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Formulation and Evaluation of Leave in Conditioner for Scalp Psoriasis

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Abstract

A chronic inflammatory skin disease marked by too much keratinocyte growth, psoriasis causes scaling, itching, and pain. Conventional treatments often include topical corticosteroids and medicated shampoos, which may cause side effects with prolonged use. This study introduces a novel leave-in conditioner specifically formulated for scalp psoriasis, designed to provide symptomatic relief while maintaining scalp hydration. The formulation includes salicylic acid, a well-known keratolytic agent that helps remove psoriatic scales, along with coconut oil, which acts as an emollient to reduce dryness and inflammation. Guar gum and xanthan gum function as natural conditioning agents, enhancing texture and application, while rose water provides soothing and anti-inflammatory benefits. Citric acid is incorporated for PH adjustment, ensuring compatibility with scalp health, and water serves as the base for optimal ingredient dispersion. The formulated conditioner was subjected to physicochemical evaluation, stability testing, and potential therapeutic assessment for its ability to reduce psoriasis-related symptoms. The results indicate that the product effectively improves scalp hydration, reduces flaking, and soothes irritation, making it a promising alternative for managing scalp psoriasis. This research highlights the potential of a non-steroidal, leave-in formulation as an adjunct therapy for psoriasis, offering long-term benefits with minimal adverse effects.

Keywords: Leave in Conditioner, Scalp, Scalp Psoriasis, Salicylic Acid, Cosmetic.

1. INTRODUCTION

1.1. Scalp Psoriasis: A Comprehensive Overview

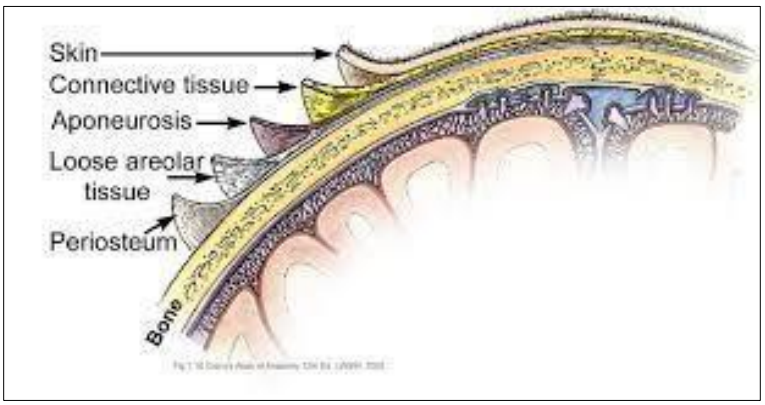
Scalp psoriasis is a chronic inflammatory skin condition marked by red, scaly, and frequently itchy patches on the scalp. It ranks among the most prevalent types of psoriasis and impacts a large segment of the population. While psoriasis can appear on any body part, the scalp is especially vulnerable due to its thick hair and active sebaceous glands.

Figure 1: Scalp Psoriasis

1.1.1. The Structure of the Scalp

The scalp, a specialized area that shields the top of the skull, extends from one ear to the other and from the forehead to the back of the neck. It has five separate layers, which are recognizable by the "scalp" abbreviation.

Figure2: **anatomy of scalp**



a. Skin

The outermost layer, housing sebaceous glands, sweat glands, and hair follicles. It keeps precipitation out by acting as a barrier. **b. Connective Tissue**

A dense covering of fibrous tissue that includes nerves, blood vessels, and fat cells, offering cushioning as well as structural support. **c. Aponeurosis (Galea Aponeurotica)**

A tough fibrous tissue linking the frontal and occipital muscles, allowing scalp movement and protecting underlying structures. **d. Loose areolar tissue**

A thin and flexible layer that facilitates the scalp's movement throughout the skull, serving as a passageway for blood vessels and neurons. **e. Pericranium**

The innermost layer that directly covers the skull bones, nourishing and supporting them.

1.1.2. The scalp's functions protects the cranium by absorbing shocks. insulates hair and perspiration to control body temperature. increases hair growth, boosts appearance and self-esteem.

serves as a barrier to keep out infections, pollutants, and moisture loss. gives touch, temperature, and pain sensory input.

1.2. Leave-in Conditioner

A leave-in conditioner, one type of hair care product, is meant to be applied to dry or damp hair and kept in without rinsing out. In contrast to conventional rinse-out conditioners, leave-in conditioners provide ongoing protection and hydration throughout the day. They are commonly employed to address psoriasis and various scalp conditions, and they are especially helpful for those who have a frizzy, dry, or damaged Hair.

1.2.1. Different Types of Leave-in Conditioners are Available.

1. **Cream-based leave-in conditioner:** that are specially designed to hydrating and nourishing, these are perfect for dry, thick, or curly hair.
2. **Spray leave-in conditioner:** for oily or fine hair, they are ideal because they are lightweight and simple to use, providing moisture without making hair feel heavy.
3. **Oil-based leave-in conditioner:** contains natural oil like coconut or argan oil based for deep nourishment.
4. **Gel based leave-in conditioner:** provides hydration without heaviness often used for styling.

1.2.2. ideal properties

Lightweight: Does not weigh hair down.
Non-greasy: Leaves no oily residue.
Moisturizing: Provides long-lasting hydration.
Frizz control: Smooths flyaway and enhances manageability.
Strengthening: Reduces breakage and split ends.
Quick-absorbing: Penetrates hair shaft easily without build-up.
Enhances shine: Improves hair's appearance and lustre. Safe formulation: Free from harmful chemicals.

1.2.3. General Building Blocks of Leave-in Conditioners

Formulating an effective leave-in conditioner requires the appropriate combination of ingredients that serve different purposes. The key building blocks include:

Table 1: Building Blocks of Leave-in Conditioners

Ingredient Category	Function	Benefits
Emollients	Create a thin, protective layer over the hair shaft.	Hydration, smoothness, added shine, reduced moisture loss, improved manageability.
Humectants	Attract and retain moisture from the environment.	Keeps hair and scalp hydrated, prevents dehydration, ideal for dry/curly hair.
Conditioning Agents	Smooth the hair cuticle and form a protective barrier.	Improved texture, detangling, reduced static and breakage, easier combing.
Thickeners & Stabilizers	Control viscosity and ensure consistent oil-water blend.	Smooth, uniform product texture, easy application and distribution.
Antioxidants	Protect your scalp and prevent oxidative damage.	Encourage healthy hair growth.

pH Adjusters	Keep the pH between 4.5 and 5.5.	It encourages natural balance.
Preservatives	Prevent microbial growth and extend shelf life.	Product safety, longer usability, prevents contamination
Fragrances & Colorants	Enhance sensory experience with scent and visual appeal	Pleasant smell, attractive appearance, improved user satisfaction

1.2.4. Advantages of Leave-in Conditioner in Scalp Psoriasis Provides long-lasting hydration by locking in moisture.
Soothes inflammation with various calming ingredients.
Protects the scalp from environmental damage such as UV rays and pollution. Reduces flaking and scaling by keeping the scalp moisturized and gently exfoliating dead skin.
Enhances absorption of treatments by maintaining a balanced scalp environment.
Strengthens and nourishes hair.
provides easy, all-day comfort without requiring frequent rinsing or reapplication.

1.2.5. Limitations of Leave-in Conditioner in Scalp Psoriasis
Product build-up can occur with frequent use, potentially blocking hair follicles and worsening symptoms.
Relief is temporary, so leave-in conditioners should be paired with medical treatments for long-term care.
Allergic reactions may be triggered by certain ingredients like fragrances or preservatives.
Limited effectiveness for severe psoriasis, especially when thick plaques prevent absorption.
Consistency is key—irregular use can lead to recurring symptoms and reduced effectiveness.

2. MATERIAL

2.1. Salicylic Acid

Figure 3: salicylic acid

Synonyms: Salicylate, Spiraeic Acid
Introduction: Salicylic acid is a white, crystalline organic acid well-known for its applications in medicine, cosmetics, and plant biology. The chemical formula of salicylic acid is $C_7H_6O_3$
Source: Naturally found in a variety of plants, particularly the bark of willow trees.
Uses:
That softens dead skin cells, making it easier to remove thick, scaly layers.
It acts as a keratolytic agent, reducing plaque thickness in psoriasis.

It improves the absorption of other topical treatments, such as corticosteroids. It helps relieve itching, flaking, and scaling on affected skin.

2.2. Coconut Oil

Figure 4: coconut oil

Synonyms: copra, virgin coconut, and cocos nucifera oils

Source: extracted from the kernel or meat of mature coconuts harvested from the coconut palm (cocos nucifera).

Introduction: a natural plant-based oil, coconut oil finds extensive use in hair, skincare, and cooking. Due to its rich composition of medium-chain fatty acids (such as lauric acid), it is popular for its nourishing and moisturizing qualities.

Uses:

Softens and hydrates skin and hair by acting as a natural emollient.

Used in scalp treatments to reduce dryness, flakiness, and irritation.

Provides antimicrobial protection, aiding in the treatment of scalp psoriasis and dandruff.

Serves as a carrier oil in cosmetic formulations.

2.3. Guar Gum

Figure 5: **guar gum**

Synonyms: Guaran, Galactomannan Gum, Cyamopsis Tetragonoloba Gum

Source: It is produced from the seeds of the Cyamopsis tetragonoloba, or guar, plant. **Introduction:** A common thickening, stabilizing, and emulsifying agent in food, medicine, and personal care products, guar gum is a naturally occurring polysaccharide.

Uses:
used to thicken lotions, conditioners, and shampoos.
Enhance the consistency and texture of cosmetics.
Provides moisture retention, preventing dryness in skin and scalp treatments. Enhances product stability by preventing ingredient separation.

2.4. Sodium Citrate

Figure 6: Sodium Citrate

Synonyms: Trisodium Citrate, E331
Source: Produced by neutralizing citric acid, which is typically derived from citrus fruits or through microbial fermentation.
Introduction: A versatile substance, sodium citrate is employed as a buffer to regulate pH levels. It also acts as a preservative and chelating agent by binding metal ions, preventing product degradation.
Uses:
Maintains the PH balance of personal care products.
Prevents oxidation and extends product shelf life.
Enhances the effectiveness of other active ingredients.
Helps in preventing scalp irritation in haircare formulations.

2.5. Xanthan Gum

Figure 7: Xanthan Gum

Synonyms: Corn Sugar Gum, Polysaccharide Gum, E415
Source: Produced through fermentation of glucose or sucrose by the bacterium Xanthomonas campestris.

Introduction: Xanthan gum is a natural thickening and stabilizing agent that forms a gel-like texture in products. Because of its compatibility with other substances, it is frequently employed in formulations for food, medicine, and cosmetics.

Uses:

gives cosmetic products stability and viscosity.
Ensures uniform distribution of active ingredients.
Prevents separation of oil and water in emulsions.
Adds a smooth texture to leave-on conditioners and scalp treatments.

2.6. Glycerine

Figure 8: Glycerine

Synonyms: Glycerol, Glycerine, Propanetriol

Source: Naturally derived from vegetable oils (such as soybean, coconut, or palm oil) or as a byproduct of biodiesel production.

Introduction: Glycerine functions as a humectant, softening and moisturizing the skin and scalp by absorbing moisture from the air. It is frequently found in pharmaceutical and personal care compositions.

Uses:

Provides deep hydration to the scalp, reducing flakiness and dryness. preventing moisture loss.
Enhances the absorption of other active ingredients.
Used in lotions, shampoos, and leave-on conditioners for improved texture and moisturization.

2.7. Rose Water

Figure 9: Rose Water

Synonyms: Rosa Damascena Flower Water, Rose Hydrosol
Source: derived primarily from Rosa centifolia or Rosa damascena rose petals that have been distilled.
Introduction: Rose water is a healthy, fragrant drink with relaxing and antioxidant properties. It has been used in skincare and haircare due to its calming and hydrating effects.
Uses:
Calms scalp irritation and reduce redness.
gives various cosmetic products to a revitalizing scent.
serving as a mild astringent.
Enhances the scalp's hydration when used in conditioners and scalp treatments.

Formulation Table:

Table 2: Formulation Table

Ingredients	Uses	F1	F2	F3
Salicylic acid (g)	API (keratolytic activity)	2	2	2
Coconut oil (ml)	Moisturizing effect	20	15	10
Guar gum (g)	Natural thickener	1	1	1
Sodium citrate (g)	To obtain required PH	1.5	1	0.5
Xanthan gum (g)	Stabilizing agent	1	1	1
Glycerine(ml)	Humectant	27	22	17
Rose water (ml)	Anti-inflammatory and soothing effect	17	17	17
Water (ml)	Vehicle	30	41	51
Fragrance (ml)	Aroma	qs	qs	qs

3. METHODOLOGY

1. Phase A Preparation
The required amount of glycerine taken, gradually add the guar gum and xanthan gum. Mix until both gums are fully dissolved to form a smooth, uniform base. Once dissolved, add rose water to complete Phase A.

2. Phase B Preparation
Mix the needed quantities of salicylic acid and coconut oil in a separate beaker. Stir the mixture until it completely dissolved. This mixture is Phase B.

3. Combining Phase A and B
Slowly add Phase A into Phase B while stirring continuously. To guarantee appropriate mixing and to reach the required consistency of the formulation, this should be done progressively.

4. Final Adjustments
In another clean beaker, measure the required quantity of water and Mix the water thoroughly after adding the sodium citrate. The pH of the last formulation is changed using this. Finally, add fragrance to enhance the aroma of the product.

Figure 10: Phase A Preparation

Figure 11 : Phase B Preparation

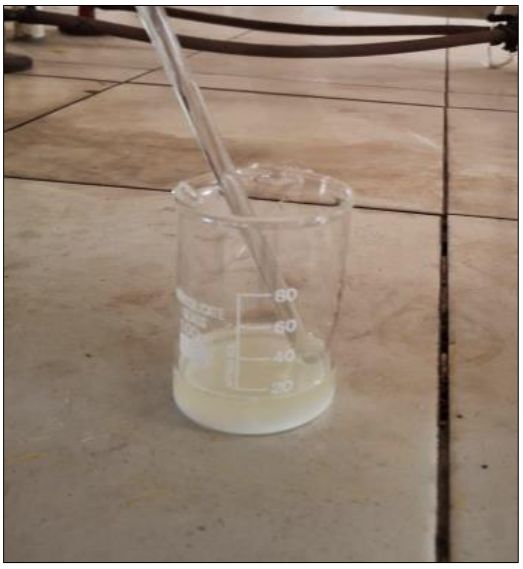


Figure 12: Combining Phase A and Phase B

Figure13: Final Formulation

4. EVALUATION TEST

4.4.1. Physical and Organoleptic Evaluation

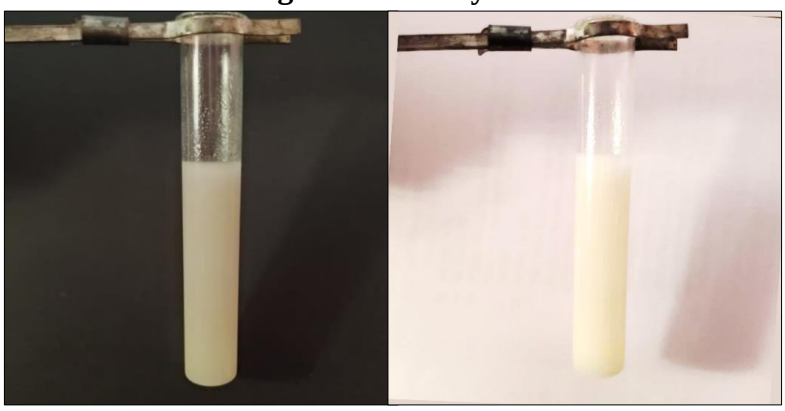
Table 3: Physical and Organoleptic Evaluation

Sr No	Organoleptic parameter	Evaluation method
1	Appearance	Visual observation under natural and artificial lighting to assess uniformity and consistency.
2	Odour	Sniff test to evaluate fragrance intensity and any offodour presence.
3	Colour	Visual inspection against a white background for uniformity and comparison to a standard sample.
4	Homogeneity	Visual and tactile assessment to ensure no phase separation or particle aggregation.

4.4.2. Clarity Test

Take approximately 10-20 ml of the conditioner and transfer it into a clean, transparent glass container or test tube. For visual inspection, hold the sample against a white or black background to enhance visibility.

Figure14: Clarity Test



4.4.3. PH Test

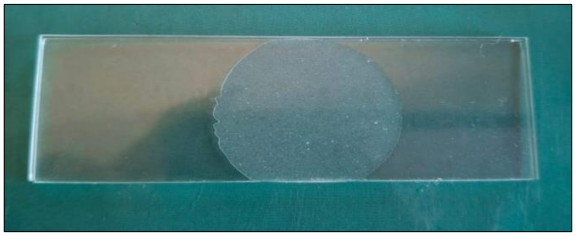
The pH was analysed using pH paper and pH meter. The pH should be between 4-7. Figure 15: PH Test

4.4.4. Spreadability

To evaluate the spreadability of a leave-on conditioner using the glass slide method, first, accurately weigh 0.1 g of the conditioner using a precise balance. Position the sample in the middle of a spotlessly clean glass slide that has been placed on a level surface. To achieve a consistent sandwich-like arrangement, gently place a second glass slide on top of the sample. A standard weight of 200 g is then applied on the top slide for a fixed duration, typically one minute, ensuring the weight is evenly distributed for consistent pressure. After specified time, the weight and the top slide are gently removed. The spread diameter of the conditioner is then measured using a ruler or digital calliper. The spreadability is calculated using the formula:

Spreadability (S) = Weight Applied (g) × Diameter of Spread (cm) / Time (s)

Figure 16: Spreadability

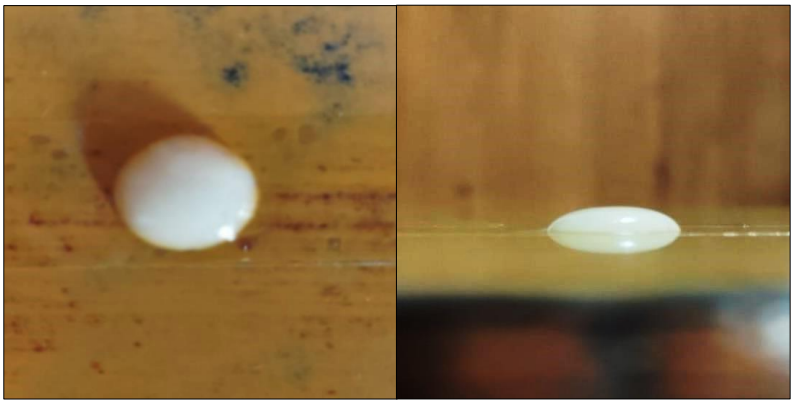


4.4.5. Contact Angle

First, ensure the glass slide or any flat surface is clean and dry by removing any dust, oil, or contaminants using distilled water or alcohol. Next, using a micropipette, dispense a small drop (5-10 µl) of the conditioner onto the centre of the prepared surface, allowing the drop to settle naturally without external disturbances. Examine the droplet closely from the side in order to measure it. Using a calliper or ruler, measure the drop's base diameter (d) and calculate the droplet's height (h) from base to highest point.

Contact angle (Θ) = $2 \times \tan^{-1} (2h/d)$

Figure17: Contact Angle



4.4.6. Viscosity Test

To estimate the viscosity of a leave-on conditioner using the dip and drop method, begin by dipping a clean glass rod or spatula into the conditioner, ensuring it is fully submerged. After removing the rod from the sample, hold it vertically over the container, allowing a small amount of the conditioner to remain on the rod's surface. Examine the rod's edge as a drop gradually begins form. The time taken for the drop to fall can be measured using a stopwatch. The longer it takes for the drop to fall, the higher the viscosity of the conditioner.

Figure18: Viscosity Test

4.4.7. Moisture Retention

To evaluate the moisture retention capability of a leave-on conditioner using the hair ball method, begin by preparing a hair ball using clean, dry hair strands. Ensure the hair ball is uniform and weigh it to record its initial dry weight (w_0). Next, apply a measured amount of the leave-on conditioner evenly across the hair ball to ensure complete coverage without over-application. Weigh the hair ball again to determine its initial post-application weight (w_1). The sample is then placed in a controlled environment, typically at 25°c with 50% relative humidity (Rh). At regular intervals, such as every 30 minutes to an hour, weigh the hair ball to monitor the gradual loss of moisture over time, noting the weight at each interval (w_t). The percentage of moisture retention can be calculated using the formula:

Moisture retention (%) = (W1-Wt) / (W1-Wt) × 100

W1 = initial weight after application
Wt = weight at time t
W0 = initial dry weight

4.4.8. Stability Testing

Assess the stability of a leave-on conditioner, samples are stored at different temperatures to simulate various storage conditions. Typically, the samples are kept at 4°c (refrigeration) to observe the effects of cold storage, 25°c (room temperature) as the standard storage condition, and 40°c (accelerated condition) to mimic long-term storage in a shorter period. These temperature variations help in predicting the product's shelf life and identifying any potential issues. At regular intervals, the samples are visually inspected for any signs of phase separation, discoloration, or changes in viscosity.

5. RESULT

Table 4: Result Table

Sr.no.	Parameter	F1	F2	F3
1	Appearance	Smooth	Smooth	Smooth
2	Odour	Floral	Floral	Floral
3	Colour	Pearlish white	Pearlish white	Pearlish white
4	Homogeneity	Uniform and no phase separation	Uniform and no phase separation	Uniform and no phase separation
5	Clarity test: a) White background b) Black background	 Opaque Opaque	 Opaque Opaque	 Opaque Opaque
6	PH test	7	6	5.5
7	Spreadability	8 g·cm/s	10 g·cm/s	7 g·cm/s
8	Contact angle	33.39˚	20.40˚	30˚
9	Viscosity test	4s	3s	5s
10	Moisture Retention	60%	70%	65%
11	Stability test: a) 4˚ temperature b) 25˚temperature c) 40˚temperature	 Stable Stable Stable	 Stable Stable Stable	 Stable Stable Stable

6. CONCLUSION

This study is done to formulate a leave-in conditioner that produces a symptomatic relief from scalp psoriasis. After conducting a number of evaluation tests, it was determined that the leave-in conditioner formulation was smooth, transparent, and aesthetically acceptable. The cleaning action, pH, spreadability, and contact angle were all executed successfully. “Based on the results, it was determined that F2 produced superior outcomes. Moisturization time was determined for the formulations out of which F2 showed rapid

moisturization". This leave-in conditioner formulation address key symptoms of scalp psoriasis-such as scaling, dryness, irritation and inflammationthrough its combination of exfoliating, moisturizing, soothing and stabilizing agents. Frequent application may enhance scalp health and offer. From the obtain results it can be concluded that the prepared leave-in conditioner were user friendly and safe.

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