Development and In-vitro Assessment of Herbal Serum and Paper Soap Incorporating Acorus calamus Linn. and Acalypha indica Linn. for Psoriasis

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***Abstract*—Psoriasis is a chronic autoimmune skin disorder characterized by erythema, scaling, and inflammation, significantly affecting patient quality of life.**

Conventional therapies, while effective, are often associated with adverse effects and long-term safety concerns, prompting the need for safer and more sustainable alternatives. Herbal formulations have gained increasing attention due to their therapeutic efficacy and minimal side effects.

The present review focuses on the development and in-vitro evaluation of herbal serum and paper soap incorporating Acorus calamus Linn. and Acalypha indica Linn., both of which possess well- documented pharmacological activities including anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties. The formulation approaches for serum and paper soap are discussed, emphasizing ingredient compatibility, stability, and skin permeability.

Furthermore, the review highlights key evaluation parameters such as pH, viscosity, spreadability, drug content, antimicrobial activity, antioxidant assays, and stability studies. Special attention is given to in-vitro models used to assess anti- psoriatic potential. The incorporation of herbal extracts into innovative dosage forms like paper soap offers advantages in terms of portability, hygiene, and ease of application.

In conclusion, the integration of Acorus calamus and Acalypha indica into topical formulations represents a promising approach for psoriasis management.

However, further clinical investigations are necessary to validate their efficacy and safety in human subjects

***Index Terms*—Psoriasis, Acorus calamus linn, Acalypha indica linn, herbal serum, Paper soap.**

I. INTRODUCTION

1.1. Psoriasis

Psoriasis is a chronic, immune- mediated inflammatory skin disorder characterized by erythematous plaques, scaling, and epidermal hyperproliferation. It affects millions worldwide and significantly impacts quality of life. The pathogenesis involves dysregulation of immune pathways, particularly T-cells and cytokines, leading to excessive keratinocyte proliferation and inflammation.[1]

Conventional treatments such as corticosteroids, retinoids, and immunosuppressants provide symptomatic relief but are associated with adverse effects, toxicity, and recurrence upon discontinuation. This has driven interest toward herbal therapies that offer safer and long-term management options.[2]

Type o Psoriasis

A. Plaque Psoriasis (Psoriasis Vulgaris)

Plaque psoriasis is the most common form, accounting for about 80–90% of cases [3]. It is characterized by well-demarcated erythematous plaques covered with silvery- white scales, commonly affecting the scalp, elbows, knees, and lower back [4].

B. Guttate Psoriasis

Guttate psoriasis presents as small, drop- shaped lesions, mainly on the trunk and limbs. It is frequently triggered by streptococcal infections and is more common in children and young adults [5].

C. Inverse Psoriasis (Flexural Psoriasis)

Inverse psoriasis affects intertriginous areas such as the axillae, groin, and inframammary regions. Lesions

are smooth, erythematous, and typically lack scaling due to moisture and friction [6].

D. Pustular Psoriasis

Pustular psoriasis is characterized by sterile pustules on an erythematous base and may be localized or generalized. Generalized pustular psoriasis is a severe condition that may require hospitalization [7].

E. Erythrodermic Psoriasis

Erythrodermic psoriasis is a rare but life- threatening form involving widespread erythema and scaling across most of the body surface. It can lead to complications such as fluid imbalance and temperature dysregulation [8].

F. Nail Psoriasis

Nail psoriasis affects fingernails and SKIN:

Skin is the largest organ of the

toenails, causing pitting, discoloration, and onycholysis. It is commonly associated with psoriatic arthritis [9].

G. Scalp Psoriasis

Scalp psoriasis presents with thick, scaly plaques on the scalp and may extend beyond the hairline. It can often be confused with dandruff but is more persistent and inflammatory [4].

H. Psoriatic Arthritis

Psoriatic arthritis is an inflammatory joint disease associated with psoriasis, characterized by joint pain, stiffness, and swelling. If untreated, it can lead to permanent joint damage [10].

Figure – 1 [11]. Type of psoriasis

human body and plays a vital role in protecting internal organs from external harm. It acts as a barrier against physical injury, harmful microorganisms, and environmental factors such as heat, cold, and ultraviolet radiation. The skin also helps regulate body temperature, enables the sense of touch, and prevents excessive loss of water from the body. Structurally, the skin is composed of three main layers: the epidermis (outer layer), dermis (middle layer), and hypodermis (inner layer). Each layer has specific functions that contribute to the overall health and protection of the body. Maintaining healthy skin is essential for overall well-being, as it reflects both internal health and external care.

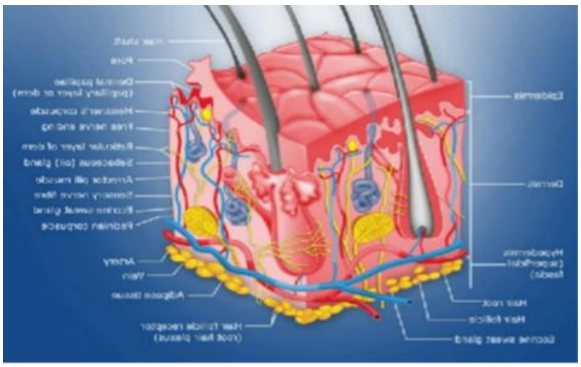

Figure – 2 Skin

1.2. Plant Proifle

1.2.1. Acalypha indica Linn. (Indian Acalypha)

History

Acalypha indica, commonly called Indian copperleaf, is widely used in traditional Indian medicine. It has been included in the Indian Pharmacopoeia and was formerly listed in the British Pharmacopoeia. It is used for treating respiratory disorders, skin diseases, intestinal worms, and wounds [12,13].

Figure – 3 (Acalypha indica)

Family: Euphorbiaceae Common Names: Indian nettle, Kuppaimeni
Biological Source: Leaves of Acalypha indica Linn.
Geographical Source: Widely distributed in India, Sri Lanka, and tropical regions
Morphology: Acalypha indica is an erect annual herb growing up to 30–75 cm in height with ovate leaves and greenish catkin-type inflorescences [14].

Chemical Constituents: The phytochemical composition of Acalypha indica reveals the presence of several biologically active constituents. These include the cyanogenic glycoside acalyphin, along with a variety of flavonoids, alkaloids, tannins. In addition, other compounds such as acalyphamide, aurantia ide, and succinimide have been identified.
Notably, the presence of iridoids. Collectively, these phytochemicals are responsible for the plant's diverse medicinal properties, including expectorant, antimicrobial, and anti- inflammatory activities [13,15]

1.2.2. Acorus calamus Linn. (Sweet Flag)
History
Acorus calamus, commonly known as sweet flag or "Vacha," has been used in Ayurvedic, Chinese, and Greek medicine for centuries. It is traditionally used to improve memory,
speech, and digestion. The plant has also been used in perfumery and as a flavoring agent. However, concerns regarding toxicity of certain constituents have led to restrictions in some countries [16,17].

Figure – 4 (Acalypha indica)

Family: Acoraceae
Common Names: Sweet flag, Vacha Biological Source: Rhizomes of Acorus calamus Linn.
Geographical Source: India, Southeast Asia, Europe

Morphology: Acorus calamus is a semi- aquatic perennial herb with long, sword- shaped leaves and aromatic rhizomes [18].

Chemical Constituents: The phytochemical profile of Acorus calamus is characterized by a rich presence of essential oils and diverse bioactive compounds. The major constituents include β-asarone and α- asarone, which are primarily responsible for its biological activity, along with methyl isoeugenol. The plant also contains a wide range of terpenoids, including monoterpenes and sesquiterpenes, as well as flavonoids, tannins, and saponins.
Additionally, lignans such as magnolin and eudesmin and phytosterols like β-sitosterol have been identified. These phytoconstituents collectively contribute to the plant's pharmacological properties, including antimicrobial and neuroprotective effects [17,19].

3.1herbal Paper Soap
The skin, being the largest organ of the human body, is continuously exposed to environmental pollutants, ultraviolet radiation, and microbial infections. Therefore, the use of cleansing agents that not only remove dirt but also offer protective and healing effects is essential. Herbal soaps fulfill this dual function by incorporating medicinal plant extracts known for their antimicrobial, antioxidant, anti-inflammatory, and wound-healing properties [20,21].
In recent years, there has been significant research interest in the development of herbal soap formulations using medicinal plants such as Acorus calamus and Acalypha indica, which are known for their potent pharmacological activities. Acorus calamus possesses antimicrobial and anti-inflammatory properties due to the presence of essential oils and phenylpropanoids, while Acalypha indica exhibits strong antioxidant and skin-protective effects owing to its rich flavonoid and alkaloid content. The incorporation of such plant extracts into soap formulations enhances their therapeutic efficacy and promotes skin health [22].

1.4. Herbal Face Serum

1.4.1. Properties

Face serums are highly concentrated topical formulations designed to deliver active pharmaceutical and cosmeceutical ingredients deep into the skin layers, characterized by a lightweight, non-greasy consistency and enhanced penetration into targeted skin tissues for managing conditions such as aging, pigmentation, dehydration, acne, and uneven skin tone [23,24].

1.4.2. Skin Damage and Protective Role

The skin is continuously exposed to oxidative stress, ultraviolet radiation, and environmental pollutants that accelerate premature aging and disrupt skin barrier function; face serums help counteract these effects by providing antioxidants, humectants, and bioactive compounds that enhance collagen synthesis, improve hydration, and support skin regeneration [20,24].

1.4.3. Phytochemical Importance

Herbal face serums have gained significant attention due to their safety and multifunctional benefits, as medicinal plants contain bioactive compounds such as flavonoids, tannins, alkaloids, and terpenoids, and plants like Acorus calamus and Acalypha indica are widely explored for their antioxidant, antimicrobial, and skin- protective properties [20,21].

1.4.4. Advanced Drug Delivery Systems

Recent advancements in novel drug delivery systems such as nano emulsions, liposomes, and phytosome-based carriers have improved the stability, bioavailability, and skin permeability of herbal actives, thereby enhancing the therapeutic efficiency of modern face serum formulations in cosmeceutical applications [21,25].

II. MATERIAL AND METHODS

2.1. Methodology

The present study involves the formulation and evaluation of herbal face serum and herbal paper soap incorporating Acorus calamus and Acalypha indica. These medicinal plants were selected due to their well-documented antimicrobial, antioxidant, and anti-inflammatory properties. The methodology includes extraction of plant materials, formulation development, and evaluation of physicochemical and biological parameters based on standard protocols reported in recent literature [26,27,28].

2.2. Materials

2.2.1. Plant Materials

- Rhizomes of Acorus calamus were collected and used for extraction.
- Fresh leaves of Acalypha indica were collected and processed.

2.2.2. Chemicals and Reagents

All chemicals used were of analytical grade:

- Ethanol / Methanol (solvent for extraction)
- Distilled water
- Carbopol 940 (gelling agent)
- Glycerin (humectant)
- Propylene glycol (penetration enhancer)
- Triethanolamine (pH adjuster)
- Tween 80 (emulsifier)
- Polyvinyl alcohol (PVA) (film- forming agent)
- Gelatin / starch
- Sodium lauryl sulfate (surfactant)
- Preservatives (methyl paraben / sodium benzoate)

2.3. Methods

2.3.1. Preparation of Plant Extracts

A. Extraction of Acorus calamus

The rhizomes were washed thoroughly to remove dirt and dried under shade for 7–10 days. The dried material was pulverized into coarse powder.

Approximately 100 g of powder was subjected to Soxhlet extraction using ethanol as solvent for 6–8 hours. The extract was filtered and concentrated using a rotary evaporator under reduced pressure. The concentrated extract was stored in an airtight container at 4°C until further use [26].

B. Extraction of Acalypha indica

Fresh leaves were washed, shade dried, and powdered. The powdered material was subjected to maceration using methanol or hydroalcoholic solvent (70% ethanol) for 48–72 hours with intermittent shaking. The extract was filtered and concentrated using evaporation techniques. The dried extract was stored for formulation purposes [27].

Plant	Extract	Colour	Consistency	Yield in= (%w/w)
1.Acorous calamus	50 %Aqueous –ethanol	Blackish Brown	Greasy	6.8
2 acalyp haindica	50 % M Aqueous – t han ol	Blackish Brow n	Greasy	7.2

2.4. Formulation of Herbal Face Serum

❖ Composition

➢ Plant extracts (active ingredients)

➢ Carbopol 940 (gelling base)

➢ Glycerin and propylene glycol (moisturizers)

➢ Tween 80 (emulsifier)

➢ Preservative and distilled water

Figure – 5 (Herbal serum)

❖ Method of Preparation

✓ Carbopol 940 was dispersed in distilled water and allowed to hydrate for 2–3 hours.

✓ Glycerin and propylene glycol were added under continuous stirring.

✓ Measured quantities of Acorus calamus and Acalypha indica extracts were added gradually.

✓ Tween 80 was incorporated to enhance solubility of phytoconstituents.

✓ Triethanolamine was added dropwise to adjust pH (5–6) and form gel consistency.

✓ Preservatives were added, and the formulation was homogenized.

✓ The prepared serum was filled into suitable containers and stored at room temperature [28].

❖ Evaluation of Herbal Face Seru

a) Organoleptic Properties

✓ Color

✓ Odor

✓ Appearance

✓ Homogeneity

b) Physicochemical Evaluation pH: Measured using digital pH meter Viscosity: Determined using Brookfield viscometer

Spreadability: Evaluated using glass slide method

c) Stability Studies

The formulation was stored at 4°C ,25°C and 40°C. Observed for changes in pH, color, and phase separation over time.

d) Biological Evaluation

Skin irritation test: Performed on human volunteers/animal model

Antioxidant activity: DPPH assay

Microbial testing: Standard plate count method

2.2.4 Formulation of Herbal Paper Soap Figure – 6 (paper soap)

2.2.4.1 Composition

➢ Polyvinyl alcohol (film- forming agent)

➢ Gelatin/starch (support matrix)

➢ Glycerin (plasticizer)

➢ Sodium lauryl sulfate (cleansing agent)

- ➢ Plant extracts
- ➢ Distilled water

2.2.4.2 Method of Preparation

- ✓ Polyvinyl alcohol was dissolved in hot distilled water with constant stirring.
- ✓ Gelatin or starch was added and mixed thoroughly.
- ✓ Glycerin was incorporated to improve flexibility of film.
- ✓ Sodium lauryl sulfate was added as surfactant.
- ✓ Extracts of Acorus calamus and Acalypha indica were added.
- ✓ The solution was poured onto a glass plate.
- ✓ It was allowed to dry at room temperature for 24 hours.
- ✓ The dried film was carefully peeled and cut into uniform strips [29].

2.2.4.3 Evaluation of Herbal Paper Soap A] Organoleptic Evaluation

- Color
- Odor
- Texture
- Transparency

B] Physicochemical Tests

a) pH determination:

The pH was determined before and after the preparation of paper soap. At first the liquid soap was prepared and the pH was detected by using litmus paper the result was red litmus paper turned blue in colour and blue litmus remained unchanged. Then after the production of paper soaps the piece of paper soap was taken an added into water a then Shaked fully then the pH meter was used for testing of pH.

b) Foam retention:

The soap strips were taken and added in water solution in a measuring cylinder the cylinder was covered with hand and was shaken for 10 times. The volume of the foam was checked in 1 minute interval. The foam heigh was found to be

c) Foam Height:

Foam Height: The sample was dispersed in 20 ml of distilled water and then transferred into the measuring cylinder and then it was Shaked for a min and immediately its foam height was calculated as F1 and then after 10 – 15 min measure the foam height and the foam height were measured and noted as F2 it should be 2 cm.

Foam height calculation = F1 – F2

F1 -3.5cm and F2- 1.5cm

Therefore, the foam height was =3.5-1.5 = 2cm

d) Anti-microbial activity:

There was various study conducted on antimicrobial activity of paper soap conducted using Acorous calamus and acalypha indica plant as a herbal extract. Microbial study was done using microorganisms. For checking the effectiveness of the herb uses the fungi a virus was grown in the culture media the soap strip was placed in the surface of the agar media then it was placed in the incubator for about 24 hrs at 30 c The herb diffuses out of the strip into the agar the microbials activity was recorded.

e) Total moisture content:

The moisture content was estimated by measuring the weight of water content in soap and the difference in the weight after the paper soap is fully dried in 100 to 115 c or by using dryer. The formulae used to find the moisture content is:

%Moisture content = initial weight – final weight / final weight *100

Initial weight = W1 Final weight = W2

Therefore,

%Moisture content = W1 – W2 / W1*100

f) Determination of % free alkali:

One piece of sample was added and boiled in alcohol for 30 min under reflux water bath, then cooled and phenolphthalein was added and then titrated in 0.1 N HCL solution.

g) Stability Test:

Short term stability studies were done in the period of 8 days for the formulations. The sample was stored in different storage temperature i.e., room temperature 37^0C and at refrigerator 2 to 800C. Sample was withdrawn on interval and analyzed for visual appearance, clarity, pH and drug content.

h) Primary skin irritation test:

For this at least three volunteers were selected and prepared soap strips was given an applying in hand the

amount of irritation was been checked.

i) Foam stability test:
Foam stability is the consistency of the amount of foam produces by paper soap. The resulting foam on paper soap is smoother than the regular soap. The foam can be stable in the presence of foaming agent solution containing surface active agent will produce stable foams, when mixes with water Glycerine actually does not contain ant surface active agents and don't have significant effect on foam stability.

j) Saponification test:
The saponification test was done by taking 3 ml of sample i.e., different kind of fats (oil) mixed well with 25 ml of KOH solution and mix well put the mixture into water bath for 30 min and cool add phenolphthalein indicator and triturate it against 0.5 N HCL. Then perform blank titration without taking the sample. The saponification was done by taking both castor oil a coconut oil as fat. The formulae used for calculation of saponification value is

Saponification value = (A-B) * N*56.1/W
k) Statistical Analysis:
All experiments were performed in triplicate and expressed as mean ± standard deviation. Statistical significance was analyzed using standard methods.

III. LIMITATIONS

1. In-vitro Study Constraints
In-vitro models cannot fully replicate the complexity of human skin, especially a chronic condition like psoriasis. Results may not directly translate to in-vivo or clinical outcomes.

2. Lack of Clinical Validation
The study does not include human or animal trials, so therapeutic efficacy and safety in real patients remain unconfirmed.

3. Variability in Herbal Raw Materials The chemical composition of Acorus calamus and Acalypha indica may vary depending on geographical source, harvesting time, and processing, affecting reproducibility.

4. Limited Standardization
Standardizing herbal extracts is challenging due to the presence of multiple active constituents and lack of defined biomarkers.

5. Stability Issues
Herbal formulations, especially serum and paper soap, may face stability problems such as phase separation, color change, or degradation of active compounds over time.

6. Limited Scope of Evaluation
In-vitro assays (anti-inflammatory, antioxidant, antimicrobial) may not cover all pathological aspects of psoriasis like immune dysregulation and keratinocyte proliferation.

7. Regulatory Constraints
Herbal cosmetic/therapeutic hybrids may face ambiguity in regulatory classification, affecting future development.

IV. CHALLENGES

1. Extraction and Optimization
Selecting the appropriate extraction method (solvent, temperature, duration) to obtain maximum bioactive compounds without degradation is complex.

2. Formulation Compatibility Incorporating plant extracts into both serum and paper soap without affecting texture, spreadability, or integrity is technically challenging.

3. Skin Permeation Issues
Ensuring adequate penetration of active constituents through the skin barrier, especially in a non-invasive formulation like serum, can be difficult.

4. Dose Standardization
Determining the effective concentration of extracts for anti-psoriatic activity without causing irritation is a critical challenge.

5. Irritation and Sensitivity Risks Though herbal, Acorus calamus (due to β- asarone content) may pose toxicity or irritation risks if not properly processed and controlled.

6. Evaluation Method Selection
Choosing appropriate and reliable in-vitro

models (e.g., cell lines, enzyme assays) that are relevant to psoriasis pathology can be difficult.

7. Paper Soap Fabrication Achieving uniform thickness, rapid dissolution, mechanical strength, and consistent drug distribution in paper soap is technically demanding.

8. Reproducibility
Maintaining batch-to-batch consistency in herbal formulations is a common challenge due to natural variability.

9. Shelf-life Determination
Conducting accelerated and long-term stability studies within academic timelines may be restrictive.

10. Scaling Up Issues
Translating lab-scale formulations to industrial-scale production may introduce additional formulation and stability challenges.

V. CONCLUSION

The formulated herbal face serum exhibited desirable physicochemical characteristics such as appropriate pH, viscosity, spreadability, and stability, making it suitable for topical application.

Similarly, the herbal paper soap showed satisfactory properties including foamability, cleansing efficiency, and antimicrobial activity, along with the added advantages of portability, convenience, and hygienic use.

These findings suggest that the formulations may serve as a safe and effective herbal alternative for psoriasis management.

However, further in-vivo and clinical studies are required to confirm their therapeutic efficacy and safety.

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