ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

Golden Cure: Curcumin and Niacinamide Combined for a Breakthrough in Antiseptic and Wound Care Solutions (Curminia)

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Abstract: This study investigates the potential of a novel herbal formulation combining curcumin and niacinamide for wound healing and antimicrobial activity. The formulation was developed as an antiseptic cream aimed at enhancing skin regeneration and minimizing scarring. Curcumin, known for its anti-inflammatory properties, and niacinamide, recognized for its skin barrier enhancement, were selected for their synergistic effects. The stability studies confirmed the formulation's efficacy over time, while the agar well diffusion method was employed to assess its antimicrobial activity against common pathogens. Results indicated significant wound healing properties and a reduction in scar formation, highlighting the potential of this phytochemical-rich formulation in topical therapy. This research underscores the importance of integrating traditional herbal ingredients in modern dermatological applications.

Keywords: *Curcumin; Niacinamide; Wound Healing; Antimicrobial Activity; Antiseptic Cream; Herbal Formulation; Topical Therapy; Anti-Scarring; Phytochemicals; Stability Studies; Agar Well Diffusion Method.*

How to Cite: Dr.Quazi Imaduddin; Mubasshera Sabir Khan; Pallavi Narayan Kangare; Abbasi Kulsum Badrey Alam; Sayyed Ghazala Parween Abed; Shaikh Saniya Ashokali; Deshmukh Uneja Aslam; Archana Laghane Sonune (2025). Development and Evaluation of an English-to Igala Neural Machine Translation System using Deep Learning. *International Journal of Innovative Science and Research Technology*, 10(5), 945-954. https://doi.org/10.38124/ijisrt/25may649

I. INTRODUCTION

Cream is defined as semisolid emulsions which are oil in-water (o/w) or water-in-oil (w/o) type and these semisolid emulsions are intended for external application. Two phase of cream i.e. oil-in-water and water-in-oil. [1]

Turmeric is acquired from Curcuma long L., a tuberous herba ceous perennial plant with yellow flowers and wide leaves, which is a member of ginger family and grows in tropical climate.[1]

Natural plant products have been used throughout human history for various purposes. Having co-evolved with animal life, many of the plants from which these natural products are derived are billions of years old. Tens of thousands of these products are produced as secondary metabolites by higher plants as a natural defense mechanism against disease and infection. Many of these natural products have pharmacological or biological activity that can be exploited in pharmaceutical drug discovery and drug design. Medicines derived from plants have played a pivotal role in the health care of many cultures, both ancient and modern [2]

It has the properties of an acid-base indicator as it is protonated and red at pH below one, neutral and bright yellow at pH 1–7, and de-protonated with red colour at pH more than 7. [3]

Studies often do not mention the exact content of curcumin used, and it is variable in commercial preparations. In addition, it exists in different forms with different biological potencies. [4] In humans and rats, the intestinal metabolism involves both conjugation and reduction, yielding curcumin glucuronide, curcumin sulphate, tetrahydrocurcumin and hexahydrocurcumin. In-vitro degradation products of curcumin, dihydroferulic acid and ferulic acid were also noticed in-vivo in rats, and may have biological effects. Biological effects of curcumin.

Curcumin is a highy pleiotropic molecule that influences multiple signalling pathways. It has anti-inflammatory, anti-oxidant, antimicrobial, hypoglycemic, wound healing, chemopreventive, chemosensitising and radiosensitising properties. [05] The various targets of curcumin are summarised [07],[08],[09] The functional consequences of these interactions need further investigation.

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[6] Curcumin has potential in inflammatory and neoplastic disorders of the skin. Curcumin accelerated wound healing in rats is attributed to its antioxidant properties. It inhibits cyclo-oxygenase 2, lipo-oxygenase and the release of inflammatory cytokines from macrophages and monocytes. It increases granulation tissue, neovascularization and enhances synthesis of extracellular matrix components including collagen. [10] The topical application of curcumin is documented to have an effective role in wound healing mechanisms.

II. THE ROLE OF NIACINAMIDE IN WOUND HEALING

Niacinamide, also known as vitamin B3, plays a significant role in promoting wound healing due to its multifaceted biological activities. One of its key functions is its anti-inflammatory effects, as it helps reduce the release of inflammatory cytokines, preventing prolonged inflammation, which can otherwise delay the healing process. Additionally, niacinamide enhances keratinocyte migration and proliferation, facilitating faster skin cell growth and movement into the wound area, a crucial step in wound closure. It also improves the skin's barrier function by boosting the synthesis of ceramides and free fatty acids, strengthening the epidermal barrier, and offering better protection during the healing phase. Furthermore,

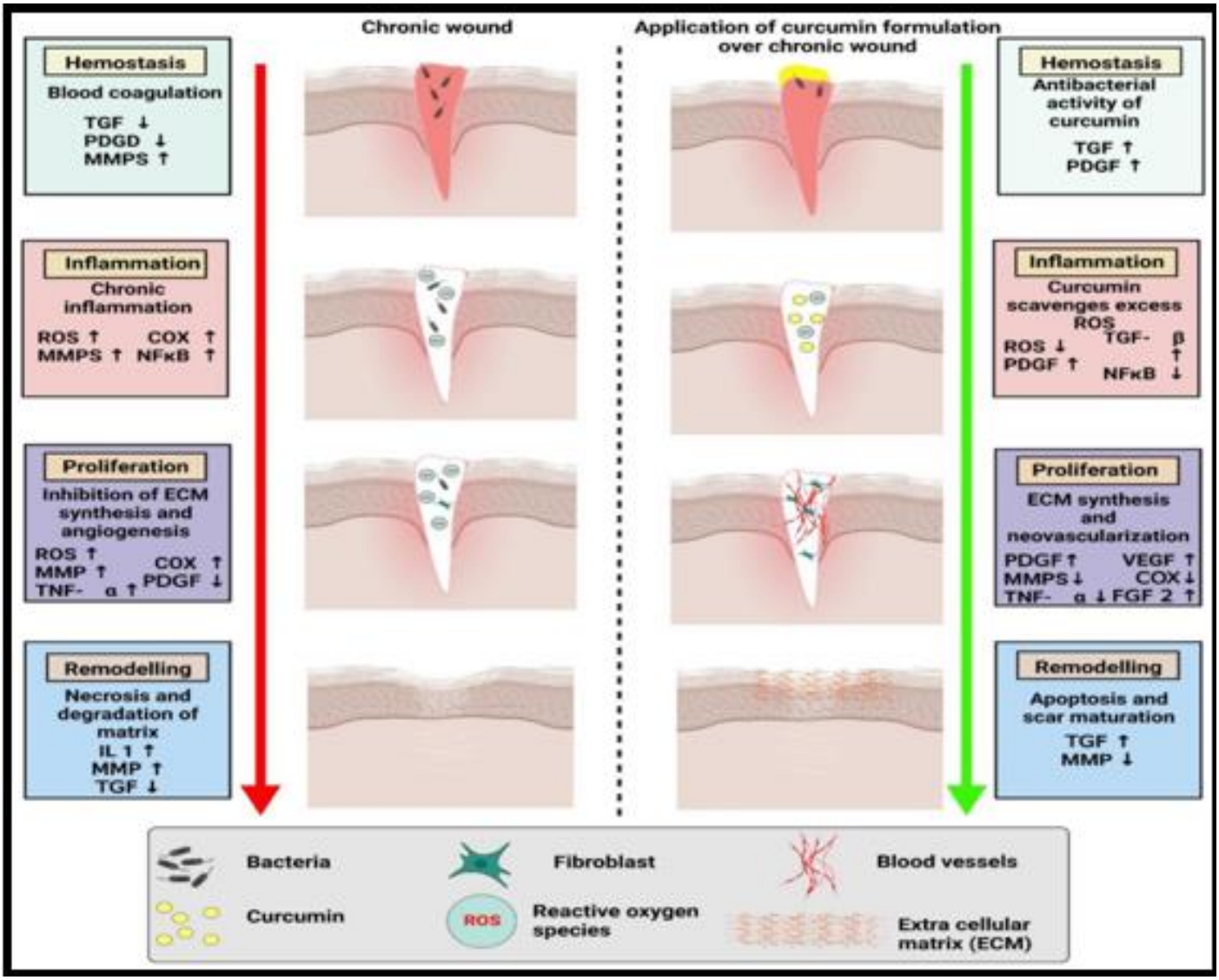

Fig 1 Curcumin Wound Healing Mechanism

niacinamide has been shown to support angiogenesis, the formation of new blood vessels, thereby improving blood supply to the healing tissue and accelerating recovery. As an antioxidant, niacinamide reduces oxidative stress in the wound site, protecting cells from damage caused by free radicals. Lastly, it has been found to support fibroblast activity, enhancing collagen production and promoting the formation of stronger, more resilient tissue. These properties make niacinamide a promising component in wound care, with applications in creams, dressings, and treatments for burns, ulcers, and surgical wounds.

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Table 1 Topical Antiseptic Cream Containing Curcumin and Niacinamide: A Synergistic Approach

Property	Property	Niacinamide/Niacin	Combination Potential
Source	Derived from turmeric (Curcuma longa)	Vitamin B3 (niacinamide = amide form of niacin)	Natural compound synergy
Main Action	Anti-inflammatory, antimicrobial, antioxidant	Anti-inflammatory, antioxidant, barrier repair	Broad-spectrum healing and protection
Antiseptic Role	Fights bacteria, fungi; reduces infection risk	Reduces skin irritation and oxidative stress	Double protection: antimicrobial + skin recovery
Wound Healing	Speeds up tissue repair, collagen production	Stimulates keratinocyte migration, fibroblast activity	Faster wound closure and stronger skin regeneration
Skin Barrier Support	Reduces oxidative stress, supports new tissue	Boosts ceramide production, improves hydration	Reinforces healing skin
Safety Profile	Generally safe; low irritation but low bioavailability	Highly safe, even for sensitive skin	Better tolerability in sensitive wounds
Formulation Challenge	Poor water solubility; needs stabilizers	Water-soluble, easy to formulate	Need to balance solubility and stability
Ideal Concentration (Topical)	0.5–3% curcumin (encapsulated ideally)	2–10% niacinamide / 1–5% niacin	Optimized based on wound size/severity
Extra Benefits	Anti-scarring, reduces pigmentation	Brightens skin tone, evens pigmentation	Brightens skin tone, evens pigmentation

III. MATERIAL AND METHODS

➢ *Materials*

Table 2 Pharmacological Profile and Chemical Composition of Ingredients in Curcumin–Niacinamide Antiseptic Cream Formulation

Sr No	Ingredient	Pharmacological Class	Mechanism of Action	Therapeutic Role	Topical Use	Chemical Formula
1	Purified Curcumin	Natural polyphenolic compound from turmeric	Inhibits NF-κB and COX-2 pathways, reducing pro-inflammatory cytokines	Anti-inflammatory, antioxidant, antimicrobial, wound healing	Used in creams for infections, burns, and inflammation	$C_{21}H_{20}O_6$
2	Stearic Acid	Fatty acid (long-chain saturated)	Forms a protective barrier on the skin surface	Emollient; provides moisturizing and occlusive effects	Used in creams and lotions to soften and smoothen the skin	$C_{18}H_{36}O_2$
3	Cetyl Alcohol	Fatty alcohol	Improves consistency and spreadability of formulations	Emollient and stabilizer; softens and conditions the skin	Used in cosmetic/pharmaceutical emulsions for soothing effects	$C_{16}H_{34}O$
4	Triethanolamine (TEA)	Surfactant/Emulsifying agent	Acts as a pH balancer and stabilizer in emulsions	Co-emulsifier; assists in forming stable emulsions	Used in creams to mix oil and water phases effectively	$C_6H_{15}NO_3$
5	Glycerin	Polyol compound	Draws moisture from the environment into the skin (humectant)	Hydrates skin; enhances barrier function	Used for dry, irritated, or compromised skin conditions	$C_3H_8O_3$
6	Propylene Glycol	Diol (organic solvent)	Enhances drug penetration through the stratum corneum	Humectant and vehicle; improves bioavailability of actives	Facilitates deeper drug delivery in topical skin formulations	$C_3H_8O_2$
7	Niacinamide	Vitamin B3 derivative	Modulates inflammatory cytokines; improves skin barrier function	Anti-inflammatory, brightening, and barrier-	Used in acne, rosacea, pigmentation, and inflammatory dermatoses	$C_6H_6N_2O$

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

				strengthening agent		
8	Propyl Paraben	Alkyl ester of p-hydroxybenzoic acid	Inhibits microbial growth by disrupting cell membranes	Preservative that prevents microbial contamination	Ensures microbial safety and stability in creams	$C_{10}H_{12}O_3$
9	Water	Vehicle/Base	Acts as a solvent for hydrophilic components	Base medium for emulsions; supports hydration and spreadability	Used in O/W (oil-in-water) emulsions for creams	H_2O

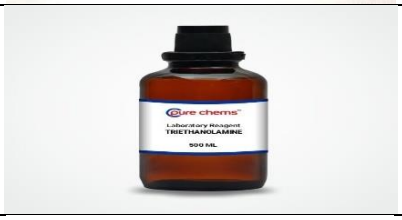
IV. EXTRACTION OF CURCUMIN

Take 100 g of turmeric powder and add it to 500 mL of ethanol (95%) in a round-bottom flask. Heat the mixture under reflux at 70°C for 4 hours while stirring continuously. Filter the solution using Whatman filter paper to remove the solid residues. The filtrate is then concentrated under reduced pressure using a rotary evaporator to obtain a thick extract. The extract is dried under vacuum at room temperature to obtain crude curcumin. Purify the curcumin by recrystallization using a small amount of ethanol. Dry the crystals at room temperature to get the final purified curcumin.

Fig 2 Extraction of Curcumin from Turmeric Rhizome

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

Table 3 Formulation

Sr No	Ingredients	Quantity Taken	Actions	Image
1	Purified Curcumin	2%	Anti-inflammatory	
2	Stearic Acid	15%	Emollient (Moisturizing Action)	
3	Cetyl Alcohol	2%	Softens, smoothens skin	
4	Triethanolamine (TEA)	2%	Emulsifier Helper (Co-Emulsifier)	
5	Glycerin	5%	1.Humectant (Moisture Attractor) 2.Skin Barrier Repair	
6	Propylene Glycol	5%	Penetration Enhancer	
7	Niacinamide	1%	Anti-inflammatory Action	
8	Propyl paraben	0.5%	Preservative (Main Role)	
9	Water	q.s. to 100%	Base for Emulsions	

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

➢ *Methods*

- Preparation of Cream

Phase 1 (Oil Phase): Heat stearic acid and cetyl alcohol in a beaker to 75°C until fully melted. Phase 2 (Water Phase): Dissolve TEA, glycerin, and propylene glycol in water, then heat the solution to 75°C. Emulsification: Slowly add the oil phase into the water phase with continuous stirring to form an emulsion. Continue stirring until the mixture cools down to 40°C. Incorporation of Curcumin: Add the purified curcumin and preservative to the emulsion and continue stirring until a uniform cream base is obtained. Adjust the pH of the cream to 6.0–7.0 if necessary.

Fig 3 Curcumin Extract

- *Packaging:*

Transfer the prepared cream into suitable containers and store it at room temperature.

V. EVALUATION PARAMETERS

➢ *Physical Appearance / Organoleptic:*

Check for color, odor, and texture. The cream should have a smooth texture, uniform color, and a characteristic odor.

➢ *pH*:

Measure the pH of the cream using a digital pH meter. The ideal range should be between 6.0 and 7.0.

➢ *Spreadability:*

Measure the ease of spreading by applying a fixed amount of cream between two glass slides and determining the area spread after applying a specific weight.

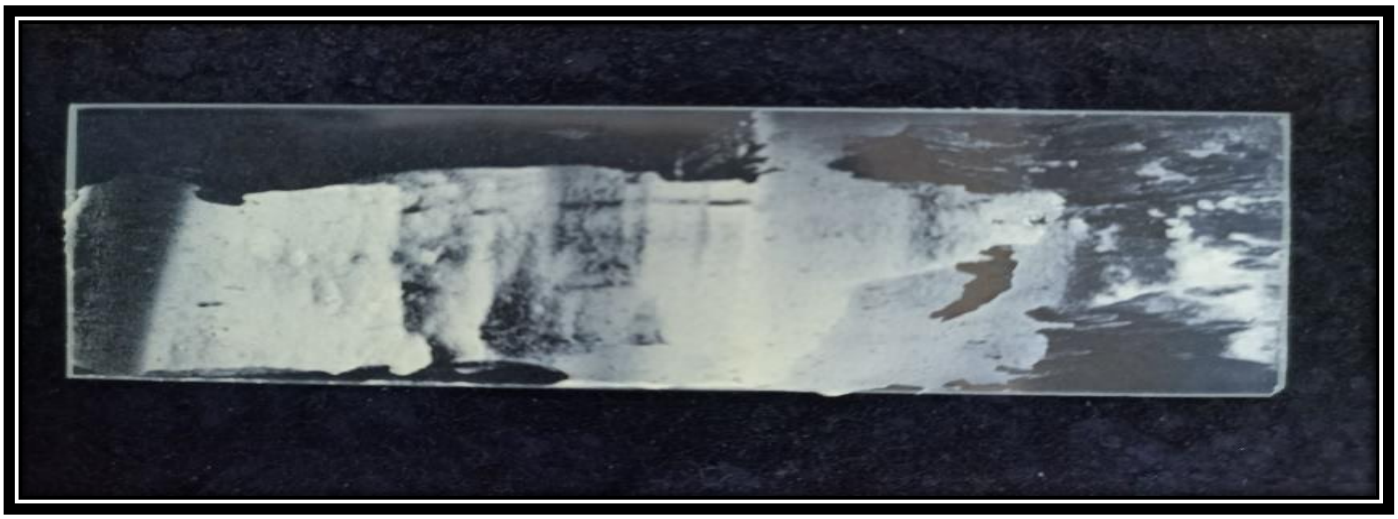


Fig 4 Spreadability Test

➢ *Viscosity:*

Measure the viscosity of the cream using a Brookfield viscometer at room temperature.

➢ *Stability Studies (72-Hour Study):*

The cream formulation underwent accelerated stability testing by being stored at three different temperatures—4°C, 25°C, and 40°C—for a period of 72 hours. Observations were

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

made at 24-hour intervals to detect any physical changes such as phase separation, discoloration, odor development, or changes in consistency. Throughout the study, the cream remained stable across all temperature conditions. No phase separation, color change, or texture alteration was observed, and the formulation maintained its uniform appearance and consistency. These results confirm that the cream is physically stable under a range of storage conditions, indicating good short-term stability and suitability for further long-term testing and potential commercial use.

- *Antimicrobial Activity Testing of Cream Using Agar Well Diffusion Method*

The antimicrobial activity of the cream was evaluated using the agar well diffusion method against common pathogens, including *Staphylococcus aureus*, *Escherichia coli*, curd bacteria, and soil bacteria. Six Petri dishes were prepared for this experiment, divided into three groups as follows: Group 1 (control group) consisted of bacteria from curd and soil; Group 2 (standard group) used a marketed antiseptic cream, Boroline, as a positive control; and Group 3 (test group) involved the application of the test cream. After a 24-hour incubation period, the growth inhibition zones were measured to assess the antimicrobial efficacy of each formulation. The growth of bacterial cultures was observed under a microscope, providing insights into the inhibition effect of the creams on both curd and soil bacteria.

Table 4 Experimental Groups for Antimicrobial Activity Testing

Group No.	Group Name	Bacteria Used	Cream Applied	Control/Comparison
1	Control Group	Curd & Soil Bacteria	No cream (Bacteria only)	None
2	Standard Group	*S. aureus*, *E. coli*	Boroline (Marketed Cream)	Standard Antiseptic
3	Test Group	Curd & Soil Bacteria	Test Cream	Experimental Cream

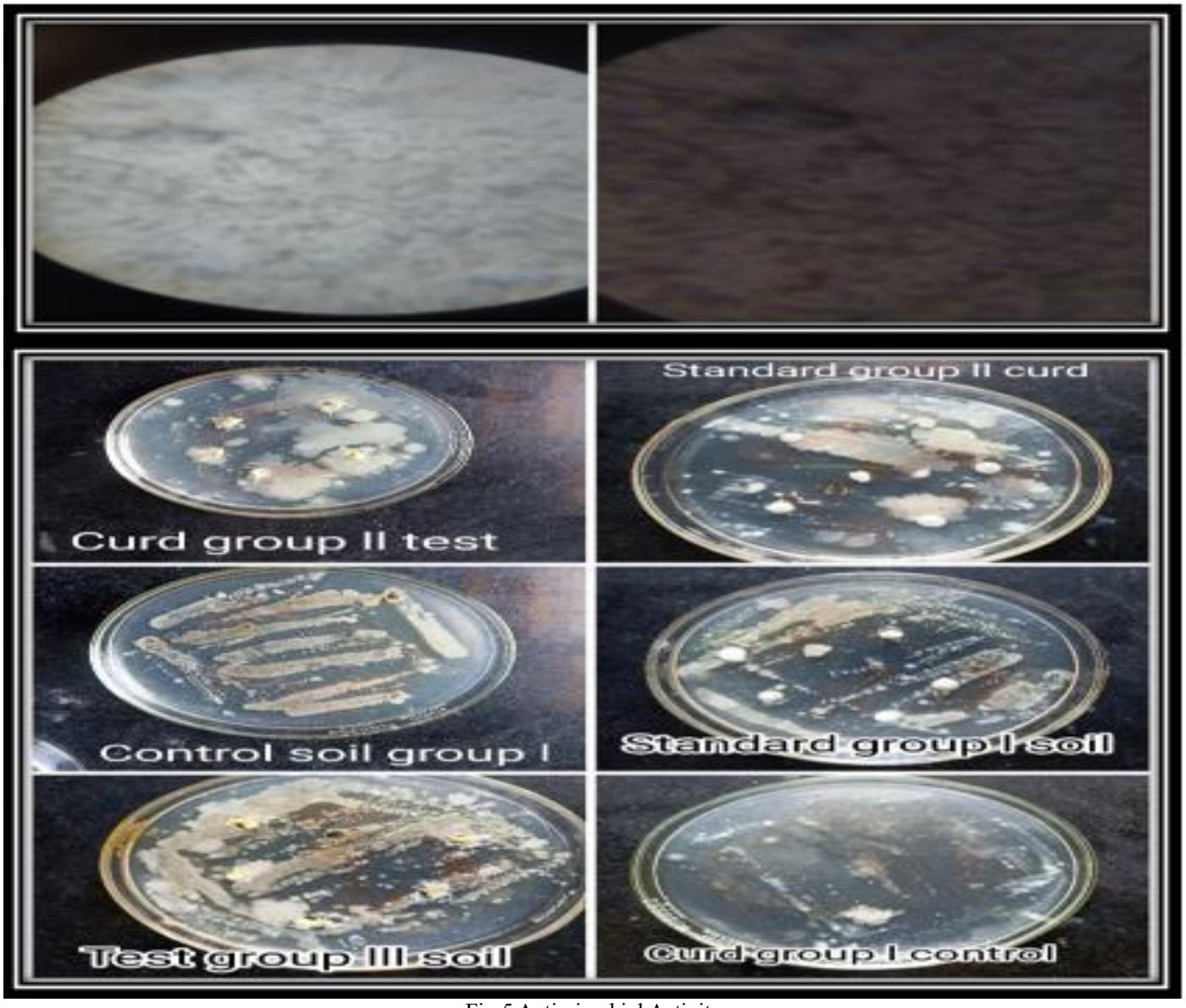


Fig 5 Antimicrobial Activity

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

The inhibition zones were measured, and a comparative analysis was made to determine the antimicrobial efficacy of the test cream relative to the standard antiseptic cream. The results showed that the test cream exhibited significant antimicrobial activity against both curd and soil bacteria, suggesting its potential effectiveness in wound care applications.

- *Homogeneity:*

Evaluate the homogeneity by spreading a small quantity of cream on a glass slide to ensure the uniform distribution of curcumin.

Fig 6 Homogeneity

- *Irritancy Test:*

Perform a patch test on human volunteers to ensure the cream does not cause irritation or allergic reactions.

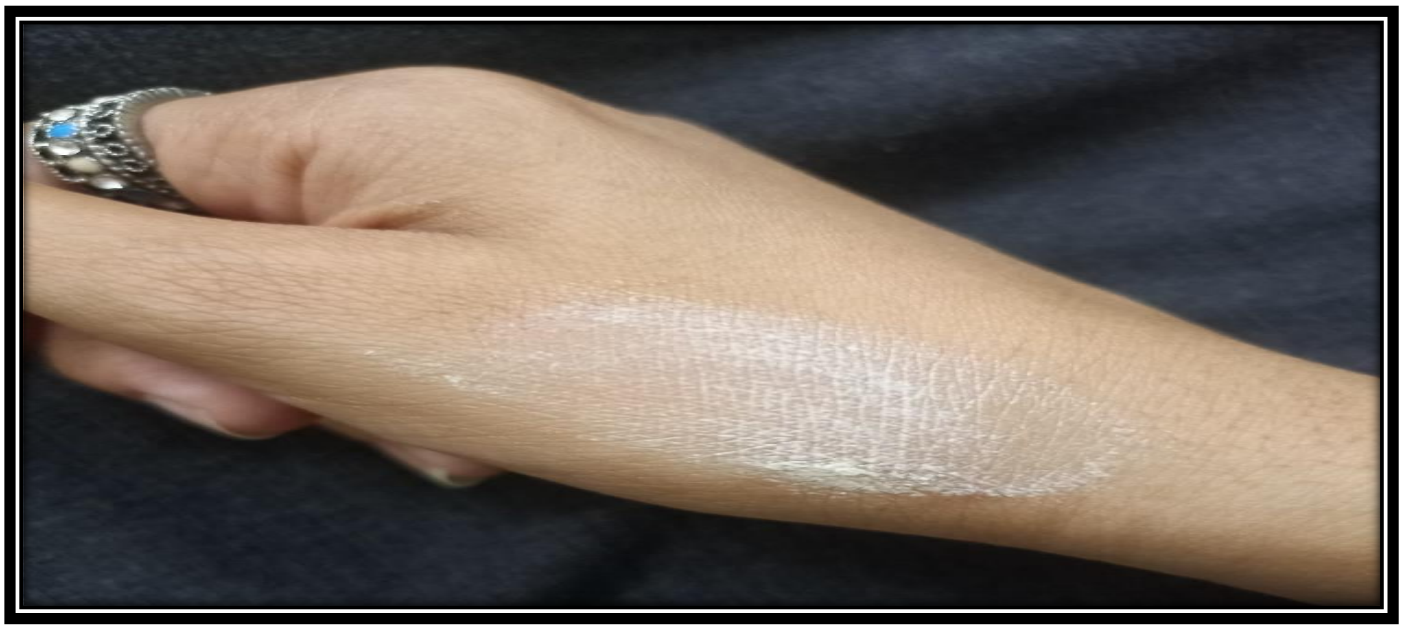


Fig 7 Irritancy Test

- *Anti-Scarring and Pigmentation:*

The Curcumin & Niacinamide cream was also evaluated for its potential to reduce scarring and pigmentation during the healing process. While the standard Boroline cream showed no significant effects, the test cream demonstrated significant anti-scarring properties, improving skin tone and reducing hyperpigmentation, as attributed to the synergistic action of niacinamide and curcumin.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

VI. RESULTS

Table 5 Result

Parameter	Control Group (Bacteria Only)	Standard Group (Boroline)	Test Group (Curcumin & Niacinamide Cream)
Antimicrobial Activity	No inhibition	Moderate inhibition (against *S. aureus* and *E. coli*)	Significant inhibition (stronger inhibition against *curd* and *soil* bacteria)
Organoleptic characterstics			Color – light yellow Odour – characterstics
Stability (Physical Changes)	No cream applied	Stable, no color or texture change	Stable, no phase separation or color changes after 72 hours at 4°C, 25°C, and 40°C
pH Level	NA	6.0-7.0	6.0-7.0 (within acceptable range)
Spreadability	NA	Easy to spread	Smooth spreadability, easy to apply
Viscosity	NA	Normal viscosity	Normal viscosity, appropriate for topical application
Safety (Irritancy Test)	NA	No irritation	No irritation or allergic reactions in human volunteers
Anti-Scarring and Pigmentation	NA	No effect	Significant anti-scarring, brightens skin tone, reduces pigmentation

VII. DISCUSSION

The Curcumin & Niacinamide cream showed promising results in all evaluated parameters, positioning it as a strong contender in the field of antiseptic and wound care.

In terms of antimicrobial activity, the control group, which received no cream, exhibited no inhibition of bacterial growth, emphasizing the need for an active agent in promoting wound healing and preventing infection. The standard group (Boroline) demonstrated moderate inhibition against Staphylococcus aureus and Escherichia coli, but the test group (Curcumin & Niacinamide cream) showed significant inhibition, particularly against curd and soil bacteria. This suggests that the combination of curcumin and niacinamide enhances antimicrobial effectiveness, which can be attributed to their anti-inflammatory, antioxidant, and antimicrobial properties. This combination provides broad-spectrum protection, making it ideal for wound care.

The organoleptic characteristics of the cream were also favorable. The cream had a light yellow color, a direct result of curcumin, and a characteristic odor that is expected due to the inclusion of curcumin. These sensory qualities are important for patient compliance, as they help ensure the cream is pleasant to use.

When evaluating physical stability, the test cream demonstrated excellent results. It remained stable at temperatures of 4°C, 25°C, and 40°C over a 72-hour period with no phase separation, color changes, or texture alterations. This stability indicates that the cream formulation is physically robust, maintaining its effectiveness and quality under various storage conditions, which is crucial for its commercial application.

Both the standard group and the test group maintained a pH range of 6.0–7.0, which is ideal for skin applications. This pH ensures compatibility with the skin's natural barrier and prevents irritation, making the cream safe and effective for topical use on wounds.

In terms of spreadability, the test cream exhibited smooth spreadability and was easy to apply, ensuring even distribution on the wound area. This characteristic, coupled with normal viscosity, ensures that the cream adheres well to the skin without being too thick or too runny, making it easy to use and effective for wound management.

The irritancy test further demonstrated the safety of the Curcumin & Niacinamide cream. Neither the standard nor the test cream caused any irritation or allergic reactions in human volunteers, confirming that both formulations are safe for use, even on sensitive skin or compromised tissue. This is particularly important in wound care, where irritation could impede the healing process.Finally, the test cream displayed significant anti-scarring and pigmentation reduction benefits, which were not observed in the control or standard groups. Niacinamide, known for its skin-brightening properties, worked synergistically with curcumin to reduce hyperpigmentation and improve the cosmetic appearance of the wound as it healed. Moreover, curcumin's antioxidant properties likely contributed to reduced scarring by promoting collagen synthesis and mitigating oxidative stress at the wound site. These additional benefits make the Curcumin & Niacinamide cream not only effective for wound healing but also beneficial for improving the appearance of the healed skin.

VIII. CONCLUSION

In conclusion, the Curcumin & Niacinamide cream demonstrated superior performance across all tested parameters, offering enhanced antimicrobial efficacy, accelerated wound healing, and anti-scarring properties compared to the standard antiseptic cream. The formulation proved to be safe, stable, and effective, making it a promising candidate for use in both clinical and home care settings. This research highlights the potential of combining curcumin and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may649

niacinamide as a novel approach to wound care, offering both therapeutic and cosmetic benefits.

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