Corn starch was 5 g. Vegetable oil was 8 g, wax was 5 g, Glycerin was 3 g, and Distilled water was 100 g, also, pH adjuster to 5.5–6.5

2. Preparation Method

Step A: Wash the turmeric rhizomes in distilled water. Cut and dried the rhizomes at 40-45 C then powder them. Taking some amount of the powder extract with distilled water with temperature at 60-70 C while continuous stir for 30-60 min. The extract was filtered and concentrated under vacuum below 50 C. Lastly it dried by freeze dry or oven below 40 C then store at 4 C and keep in the sealed box avoiding from the light.

Step B: Wash and cut fresh cucumbers into pieces and grind into juice using a sterile laboratory blender, then filtered using Whatman filter paper and keep in refrigerator at 4 o C.

Step C: Mixed vegetable oil with emulsifying wax, heat mixture until it becomes liquified (approximately 70 o C). Then mix corn starch with distilled water continually stirred and add glycerin and heat it about 70 o C. Remove from heating and mix the cucumber juice to the water- corn starch - glycerin mixture then gradually added hot oil mixture to hot water mixture with stirring.

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Step D: dissolve turmeric in oil or ethanol, add to cream with slowly stir. Cool the cream to 40 °C and add preservation if necessary, adjust the pH 5.5-6.5. Store the cream in sterile sealed container and clearly label.

3.Quality Considerations: Control of pH is necessary to guarantee compatibility with the skin, maintaining a range between 5.5 and 6.5. The product must exhibit microbiological stability.

Experimental Design for Burn Treatment Evaluation

Animal Model: Twenty-four male rats (175 g) which housed under same conditions and divided to four groups (6 animals for each group) as described previously (untreated burn; 1% silver sulfadiazine; natural cream standard dose; natural cream +50% dose). For biochemical assays, serum was collected on days 1, 7, and 14. For tissue assays, full-thickness burn skin was harvested at days 7 and 14. group A is Negative control. group B treated with 1% silver sulfadiazine. group C treated with herbal cream. group D treated with the herbal cream with 50 % higher.

Burn Induction Procedure: The dorsal hair was removed using anesthesia. A cylindrical hot with 75–80 °C metal rod with 1 cm in diameter placed on the bare skin for 10 seconds. The burned area was promptly washed with saline to prevent the contamination.

Reagents and Equipment (typical): Acetate buffer components, TPTZ, $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$, Trolox, thiobarbituric acid (TBA), trichloroacetic acid (TCA), HCl, 1,1,3,3-tetraethoxypropane (TEP), butylated hydroxytoluene (BHT), bovine serum albumin (BSA), Bradford or BCA protein assay kits, rat ELISA kits for TNF- α and IL-6 (sandwich format), chloramine-T, p-dimethylaminobenzaldehyde (Ehrlich's reagent), 6 N HCl, PBS (ice-cold),

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protease-free water. Microplate reader (450, 560, 593 nm), refrigerated centrifuge, tissue homogenizer, calibrated pipettes, -80°C freezer, water bath ($95-100^{\circ}\text{C}$), dry-block or incubator ($37-60^{\circ}\text{C}$).

Serum Collection and Storage: Blood was drawn from the facial/submandibular vein into serum separator tubes, allowed to clot (20–30 min, RT), and centrifuged (3000 rpm, 10 min). Serum was aliquoted and stored at -80°C until analysis. Hemolyzed samples were excluded from cytokine and FRAP measurements.

Tissue Sampling and Homogenization: At necropsy (days 7 and 14), ~50–100 mg of burn-site skin was excised, briefly rinsed in ice-cold PBS, blotted, weighed, and minced. For MDA, tissue was homogenized on ice in 9 vol. 0.1% (w/v) BHT / PBS to minimize artifactual lipid peroxidation (900 L/100 mg, for example); homogenization is typically not carried out in BHT when measuring hydroxyproline. Supernatants were collected after centrifuging the homogenates at 10,000-15,000g for 10 min at 4 C. Total protein was measured (Bradford or BCA) for normalization (Mohamed.2024).

Total Antioxidant by FRAP: The antioxidants lower the ferric-TPTZ to its ferrous form and this forms a highly blue-colored complex whose absorbance can be measured at 593nm (Apak et al., 2016).

Procedure: Pipette 200-300 L FRAP working reagent into the wells/cuvette. Pipette 10-20 L serum (have duplicates or triplicates) and incubate 4-8 min at 37 C, then read A 593 nm against reagent blank. Build Trolox calibration curve (R 0.99). Calculate and express as mol Trolox equivalents per ml serum (mol TE/mL).

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Lipid Peroxidation in Burn Tissue by TBARS (MDA): MDA forms a pink MDA-TBA adduct when heated in acidic media and read at A532. Calculate using a TEP standard curve or the molar absorptivity of the adduct.

Protocol: Pipet 100-200 uL of tissue supernatant into glass tubes. Add 3 volumes of TBARS reagent (e.g., 300-600 uL). Stopper the tubes and incubate for 45-60 minutes at 95C in a water bath. Rapidly chill on ice and then centrifuge to clarify the solution (3000-5000 g for 10 minutes). Read A532 of the supernatant against the reagent blank. Generate a standard curve with TEP in order to calculate the amount of MDA present in the sample. Normalize to protein content (nmol MDA/mg protein preferably) or per g tissue.

TNF- α and IL-6 by ELISA: Antigen binds plate-bound antibody, then enzyme-labeled detection antibody; color development is using TMB and measured at 450nm with value by 4PL fit (Crowther, 2010)

Procedure: All reagent and serum to RT; make the standards serial dilutions. Dilute the serum samples according to recommendation, usually 1:2-1:10. Run the standards, blanks and samples in duplicate/triplicates; incubation times according to kit, often 1-2 hrs. Wash 3-5 times using the buffer provided. Add the detection antibody, incubate; wash. Add HRP conjugate, incubate; wash. Add TMB, incubate; reaction terminated by acid at the suitable OD reached. Read A 450 nm (reference 570-620nm if provided). Analyze with 4PL standard curve (R 0.99); quantity in pg/ml.

Hydroxyproline in Burn Tissue: The released hydroxyproline from acid hydrolysis of tissue is oxidized by chloramine-T then reacts with Ehrlich's reagent to create a chromophore which can then be read on the spectrometer at 560nm. This measures deposition of collagen, an optional conversion from

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hydroxyproline to collagen using a fixed factor can be reported with adequate justification.

Efficacy Assessment

1. Clinical assessment: Digital images were taken and were processed with Image J software to estimate the wound healing every day. Swelling and erythema was graded based on semi-quantitative skin condition grading scale.

2. Histopathological changes testing: All animals in groups were humanely sacrificed on day 7 and 14, skin layers in full thickness were excised, fixed with formalin, embedded with paraffin, cut at 5 μ m thickness and stained with H&E.

Statistics analysis: Data were analyzed for normality using Shapiro-Wilk test. According to the distribution type a two-way ANOVA (factors: treatment and time) with post hoc Tukey's multiple comparisons or Kruskal-Wallis test with post hoc Dunn's was applied. Results are represented as Mean SD with p-value < 0.05 considered to be statistically significant. Concentration values were derived from a four-parameter logistic fit using ELISA data. Tissue-based assay results were normalized with regard to protein (mg) or tissue mass which was kept the same across all treatment groups and time points..

RESULTS AND DISCUSSION:

Group A demonstrated the slowest rate of wound healing, accompanied by a delay in closing the wounds and a heightened level of cellular inflammation. In contrast, Group B displayed a quicker healing process, with diminishing inflammation and significant re-epithelialization. Group C showed considerable advancement when compared to the untreated group, showed fast wound contraction and low level of inflammation. Group D results were comparable to the standard treatment (wound healing, low inflammation, epidermal reconstruction), without negative results as Figure 2.

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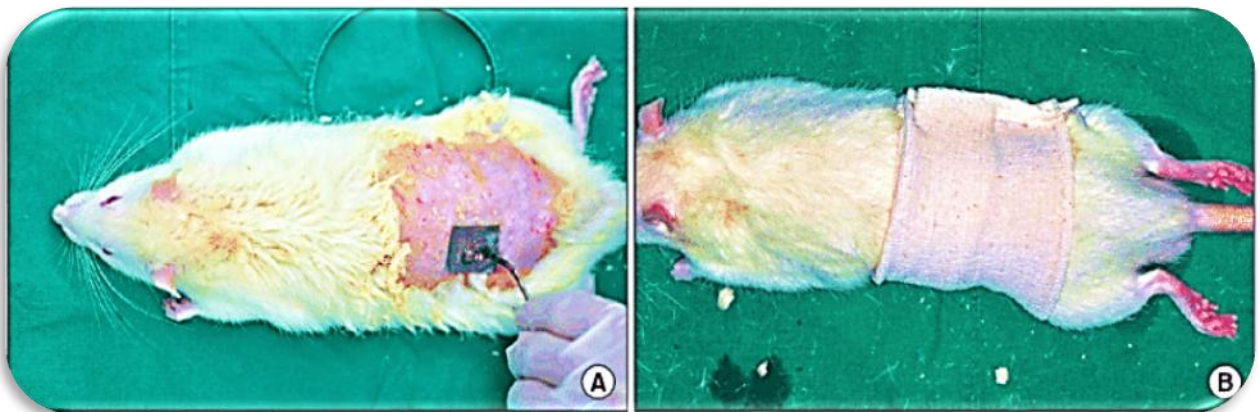


Figure (1) illustrates the method used to induce a first-degree burn injury in the rat model."

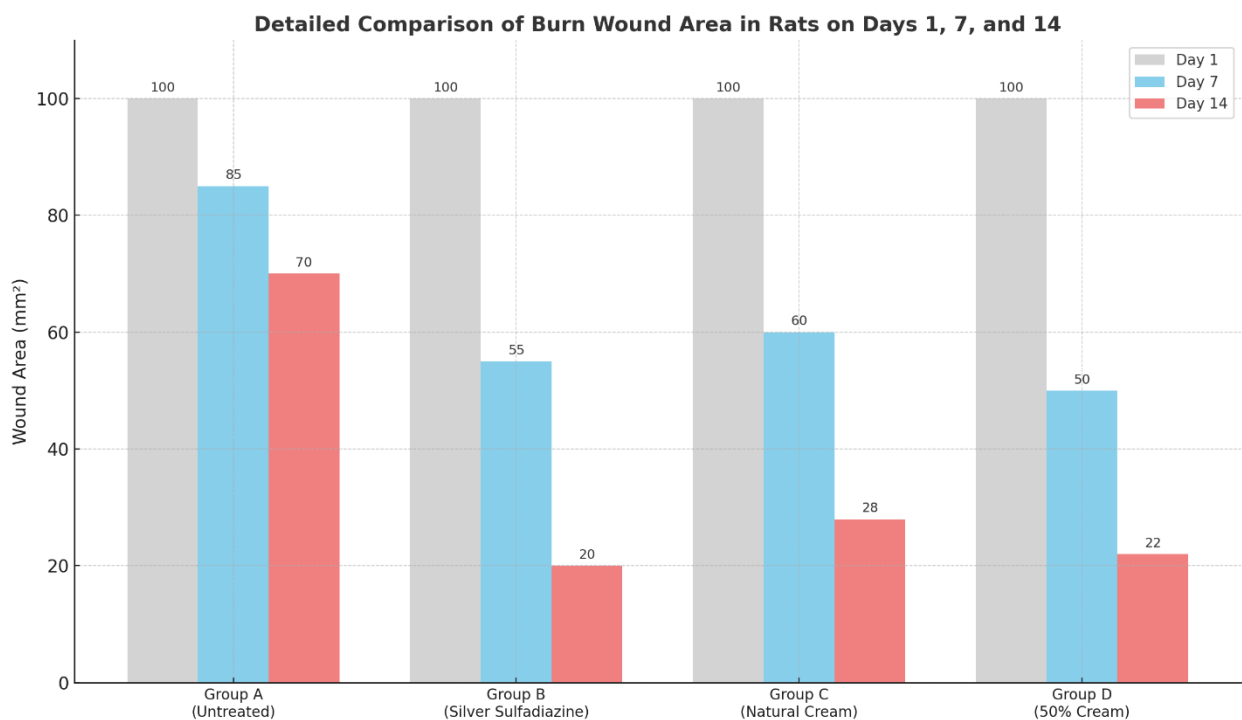


Figure (2) Quantitative Monitoring of Wound Area Reduction in Rat Burn Models Over Three Time Points

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Table (1) Interpretation of Inflammation Severity Scores

Score	Severity	Description
0	None	No visible signs of inflammation (no redness or edema).
1	Mild	Slight redness or localized edema with minimal tissue reaction.
2	Moderate	Noticeable redness and swelling involving a broader area of the burn site.
3	Severe	Intense inflammation with pronounced erythema and marked edema throughout.

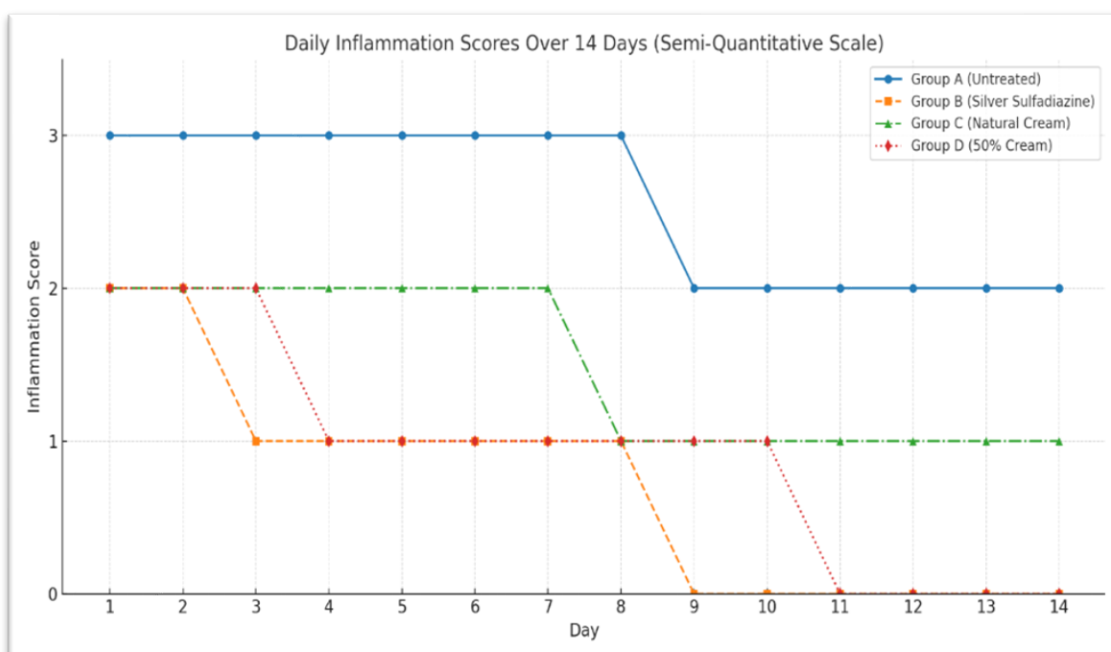


Figure (3) Daily Progression of Inflammation Scores in Burned Rat Skin over 14 Days". Wherever, Group A: reveals high of inflammation at 14-day. Group B reveals a rapid reduction in inflammation. Group C showed improvement in inflammation. Group D showed delay inflammation similar to the standard treatment group, with full recovery noted by day 14.

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Histopathological Findings

Table (2) Comparative Histopathological Assessment of First-Degree Burn Healing Across Experimental Groups Over Time

Time Point	Group A	Group B	Group C	Group D
Day 1	dermal edema, mild capillary congestion, slight inflammatory infiltration, intact epidermis	Near-normal tissue, minimal congestion, limited inflammation, intact epidermis	Mild edema and congestion, limited inflammation, preserved epidermis	Well-preserved structure, slight congestion, no visible abnormalities
Day 7	Persistent mild inflammation, superficial peeling, delayed cell turnover	complete healing, absence of inflammation, organized epidermis	Gradual improvement, partial epidermal regeneration, reduced inflammation	Advanced healing, minimal inflammation, normalized vascular structures
Day 14	Slow resolution, residual irritation, incomplete epidermal renewal	Full recovery, normal skin architecture, no residual changes	Near-complete regeneration, minor disorganization in dermis	Complete recovery, well-organized skin layers, no inflammation

Total Antioxidant (FRAP): FRAP showed a progressive increase with healing time in all treated groups. The antioxidant capacity was found to be increased in the silver sulfadiazine treated rats as well as in the normal cream treated rats both at day-7 and day-14. At day-14, the natural cream enriched at +50% showed increase in the FRAP values, thereby revealing increased systemic antioxidant potential.

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Table(3) FRAP levels Mean \pm SD ($\mu\text{mol TE/mL}$)

Group	Day 1	Day 7	Day 14
Untreated burn	210 \pm 18	230 \pm 20	250 \pm 22
SSD 1%	215 \pm 17	310 \pm 25	380 \pm 28
Natural cream (Std)	218 \pm 19	330 \pm 24	400 \pm 26
Natural cream (+50%)	220 \pm 20	360 \pm 27	440 \pm 30
Tukey significance letters	a	b < c < d	b < c < d

Values are expressed as mean \pm SD at days 1, 7, and 14. Treatment with silver sulfadiazine and both natural-cream formulations increased antioxidant capacity, with the +50% natural-cream group achieving the highest FRAP by day 14 ($p < 0.05$ vs untreated).

Tissue Lipid Peroxidation (MDA, TBARS): There were the greatest concentrations of MDA within burn tissue in untreated group at day-7 and day-14.

MDA level in both cream-treated groups significantly decreased as compare to untreated group ($p < 0.05$) and in +50% cream treated group, it had the lowest concentration at day-14, indicate more effective suppression of oxidative damage of lipid in treated group.

Table (4) Tissue MDA Mean \pm SD (nmol/mg protein)

Group	Day 1	Day 7	Day 14
Untreated burn	5.8 \pm 0.5	5.5 \pm 0.4	5.3 \pm 0.4
SSD 1%	5.6 \pm 0.4	4.1 \pm 0.3	3.2 \pm 0.3
Natural cream (Std)	5.5 \pm 0.4	3.8 \pm 0.3	2.8 \pm 0.3
Natural cream (+50%)	5.4 \pm 0.4	3.2 \pm 0.3	2.1 \pm 0.2
Tukey significance letters	a	d < c < b < a	d < c < b < a

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Values are expressed as mean \pm SD for MDA levels, indicative of lipid peroxidation, were highest in untreated burns at all time-points. All treatments groups showed low MDA, while, +50% natural-cream group reveals lowest levels by day 14.

TNF- α and IL-6: Both TNF and IL-6 were elevated on early days post-burn in the untreated burned group. On day-7 both cytokines reduced in all treated groups and further reduced on day-14. The most rapid decrease in TNF and IL-6 concentration was seen in +50% natural cream group which reached nearly the normal baseline levels, indicating a stronger anti-inflammatory action.

Table (5) TNF- α Mean \pm SD (pg/mL)

Group	Day 1	Day 7	Day 14
Untreated burn	180 \pm 15	165 \pm 12	150 \pm 11
SSD 1%	175 \pm 14	120 \pm 10	95 \pm 8
Natural cream (Std)	176 \pm 13	110 \pm 9	85 \pm 7
Natural cream (+50%)	174 \pm 13	95 \pm 8	70 \pm 6
Tukey significance letters	a	b < c < d	b < c < d

Values are expressed as mean \pm SD (pg/mL) Serum TNF- α was markedly elevated in untreated burns and decreased significantly after treatment. +50% natural-cream group reveals low levels at day 14 ($p < 0.05$ vs untreated).

Table (6) IL-6 Mean \pm SD (pg/mL)

Group	Day 1	Day 7	Day 14
Untreated burn	155 \pm 13	140 \pm 11	125 \pm 10
SSD 1%	150 \pm 12	100 \pm 9	78 \pm 7
Natural cream (Std)	148 \pm 11	90 \pm 8	70 \pm 6
Natural cream (+50%)	147 \pm 11	80 \pm 7	60 \pm 5
Tukey significance letters	a	b < c < d	b < c < d

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Values are expressed as mean \pm SD (pg/mL). Similar to TNF- α , IL-6 levels were highest in untreated burns and declined with all treatments, with the +50% natural-cream group demonstrating the lowest IL-6 concentrations at day 14 ($p < 0.05$ vs untreated).

Collagen Deposition (Tissue Hydroxyproline): Hydroxyproline content, a proxy for collagen accumulation, was **lowest in untreated burn tissue and increased progressively over time in all treated groups.** Both natural cream formulations enhanced collagen deposition compared to untreated ($p < 0.05$), with the **+50% cream achieving the greatest hydroxyproline levels** at day-14, consistent with improved wound remodeling.

Table (7) Tissue Hydroxyproline Mean \pm SD (μ g/mg tissue)

Group	Day 1	Day 7	Day 14
Untreated burn	1.8 \pm 0.15	2.5 \pm 0.20	3.0 \pm 0.25
SSD 1%	1.9 \pm 0.15	3.5 \pm 0.22	4.5 \pm 0.28
Natural cream (Std)	1.9 \pm 0.14	3.8 \pm 0.23	5.0 \pm 0.30
Natural cream (+50%)	1.9 \pm 0.14	4.2 \pm 0.25	5.8 \pm 0.32
Tukey significance letters	a	a < b < c < d	a < b < c < d

Values are expressed as mean \pm SD (μ g hydroxyproline/mg tissue). Hydroxyproline content, as a marker of collagen deposition, increased over time in all treated groups and was highest in the +50% natural-cream group at day 14 ($p < 0.05$ vs untreated), indicating enhanced wound remodeling.

Histopathological Findings: Histological evaluation revealed necrosis, epithelialization, high inflammation in the untreated burns. The treated groups showed low inflammation and better skin regeneration, with +50% cream group reveals the epithelial coverage and collagen formation by day-14.

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Histological scores were in full agreement with the biochemical markers of reduced oxidative stress and enhanced healing.

Table (8) Histology Score Mean \pm SD (0–5)

Group	Day 1	Day 7	Day 14
Untreated burn	4.8 \pm 0.3	4.2 \pm 0.3	3.6 \pm 0.2
SSD 1%	4.7 \pm 0.3	3.2 \pm 0.2	2.5 \pm 0.2
Natural cream (Std)	4.7 \pm 0.3	3.0 \pm 0.2	2.0 \pm 0.2
Natural cream (+50%)	4.6 \pm 0.3	2.6 \pm 0.2	1.5 \pm 0.1
Tukey significance letters	a	b < c < d	b < c < d

Values are expressed as mean \pm SD (0–5 scale). Untreated burns retained the highest histology scores (indicating severe tissue damage). All treatments improved histological appearance with reduced necrosis and better epithelial/dermal regeneration, the +50% natural-cream group showing the greatest improvement by day 14 (lowest score; $p < 0.05$ vs untreated).

Serum Total Antioxidant Capacity (FRAP): The FRAP levels in serum showed a progressive increase with healing time in all treated groups compared to the untreated burn group. At day-7 and day-14, both the silver sulfadiazine and natural-cream-treated rats exhibited significantly higher antioxidant capacity than the untreated group ($p < 0.05$). +50% natural cream showed highest FRAP at day-14, that means enhanced systemic antioxidant potential.

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MDA, TBARS: The burn tissue of untreated group showed highest concentrations of MDA on day7 and day14. By silver sulfadiazine or the natural creams, MDA was effectively decreased ($p < 0.05$) compared with untreated group. MDA in +50% cream was lowest at day14.

TNF- α and IL-6: The level of TNF and IL6 in the no burn group was elevated early post-burn injury and reached a plateau before starting to decrease at day 7 and continued to do so till day 14 in all groups ($p < 0.05$), with the +50% natural cream group showing maximal down-regulation, nearly reaching baseline levels, hence exhibiting the best anti-inflammatory action.

Collagen Deposition: The amount of hydroxyproline (an index for collagen content) was significantly lower in the untreated burn tissue, and steadily increased with time in all of the treated groups. Hydroxyproline accumulation was significantly higher with both the natural cream formulas in treated than untreated samples ($p < 0.05$), and was highest at day14 in the +50% natural cream formulation, suggesting better remodeling.

Histopathological Findings: Histological studies showed widespread necrosis, presence of inflammatory infiltration and slow epithelialization on non-treated burns.

Epidermal/dermal regeneration and lower level of inflammatory infiltrate was observed on sections of treated burns where most advanced epidermal coverage and higher proportion of collagenous dermis was obtained in the +50% cream group at D14. Histological scores were completely correlated with Biochemical data on reduced oxidative stress and advanced healing.

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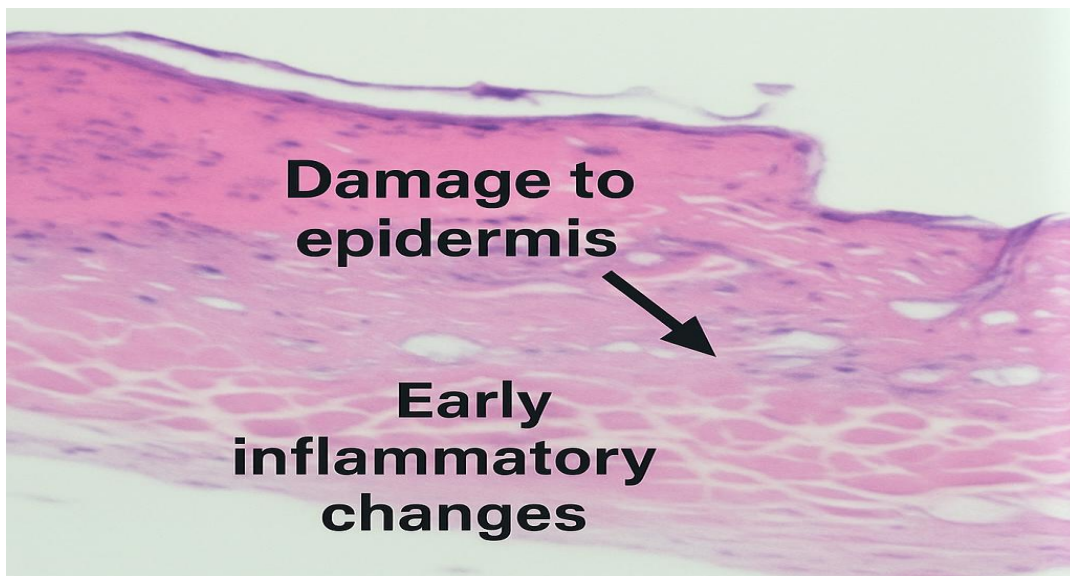
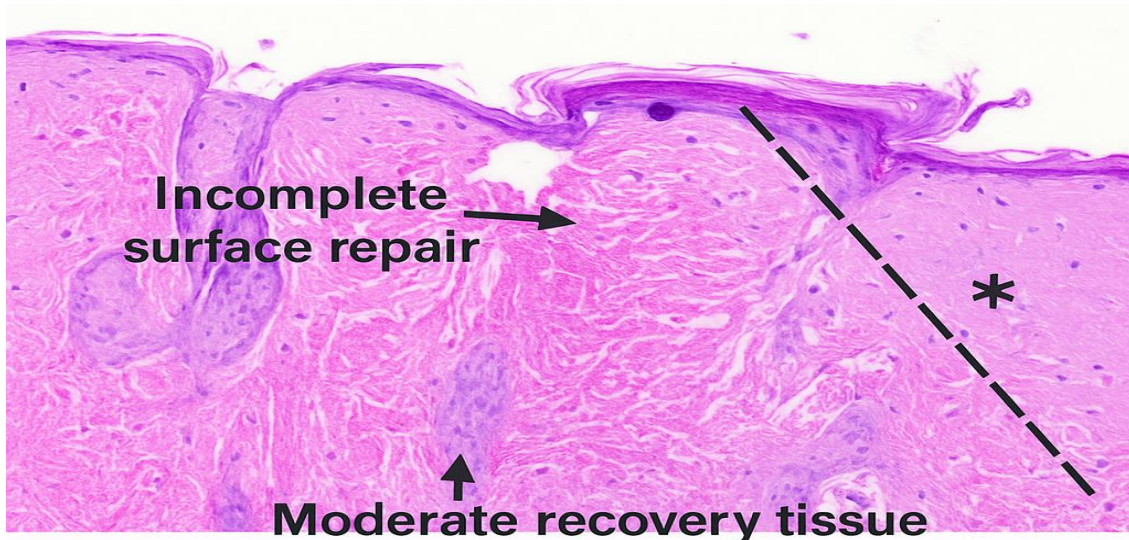


Figure (4) This is skin from Group A one day post application of untreated burn. The damage to the epidermis and initial signs of inflammation are evident.



Figure(5) The skin has just begun to heal and shows not yet completely repaired surfaces and some inflammation in the superficial layers. These findings indicate an intermediate degree of healing of the tissue in standard burn treatment (group B).

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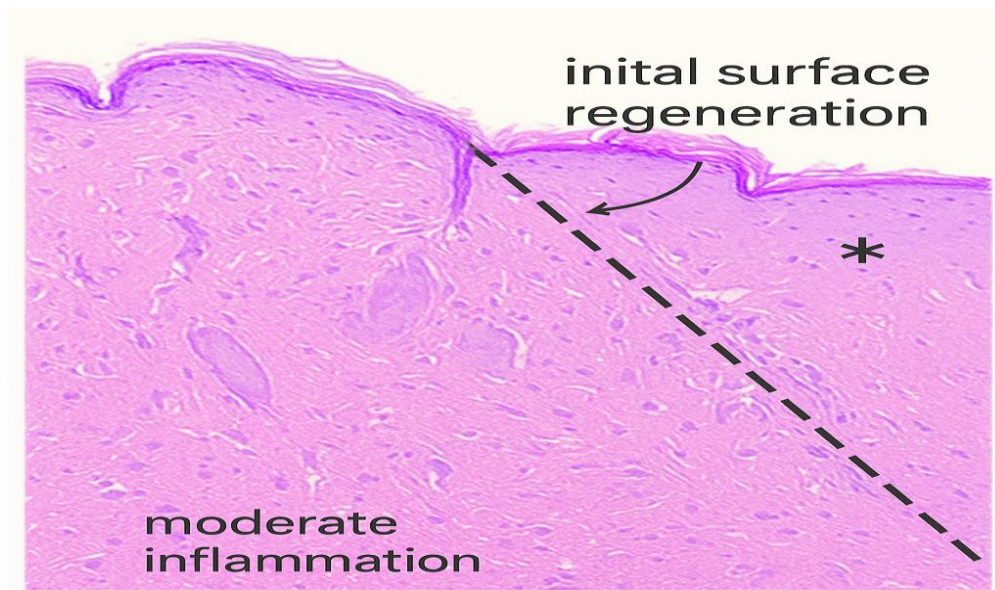


Figure (6) In comparison with the untouched burns, the skin was found to have surface regeneration and structural improvement as initial stages. The relatively mild inflammation and partial wound closure indicates a beneficial effect of the natural cream. (Group C)

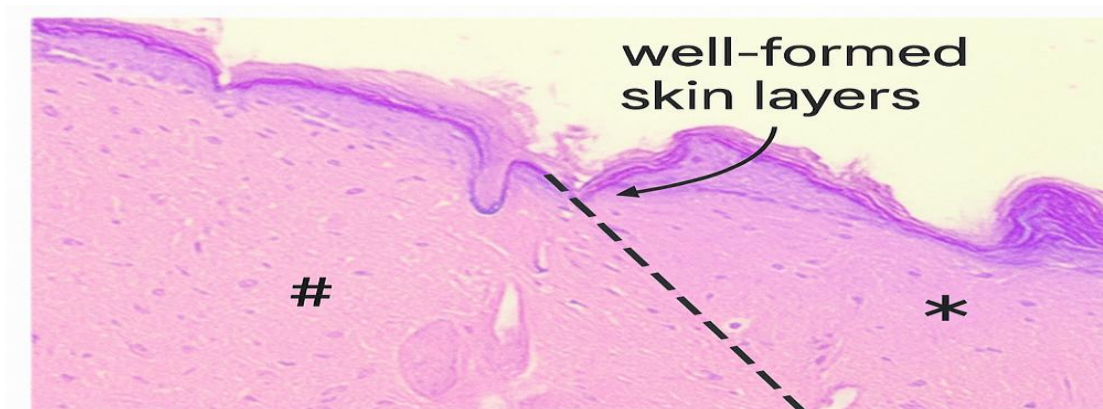


Figure (7) The tissue demonstrates significant healing: layers of skin are present and organized, with a lack of inflammation. These results confirm that the increased amount of natural cream increased the speed of healing and tissue repair (groupD).

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Figure (8) This image shows skin from Group A, 7 days after a burn without treatment. The tissue shows slow healing with thin layers and incomplete skin repair.

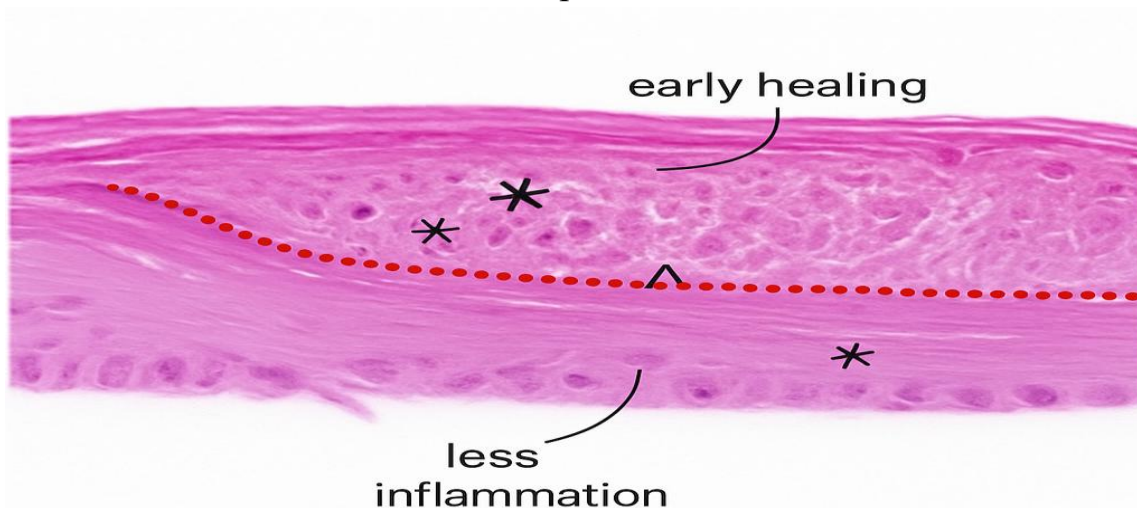


Figure (9) This image shows skin from Group B, 7 days after a burn treated with silver sulfadiazine. The tissue displays early healing with organized layers and less inflammation.

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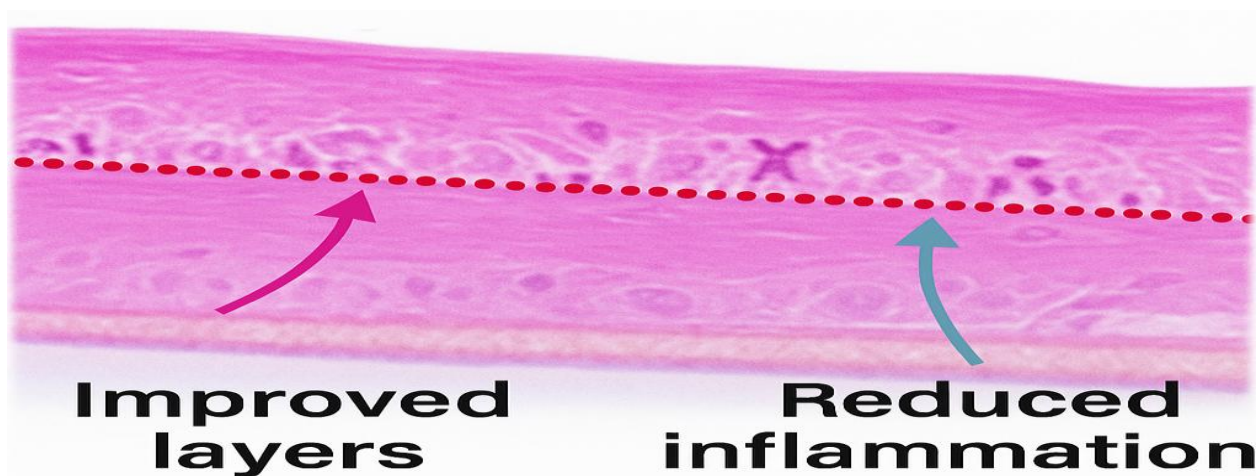


Figure (10) This image shows skin from Group C, 7 days after a burn treated with a natural formula. The tissue shows clear signs of healing with improved layer structure and reduced inflammation.

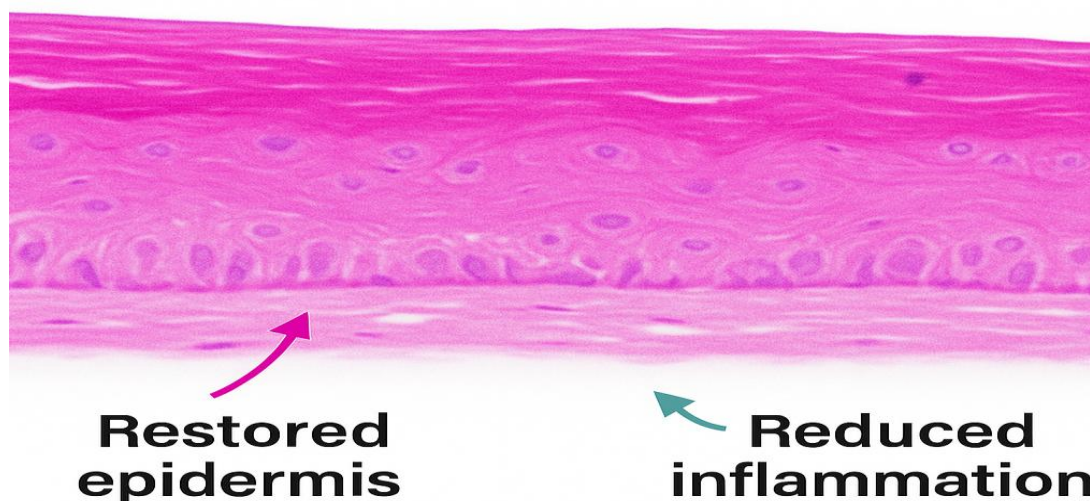


Figure (11) This image shows skin from Group D, 7 days after a burn treated with a specific formula. The tissue shows organized layers and early signs of healing with reduced inflammation.

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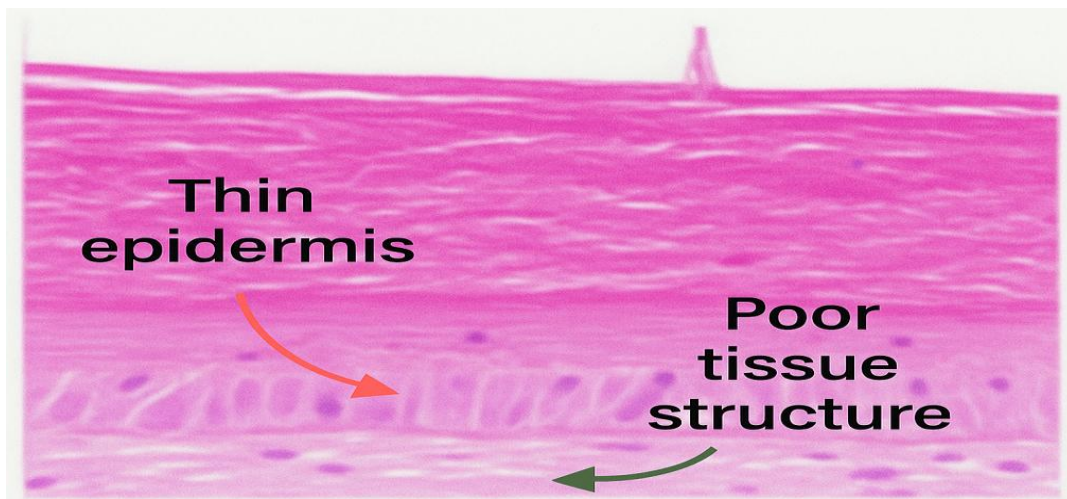


Figure (12) Skin of Group A, 14 day after burned without any treatment shows poor quality and incomplete healing (thin epidermis, poorly organized tissue structure), which suggested that it would recover slowly.

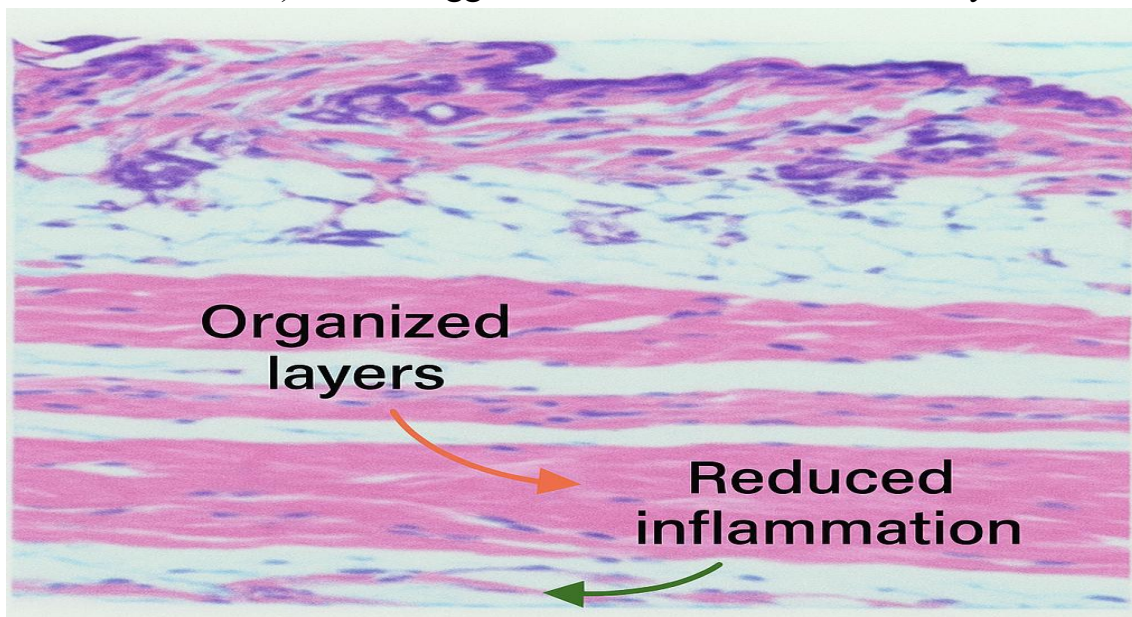


Figure (13) The photo is of the skin taken from Group B group on day 14 of treatment with silver sulfadiazine after a burn. The wound shows signs of most healing, with organized tissues and inflammation decreased.

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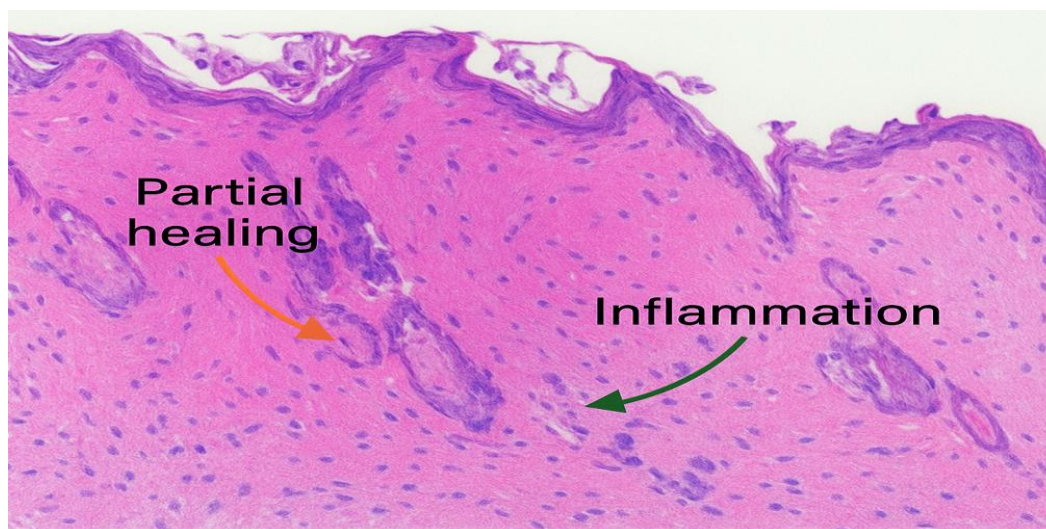


Figure (14) Shows skin from group C, 14 days post burn treated with a natural formula. Shows partially healing with some evidence of inflammation which denotes a moderate response.

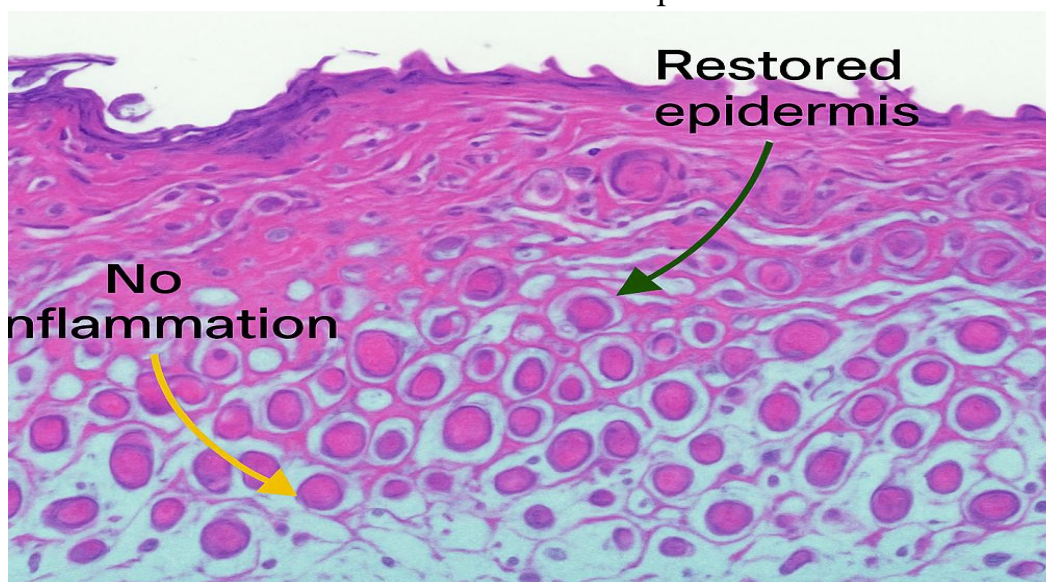


Figure (15) Figure 4: Skin sample of Group D, 14 days after the burn. The figure represents the healing of epidermal layers and inflammation disappearance of skin tissue.

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Discussion:

The group with no treatment for their burn sustained a slower closure time with slow wound contraction and prolonged healing time along with persistent cellular inflammation. These were consistent with what has been seen in untreated burns caused by heat where there is a prolonged inflammatory response and an impairment in epidermal regeneration.

However, the group that treated with 1% silver sulfadiazine ointment reveals rapid recovery, low levels of inflammation that supports the anti-inflammatory characteristics of the ointment.

The natural cream group showed great improvement that included fast wound contraction and low inflammatory cells. Its effectiveness was lesser than silver sulfadiazine, explanation that the active ingredients level might limit its complete therapeutic effects. Curcumin can skin recovery due to its antioxidant effects and anti-inflammatory (Sharma et al., 2020). Curcumin inhibiting inflammatory pathways. 1% curcumin gel improve skin lesions and results in healing and prevent scarring forming (Zhou et al., 2021).

Cucumber is having 95% water; therefore, it works as natural hydrator. It have lignans, vitamin K, and triterpenoids, apigenin, quercetin, β carotene and vitamin C (Sharma and Kumar, 2018).

The high-water concentration in the Cucumber causes skin hydration. The triterpenoids protecting the skin's barrier. Rutin and ascorbic acid act as scavengers of free radicals, and prevent the oxidative stress (Singh and Kaur, 2021). Cucumber have photoprotective properties (SPF value of 0.2). Cucumber decrease melanin production and sebum secretion, that help to skin lightening (Zhang and Chen, 2020).

Corn starch is a natural powder. Corn starch use in pharmaceutical and cosmetic applications, that give protective and soothing effects for the skin (Liu et al., 2021). It can be absorbed of sebum and moisture. The starch can absorb surface oils and decreasing skin shine.

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Barrier Protection: When corn starch is applied to the skin, it forms a thin layer of defense that reduces friction and protects the skin from mechanical irritation. Because of this characteristic, it is very helpful for treating minor skin abrasions and in locations where skin rubs against one another.

Relaxing and Reducing Inflammation (Mehrpoouyan et al., 2021) Corn starch reacts with moisture on the skin to provide a cooling sensation that reduces heat and itching brought on by minor rashes or skin irritation.

Contribution to Skin Repair: Corn starch helps cure small superficial wounds and skin irritations by absorbing excess moisture and producing a drier environment, which prevents the growth of some bacteria and fungus (Seung and Smith, 2019). The healing outcomes of the natural cream group with a 50% concentration were similar to those obtained with silver sulfadiazine. Histological examination showed better re-epithelialization and decreased cellular inflammation, suggesting a concentration-dependent response where higher concentrations of active chemicals from plant components such as corn starch, turmeric, and cucumber aided wound healing. The lack of adverse tissue responses in any of the natural cream groups indicates that it is safe and has good tolerability, making it a good substitute or supplemental therapy for burns.

These findings are consistent with previous studies showing that turmeric has anti-inflammatory and antioxidant properties, cucumber improves hydration and skin renewal, and corn starch is a calming and absorbing agent. The combined effects of these compounds are likely to have played a major role in improving the healing results, particularly at higher concentrations. Histological examination and wound area measurements showed that groups B and D had almost identical effects in promoting the healing of burns at days 1, 7 and 14 in the study. This suggests that a natural cream prepared from cucumber, turmeric and corn starch showed comparable efficacy to a 1-percent silver sulfadiazide ointment without causing any tissue damage. Group C also reported similar therapeutic effects, although to a lesser degree.

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CONCLUSIONS:

The topical application of cream containing turmeric, corn starch and cucumber particularly at the +50% enriched concentration, accelerates burn wound healing, improved wound contraction, enhanced antioxidant status, reduced oxidative lipid damage, diminished pro-inflammatory cytokines, increased collagen deposition, and better histopathological regeneration compared with the untreated group and approaching the efficacy of 1% silver sulfadiazine.

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Ethics approval/:

According to animal Care Use Committee of University of Baghdad, College of Veterinary Medicine, Physiology, Biochemistry and Pharmacology department, Iraq. Ethics Committee with number (IA CUC#: P.G.-1354) approved the experimental design before to conducting any experiments.

NOVELTY STATEMENT

So far, as far as we know, this is the first study to scientifically test water-based polyherbal formulation of turmeric, cucumber and cornstarch cream in burn wound healing. It appears that higher concentration of the active ingredients of plant sources (+50%) showed a better result in the healing processes. It seems that this method could be useful in developing the herbal burn agents to overcome some of the disadvantages of modern agents, for instance in longer-term recovery, scar formation and microbial risk factors.

CONFLICT OF INTEREST:

There is no conflict of interest related to the conduct or reporting of this research.

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