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Research Paper

Development And Characterization of a Polyhedral Anti-Acne Cream: A Synergistic Approach with Manjistha, Mulethi and Beetroot

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ABSTRACT

Acne vulgaris is a widespread dermatological condition caused by bacterial infections, excessive sebum production, and inflammation. Conventional treatments often lead to side effects such as skin irritation and antibiotic resistance, prompting the need for natural alternatives. This study focuses on the formulation and evaluation of a polyherbal anti-acne cream incorporating manjistha (Rubia cordifolia), mulethi (Glycyrrhiza glabra), and beetroot (Beta vulgaris). These medicinal herbs are known for their antimicrobial, anti- inflammatory, antioxidant, and skin-brightening properties. The cream was formulated using a water-in-oil (W/O) emulsion and assessed for physicochemical properties, stability, and antimicrobial efficacy against Propionibacterium acnes and Staphylococcus aureus. Results demonstrated that the cream had an optimal pH (5.5–6.0), good spreadability, and no phase separation over a 30-day stability study. The antimicrobial assay showed a significant zone of inhibition, confirming its potential to combat acne-causing bacteria. Overall, the findings indicate that this polyherbal formulation is a promising, natural, and effective alternative for acne management. Future studies can focus on clinical evaluations to assess its efficacy in real-world applications.

INTRODUCTION

The skincare industry has witnessed a surge in the development of innovative formulations aimed at addressing common skin concerns such as acne, pigmentations, scars and dullness etc. Among all those semi-synthetic face creams have gained significant attention due to its ability to combine the benefits of natural ingredients with scientifically enhanced compounds. Acne is nothing but the common skin condition which occurs when hair follicles become clogged with sebum, bacteria or dead skin cells. It majorly affects the chest, face, back and even shoulders.

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It's most common amongst the teenagers because of hormonal changes. It can even affect people of all ages. Nowadays adults are also facing the issues regarding the acne.[2]

There are various causes of Acne-

1) Clogged hair follicles
2) Excess production of sebum
3) Hormonal changes 4)Bacterial infection
5) Genetics
6) Diet and Lifestyle

Acne has different origins and thus there are various types of acne

A1) Non-inflammatory acne -

A) Blackheads-open comedones and are oxidized hence black in colour.
B) Whiteheads closed comedones-.

2) Inflammatory acne -

A) Cysts –pus filled and causes scarring
B) Pustules-pus filled
C) Nodules-large and deep painful lumps under skin.
D)Popules-small inflammed bumps

Various treatments are available in market to target those acnes

1) Topical treatment-one of the primary treatments.

A) Retinoids-Eg-Tretinoin,etc.They prevent clogged pores and they promote cell turnover.

B) Salicylic acid-It is useful for exfoliation.

C) Benzoyl Peroxides-kills the acne causing bacteria.

D) Azelaic acid-reduces the swelling.

2) Oral medications-

A) Oral contraceptives-those helps to normalize the hormonal levels in body especially useful for females.

B) Antibiotics-they almost kill the bacteria and also reduces the inflammation. C)Isotretionin-one of the strongest retinoid for severe acne cases.

3) Natural and semi-synthetic treatments-

A) Vitamin C-brightens the skin.

B) Tea tree oil-shows antibacterial properties.

C) Niacinamide-helps in reduction of oil production.

4) Lifestyle changes-

a) Proper diet with low sugar and dietary intake.

b) Must wash the face twice a day.

c) Drink plenty of water.

d) Must manage the stress factor.

Semisynthetic formulations –

Those formulation refers to the combination of natural sources and partially synthesized chemicals.Those formulations are used in lubricants, pharmaceuticals, other chemical industries.They are very useful to enhance the properties such as stability, solubility, efficacy or bioavailability. There are various examples of semisynthetic formulations-

1. Opiods
2. Lubricants
3. Cosmetics and personal care
4. Antibiotics
5. Agrochemicals

Basically the cosmetics and personal care consists of various formulations containing ingredients that are derived from natural sources but are chemically modified. This modification is done to improve their performance, stability,texture or absorption.

Our project focuses on the treatment of the acne and its scarring along with providing glow and reducing inflammation. There are various herbal and synthetic ingredients used to prepare the formulation. The demand of herbal based cosmetics has increased due to their natural efficacy,fewer side effects,and biocompatibility.

Manjistha(Rubia cordifolia) possesses anti-inflammatory,anti-microbial ,and detoxifying properties making it beneficial for acne prone skin.Mulethi (Glycyrrihza glabra) is known for its anti-bacterial anti-inflammatory,and skin brightening effects.Beetroot(Beta vulgaris) is rich in antioxidants helps reduce acne by scavenging free radicals and controlling sebum secretion. This study aims to develop a stable polyherbal anti-acne cream and evaluate its physiochemical properties and antimicrobial efficacy against acne-causing bacteria.[16]

Plant profile:[1],[19]

Plant name	Botanical name and Family	Chemical constitute	Uses & Purpose in cream
Manjistha	Botanical name : Rubia cordifolia Family : Rubiaceae	Rubiadin , rubiprasin , alizarin , garncin , mullugin and furomollugin , purpurin , manjistin, xanthopurpurin and pseudopurpurin	Uses : have anti inflammatory , bronchodilator , pain – relieving and anti– microbial activities,cureskin infection Purpose : Make your skin free from the acne and further allergic reaction
Mulethi	Botanical name : Glycyrrhiza glabra Family : Leguminosae	Glycyrrhizin ,Gkycyrrhetinic acid, Liquidation,isoliquiritin, Glabridin, Liquiritigenin	Uses: Anti – inflammatory, Anti-microbial Liver protection Anti- acne Purpose: oil control, Make your skin free form acne
Beetroot	Botanical name : Beta vulgaris Family : Amaranthaceae	Betlains , Betacyanins , Betaxanthins	Uses: antioxidant anti-inflammatory, Glowing skin Purpose : make your skin free from acne , Skin Brightening and glow

Instruments :

Sr.no	Instrument name
1.	Electonic weighing balance
2.	pH meter
3.	Heating mantle

4.	Electronic waterbath
5.	Soxhelet Apparatus

MATERIALS AND METHODS-

Sr. No	Ingredients	Functions (Role)
1	Beetroot	API
2	Mulethi	API
3	Manjistha	API
4	Glycerin	Humectant
5	Potassium hydroxide	PH adjuster
6	Salicylic acid	Anti-acne agent
7	Bees wax	Thickening agent
8	Stearic acid	Surfactant
9	Methyl paraben	Preservative
10	Rose water	Natural astringent

Active ingredients-Manjishta,Mulethi,Beetroot extract Cream base:Stearic acid,glycerin,beeswax,Rosewater Preservatives-methyl paraben [1] , [8]

MATERIAL AND METHOD:

Collection of plant material: The Bulb of Beetroot (Beta vulgaris) of family Amarthace and Root of Mulethi (Glycyyrhiza glabra) of family Fabaceae and Stem of Mnjistha (Rubia cadiafolia)of family Rubiaace is collected and authenticated from the botanical laboratory's sources. Make it into the powdered form.

Preparation of Extract:

A. Extraction of Mulethi:

First, the Mulethi roots are dried and ground into a coarse powder. About 20 grams of this powder is placed in a paper thimble, which is then put inside the Soxhlet extractor. A solvent like ethanol or a mixture of ethanol and water (70:30) is poured into the round-bottom flask connected to the extractor. The setup is heated gently, and the solvent starts to evaporate, moves up the apparatus, and drips onto the Mulethi powder. It soaks the powder, dissolves the useful compounds, and then drains back into the flask. This cycle repeats many times (usually for 4 to 6 hours), making sure that most of the active compounds are extracted. After the process is done, the solvent in the flask now contains the Mulethi extract. The solvent is then removed by evaporation to get the final concentrated extract, which can be used for further research or formulation.[5] , [16]

B. Extraction of Beetroot :

First, fresh beetroot is washed thoroughly to remove dirt, then sliced into small pieces and dried in shade to remove moisture. Once dried, the beetroot pieces are ground into a coarse powder. Around 50 grams of this powder is placed in a clean glass container. Then, about 500 ml of a suitable solvent like ethanol, water, or a hydroalcoholic mixture (ethanol:water in 70:30 ratio) is added to the powder. The container is sealed and kept at room temperature for Beetroot 2 days. During this time, the mixture is stirred or shaken occasionally to help the solvent extract the pigments like betalains and other nutrients from

the beetroot. After the soaking period, the mixture is filtered to remove the solid parts. The liquid extract is then concentrated by slowly evaporating the solvent. The final extract is stored in an airtight container for further use in food, cosmetics, or herbal products.[4] , [15]

C. Extraction of Manjistha :

First, the roots of Manjistha are cleaned, dried, and ground into a coarse powder. About 50 grams of this powder is taken and placed in a clean glass container. Then, around 500 ml of a suitable solvent like ethanol, water, or a hydroalcoholic mixture (ethanol:water in 70:30 ratio) is added to the powder. The container is covered and left at room temperature for 2 days. During this time, the mixture is stirred or shaken once or twice a day so that the solvent can soak into the plant material and extract the active compounds. After the soaking period, the mixture is filtered to separate the liquid extract from the leftover plant material. The liquid extract is then concentrated by slowly evaporating the solvent. The final extract is stored in a clean, airtight container for further use in medicines or studied.[4], [9], [10] , [11]

Identification Test:

•There are different methods of identification of plant.

•Primarily preliminary phytochemical screening test for given active phytoconstituents present in given plant part is been performed as below.[4] ,[5]

, [6]

- **Test for Beetroot :**

Chemical Class: Betalain

Herb: Beta vulgaris

Plant Part : Bulb

A. Characterization of Dry Beetroot Extract:

Parameter	Beetroot Extract (Reference)	Beetroot Extract (Standard)
Colour	Deep red	Deep red
Odour	Characteristic	characteristic
Solubility	Soluble in Ethanol	Soluble in Ethanol
Melting point	180℃	183℃

B. Phytochemical Analysis of Dry Beetroot Extract :

Chemical Test	Observation	Inference
Powdered drug treated with the Ferric Chloride Solution	dark-colored complex	Tannin present
Powdered drug treated with the few drop of sodium hydroxide	Red pigment turns yellow Brown Colour	Flavonoids present
Powdered drug treated with ammonia solution	Brown colour	Anthraquinone glycosides present
Powdered drug treated with the HCI solution	Red Colour	Betacyanins present

- **Test for Mulethi:**

Plant Part: Root

Chemical Class: Triterpenoid saponin

A. Characterization of Dry Mulethi Extract :

Herb: Glycyrrhiza glabra

Parameter	Mulethi Extract (Reference)	Mulethi Extract (Standard)
Colour	Brown	Brown
Odour	Characteristic mild	characteristic mild
Solubility	Soluble in water	Soluble in water
Melting point	220 -230℃	223℃

B. Phytochemical Analysis of Dry Mulethi Extract :

Chemical test	Observation	Inference
Powdered drug treated with the 5% Ferric Chloride Solution	Yellow colour	Tannins present
Powdered drug treated with ammonia solution	Deep blue colour	Anthraquinone glycoside present

Test for Manjistha:

Plant Part: Stem

Chemical Class: Anthraquinone

A. Characterization of Dry Manjistha Extract:

Herb: Rubia cardifolia

Parameter	Manjistha Extract (Reference)	Manjistha Extract (standard)
Colour	Red	Red
Odour	Characteristic	Characteristic
Solubility	Soluble in Methanol and choroform	Soluble in Methanol and Choroform
Melting point	259℃	256℃

B. phytochemical analysis of Dry Manjistha Extract :

Chemical test	Observation	Inference
Powdered drug treated with the 5% Certificate choride solution	Blue colour	Tannins present

Formula :

Sr. No	Ingredients	F1	F2	F3
1	Mulethi	4gm	3gm	2.5gm
2	Beetroot	1gm	1gm	2gm
3	Manjistha	1gm	2gm	3gm
4	Glycerin	2ml	4ml	2ml
5	Salicylic acid	0.02gm	0.02gm	0.02gm
6	Potassium hydroxide	1gm	1gm	0.05gm
7	Beeswax	2gm	2gm	2gm
8	Stearic acid	2gm	2gm	2gm
9	Methyl paraben	0.05gm	0.05gm	0.05gm
10	Rose water	2ml	2ml	2ml

F2 is most stable formula.[1,8,19] Method of Preparation:

Procedure:

1. Preparation of Aqueous Phase:

- Dissolve NaOH in rose water
- Add Salicylic acid and Glycerine to the rose water mixture and stir well.



2. Preparation of Oil Phase:

- Melt Beeswax and Stearic acid in a water bath at 70°C until completely dissolved.
- Methyl Paraben to the melted mixture.

Mixing Both Phases:

Gradually add the aqueous phase into the oil phase while continuously stirring at 70°C using a mechanical stirrer or hand blender.



3. Addition of Herbal Powders:

- Dissolve Manjistha, Mulethi, and Beetroot powders in a small amount of rose water separately.

• Add this herbal extract to the emulsion with continuous stirring until uniform.

4. Cooling:

Continue stirring until the cream reaches room temperature and thickens.

5. Packaging:

Transfer the cream into sterilized container and Store in a cool, dry place.[18]

Evaluation of cream:

a) Colour : The colour of the cream was observed by visual examination.

b) Odour : The odour of cream was found to be characteristics.

c) State : The state was cream was examined visually. The cream was semisolid in state .

d) Consistency : The formulation was examined by rubbing cream on hand manually. The cream having smooth consistency .

E) PH of Cream : The pH of the cream should be in range of 5.4-5.8, to avoid irritancy to the skin .pH of prepared herbal cream was measured by using digital ph meter. The solution of cream was prepared by using 100 ml of Distilled water and set aside 2h. Ph was determined in three times for solution and the average value was calculated. [12]

F) Spreadability : spread ability of formulated cream was measured by placing sample in between two slides then compressed to uniform thickness by placing a definite weight for defined time. The specified time required to separate the two slides was measured as Spredability . Lesser the time taken for sepration of two slides results showed better Spredability. Spreadability was calculated by the following formula. [13]

Spreadability formula:

Weight tide to upperslide (W) × Length of glass slide (L)

/ Time taken to separate slide (T)

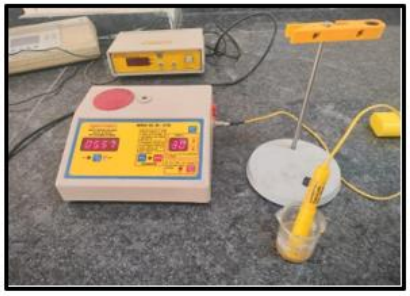
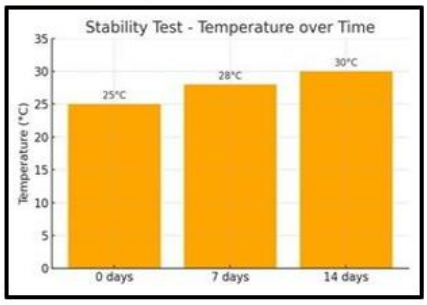
G) Washability : formulation was applied on the skin and then ease extends of washing with water was checked . [17]

I) Viscosity- Viscosity of cream was done by using Brooke field viscometer at the temp of 25 Degree c . using spindle , 63.at rpm. Hu

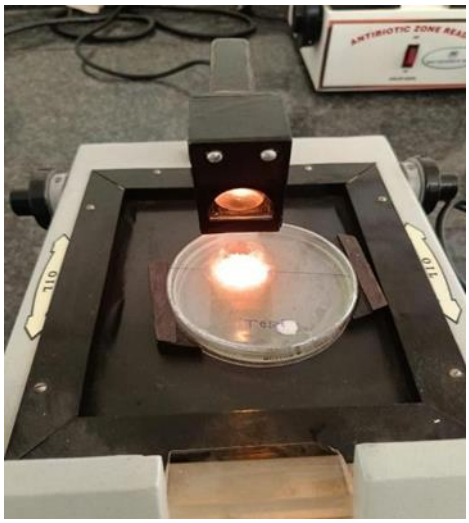
Phase separation - The prepared cream was transferred in a suitable wide mouth container. Set aside for storage the oil phase and aqueous phase were visualizing after 24h. [17]

After feel : Emoliency slipperiness and amount of residue left after the application of the fixed amount of cream was found to be good.[14]



Anti-microbial activity-this activity of formulated cream was tested against Propionibacterium acnes and Staphylococcus aureus using agar well diffusion method.The zone of inhibition was measured to determine effectiveness.[7]

Result of Evaluation Test :

Sr.no	Evaluation parameter	F1	F2	F3
1	Colour	Reddish brown	Reddish brown	Reddish brown
2	Odour	Pleasant	Pleasant	Pleasant
3	pH	5.8	5.5	5.6
4	Consistency	Textury	Smooth	Rough

5	Texture	Gritty	Smooth	Rough
6	Skin irritation test	Non – Irritant	Non – Irritant	Non - Irritant
7	Phase separation	No phase separate	No phase separate	Phase separate
8	Stability	Rss stable	Stable	Stable
9	Spreadability	5 sec	7 sec	4 sec
10	Washability	Easily washable	Easily washable	Easily washable

Clindamycin gel is preferred as standard drug.

Result of Antimicrobial activity [7]

microorganism	Standard drug	Reference	Interpretation
P.acnes	17±1.1	18±1.2	More effective than standard
S.aureus	14±0.5	15±0.9	More effective than standard

Mechanism of Action- 1)Antimicrobial action-

Manjishta contains anthraquinones and flavonoids which inhibit bacterial growth by disrupting bacterial cell walls and blocking quorum sensing,preventing acne bacteria from multiplying.

Mulethi has glycyrrhizin and liquiritin which show potent antibacterial properties against acne causing microbes,reducing inflammation and infection.

2) Anti-inflammatory action-

Manjishta suppresses pro-inflammatory cytokines and also reducing redness and swelling. Mulethi inhibits COX-2 and LOX enzymes preventing the formation of inflammatory prostaglandins and leukotrienes. Beetroot is rich in betalains which acts as natural antioxidants and anti- inflammatory agents calming irritated skin.

3) Sebum Regulation-

Mulethi regulates 5α-reductase enzymes activity controlling sebum production and preventing excess oil buildup which contribute to acne formation.

Beetroot contains natural nitates and polyphenols that helps balance skin hydration while preventing pore clogging.

4) Antioxidant and skin healing properties-

Manjishta has strong antioxidant properties protecting the skin from oxidative stress induced damage that worsens acne. Beetroot's vitamin C and betalains promote collagen synthesis aiding in faster wound healing and scar reduction.

5) Skin Brightening and even tone effect-

Mulethi contains glabridin,which inhibits tyrosinase enzyme activity preventing post-acne hyperpigmentation and brightening skin tone. Manjishta helps in detoxification and improving blood circulation. [3], [7]

CONCLUSION:

The globe is shifting towards the traditional use of safer, natural products. In the current study, a formulation of herbal anti-acne face cream that contains a combination of anti-inflammatory herbal plant material that is useful for preventing acne formation is evaluated. This mixture, which combines herbal components with oil- and water-

based materials, is extremely environmentally friendly. Formulation of cream was done by slab method and further evaluated by various evaluation parameters such as physical properties, PH , Spreadability , Washability , non-irritancy test, viscosity and phase separation of cream and gives good results.This finding supports its potential as a natural alternatives for acne treatment.

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