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POLYHERBAL GEL IN THE MANAGEMENT OF ACNE AND HYPERPIGMENTATION: A REVIEW

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ABSTRACT

Acne Vulgaris and including hyperpigmentation are relatively common skin problems throughout the world today. Most individuals affected with vulgar or including hyperpigmentation suffer considerable emotional or mental trauma due to their appearance and the embarrassment associated with it. The conventional methods utilize manmade pharmaceutical grade medication that provides substantial side effects, including but not limited to skin irritation, dryness and permanent scarring to the skin. With this in mind, there has been a strong demand for natural and or herbal alternatives for the treatment of vulgar acne and hyperpigmentation from the global Population.[1,14] This study was focused on the design, formulation, development and evaluation of a natural or herbal based formulation called a polyherbal gel for the topical management of vulgar acne and hyperpigmentation. The polyherbal gel used a unique combination of herbal ingredients (neem, turmeric, aloe vera, and liquorice) for their proven benefits, including their anti-microbial, anti-inflammatory, anti-oxidant properties and ability to lighten skin pigmentation.[4] The formulation of the polyherbal gel utilized a natural gelling agent Carbopol to prepare and optimize the gel for consistency, stability and ease of application. In addition to an assessment of the physicochemical properties of the gel (pH, viscosity, spreadability, homogeneity, and appearance), an evaluation of the antimicrobial activity of the polyherbal gel against the bacteria that cause vulgar acne was also conducted to assess its efficacy.[8] In addition to the experimental assessments to demonstrate the effectiveness of the formulation as a topical treatment modality of vulgar acne and hyperpigmentation, a stability study of the formulation was conducted under a different environment and temperature to assess the long-term stability and performance of the gel. Based upon the characteristics of the physicochemical properties and stability of the formulated gel and the significant antimicrobial activity, and in accordance with the traditional use of the polyherbal ingredients, it can be assumed with reasonable confidence of the efficacy of the polyherbal gel in the treatment of vulgar acne and including hyperpigmentation.[13,14] To conclude, the formulated polyherbal gel proved to be an effective, safe, and cost-effective alternative to synthetic compounds for treating acne and hyperpigmentation. This research indicates that topical herbal-based formulations may have potential uses within dermatology and warrant additional study and commercialization.

KEYWORDS: Acne Vulgaris, Hyperpigmentation, Conventional method, Treatment, Polyherbal gel, Unique combination, Effectiveness, Longterm stability.

INTRODUCTION

Skin, which serves as the largest bodily organ, covers about 1.5 to 2 square meters of surface area and serves as a protective barrier for our bodies. As the largest organ found on your body, it separates your internal organs from your external environment and protects you from injury while also protecting you from harmful microorganisms, chemicals, and excess water loss. Skin also regulates body temperature, is responsible for sensory perception and synthesizes vitamin D when exposed to sunlight.

The structure of the skin is made up of three distinct layers there is also an additional area the surface, all

providing different functions to the skin. The first layer is the epidermis, and it is the outermost layer, and it is responsible for protection and contains cells that produce keratin and melanin, which is responsible for the color of the skin and provides protection against UV light.[7]

Under the epidermis is the forearm weighing dermis layer that ensures blood supply, nerve supply, hair follicles, sweat glands, sebaceous glands, skin strength, skin elasticity, nutritional supply through the presence of collagen fibres and elastin fibres. At the deepest layer is the hypodermis layer also referred to as the subcutaneous layer. At this layer, you have fat and connective tissue. It is the layer responsible for keeping you warm, storing energy, and providing the cushioning of the internal body systems. The skin is also responsible for various functions. The functions include the prevention of infections by providing barriers against infections and ensuring that no foreign particles are allowed into the body. It is also responsible for the prevention of dehydration by ensuring water is retained inside the body and kept out of the body. It is also responsible for regulating the body temperature by the production of sweat. It is also a sensory receptor.[15]

Acne

Acne vulgaris is a common skin condition characterized by inflammation and irritation of the skin. It is mostly seen in young people, but anyone can contract it because of its wide-ranging nature. It typically affects the hair and oil-producing glands on the face and upper body area.

The formation of acne is caused by four primary factors hormones increasing oil production from the oil glands, clogged oil-producing glands by dead skin cells, colonization with Cuti bacterium acnes bacteria, and local inflammation in the area of the hair and sebaceous gland units. The presence of androgens during puberty increases the amount of oil that is produced by the sebaceous gland. This increased production of oil is responsible for the formation of comedones (whiteheads and blackheads), pink pustules and papules, and larger raised, firm lesions called nodules and cysts, depending on the severity of the patient's acne.[3]

Patients may experience a variety of forms of acne based on how severe the acne is, including comedonal; papular; pustular; nodular; and cystic acne. In general, comedonal acne is considered mild while papular, pustular, and nodular acne may be classified as moderate to severe or have the potential to cause pain and/or scarring. There are numerous factors that can worsen the symptoms of acne, such as stress, poor diet, cosmetics that contain oil, exposure to pollutants, and genetic susceptibility.

Acne is a disease of the epidermis caused by four different processes: excessive secretion of sebum from sebaceous glands, hyperkeratinisation of the hair follicles, colonization of the pilosebaceous unit with microorganisms, and inflammatory response to bacteria. If left untreated, can lead to complications such as chronic scarring and/or post-inflammatory hyperpigmentation that can negatively impact a person's physical and emotional health. The treatment of acne involves both topical and systemic (oral) approaches. Topical treatments include such agents as benzoyl peroxide, retinoids, and antibiotics; systemic treatments include oral antibiotics or hormonal agents used in patients with severe manifestations of their acne. There are potential side effects associated with the use of these drugs such as dryness, irritation, or development of antibiotic resistance. Because of the antibacterial, anti-inflammatory, and antioxidant properties of many herbal and polyherbal formulations these treatments are emerging as safe alternatives for the long-term treatment of acne.

Various types of Acne

1. Non-inflammatory Acne

This is the mildest form of acne and does not involve major inflammation.

- Whiteheads

Pores get clog due to oil and dead skin but it remains closed.

- Blackheads

When clogged pores are open and the surface became Black due to oxidation.

2. Inflammatory acne

It involves Swelling, Redness, and Infection.

- Papules
- Pustules

3. Moderate acne

More severe than mild acne
Combination of Papules and Pustules

4. Severe Acne

It may lead to Permanent Scarring

- Nodules

Large, Hard, Painful lumps

- Cysts

Soft, pus-filled lesions can cause scars

5. Special types of Acne

- Hormonal Acne

Due to hormonal imbalance

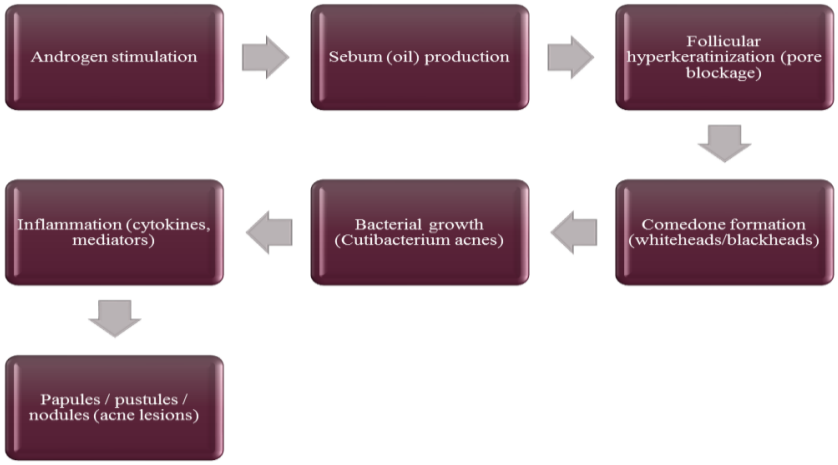
- Acne mechanica

Due to friction or pressure

- Cosmetic Acne

Appear due to oily skin

Pathophysiology of Acne VulgarisAcne occurs when sebaceous glands produce excess oil due to hormonal (androgen) stimulation. Dead skin cells block the pores, forming comedones.



Mechanism of Action

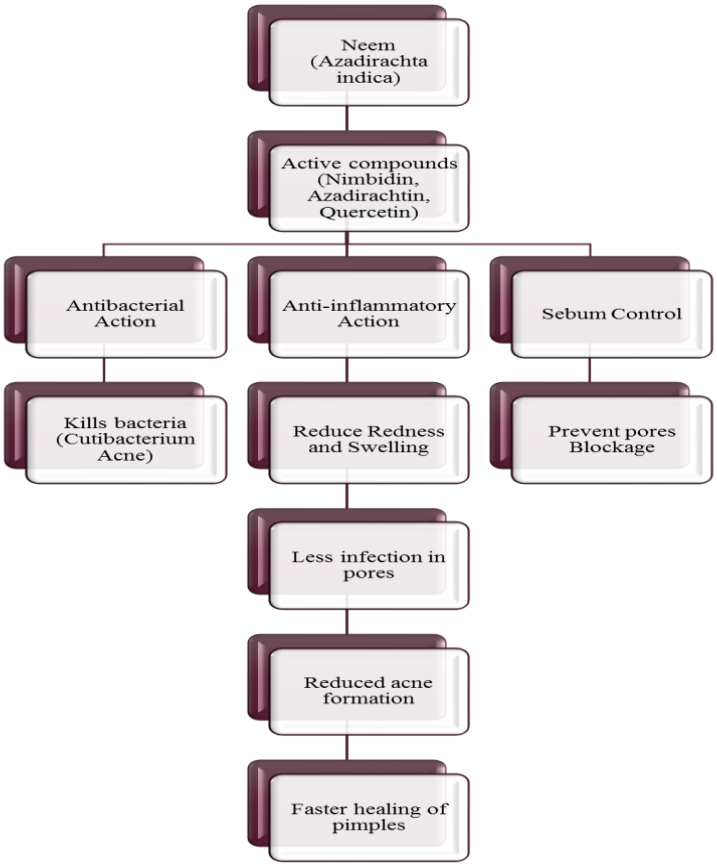
1. **Antibacterial action**
- Neem kills acne-causing bacteria (Cuti bacterium acnes)

2. **Anti-inflammatory action**
- Turmeric + Aloe vera reduce redness, swelling, pain

3. **Sebum control**
- Neem helps reduce excess oil → prevents clogged pores

4. **Healing & soothing**
- Aloe vera promotes skin repair

5. **Prevents post-acne marks**
- Liquorice reduces pigmentation after acne



Hyperpigmentation

Hyperpigmentation is a type of dermatological issue where certain areas of the skin like face, neck or sometimes on hands appear darker than the rest of the skin due to an excess amount of melanin produced which is generally due to the release of pigment which responsible for skin colour or unequal distribution of melanin throughout the body. Although this is usually harmless to health, it can cause many cosmetically and psychologically distressing conditions in people who are affected.

Hyperpigmentation is caused by increased activity of melanocytes are the cells that produce melanin as a result of prolonged exposure to ultraviolet UV radiation, increases in hormones e.g., from pregnancy or oral contraceptive usage, inflammation or injury certain topical medicines and or cosmetic products, and or exposure to environmental pollution and aging.[17]

Hyperpigmentation is diagnosed through a physical examination, including the observation of the different types of hyperpigmentation that exist. Melasma presents as symmetrical brown patches on the face or body, usually related to hormonal activity. Post-inflammatory Hyperpigmentation PIH results from injury for e.g. acne, burn and develops dark dots at the site of healing. Solar lentigines sun spots are caused by chronic sun exposure.[18]

Various Types of Hyperpigmentation

1. Melasma

It is a common type which is Characterized by Dark Patches, usually appears on skin like face, neck, forehead and nose.

2. Post inflammatory Hyperpigmentation

It appears after inflammation as it causes a dark spot at the site of inflammation

3. Sun-induced Hyperpigmentation

Known as Sunspots or Age spots, it causes due to exposure to Ultraviolet UV radiation.

Mechanism of Hyperpigmentation

UV exposure / Acne / Inflammation / Hormones
↓
Activation of melanocytes
↓
Tyrosinase enzyme activity
↓
Tyrosine → DOPA → Melanin formation
↓
Increased melanin production
↓
Melanin transfer to skin cells (keratinocytes)
↓
Deposition in epidermis/dermis
↓
Dark spots / pigmentation

MATERIAL AND METHODS

1. Herbal Ingredients

Fig no 1: Azadirachta indica.

a. Azadirachta indica

It consists of dried leaves, bark, and seeds of Azadirachta indica.

- **Family**- Meliaceae.
- **Chemical constituents**- Azadirachtin, nimbin, nimbidin, flavonoids and tannins
- **Properties**- Anti-bacterial, Anti-inflammatory, Anti-fungal, Anti-oxidant.
- **Role**
- Sebum Regulation.
- Wound Healing and Scar Reduction.
- Antioxidant Activity.
- Skin Purifying & Detoxifying Action.

Fig. no. 2: Curcuma longa.

b. Curcuma longa

It includes dried rhizomes of curcuma longa.

- **Family**- Zingiberaceae.
- **Chemical constituents**- curcumin, volatile oils, resins and proteins.
- **Properties**- Anti-inflammatory, Antibacterial, Antioxidant, Antiseptics.

Fig no 3: Aloe barbadense Miller.

c. Aloe barbadense

It includes fresh or dried leaves juices of Aloe barbadense Miller

- **Family**- Liliaceae
- **Chemical constituents**- Aloin, Aloe-emodin, Vitamins, Enzymes and Amino acids.
- **Properties**- Wound healing, moisturizing, Anti-inflammatory, Anti-oxidant.

Fig no 4: Glycyrrhiza Glabra.

d. Glycyrrhiza glabra

It consists of dried roots of Glycyrrhiza glabra.

- **Family**- Fabaceae
- **Chemical constituents**- Glycyrrhizin, Glabridin, Flavonoids, Saponins.
- **Properties**- Helps in depigmentation, Anti-oxidant, Anti-inflammatory, Anti-allergic.[30]

2. Excipients

a. Carbopol 934 - Gelling agent
b. Glycerine - Humectants
c. Propylene glycol - Penetration enhancer
d. Methyl paraben - Preservatives
e. Triethanolamine TEA - Ph adjuster

3. Solvents

a. Ethanol
b. Distilled water

Different Methods of Preparation

1. Conventional Carbopol Gel Method (Most Common)

Steps

- Disperse Carbopol 934 in distilled water with continuous stirring
- Allow it to hydrate and swell (30–60 min)
- Add propylene glycol + glycerine (humectants)
- Incorporate herbal extracts (Neem, Aloe vera, Turmeric, Liquorice)
- Add methyl paraben (preservative)
- Adjust pH using triethanolamine → gel formation occurs
- Make up volume with distilled water

Advantage: Simple, stable, widely accepted

2. Direct Mixing Method

A simpler variation without pre-hydration steps.

Steps

- Mix all liquid ingredients first
- Add Carbopol slowly with stirring
- Neutralize with triethanolamine
- Add extracts at the end

Advantage: Time-saving
Limitation: Risk of lump formation

3. Hot Process Method

Used when some ingredients need heating for proper mixing.

Steps

- Heat aqueous phase (60–70°C)
- Dissolve Carbopol and other ingredients
- Cool the mixture
- Add heat-sensitive herbal extracts
- Adjust pH

Advantage: Better solubility
Limitation: Heat may degrade actives

4. Cold Process Method

No heating involved (best for herbal formulations).

Steps

- Hydrate Carbopol in cold water
- Add all ingredients under stirring
- Neutralize with triethanolamine
- Add extracts at low temperature

Advantage: Preserves herbal activity

Table no 1: Plant Profile.

Parameter	Details	Details
Plant Name	Neem	Aloe vera
Botanical Name	Azadirachtra indica	Aloe barbadense
Family	Meliaceous	Liliaceae
Photo		
Common Name	Neem, Indian lilac	Aloe, Ghritkumari
Parts Used	Leaves, bark, seeds	Leaves, Gel or latex
Chemical constituents	Azadirachtin, Nimbin, Nimbidin	Aloin, aloe-emodin, Anthraquinones, polysaccharides
Plant Description	Tall tree with spreading Branches	A perennial succulent plant with thick fleshy leaves arranged in a rosette
Leaves	Pinnate, green, serrated	Thick, fleshy, green
Flower	Small, white, fragrant	Yellow to orange tubular
Medicinal uses	Skin disease, fever, diabetes	Wound healing, burns, acne treatment
Traditional uses	Blood purification, infection	Used in ayurveda for skin disease, digestion, liver disorder
Pharmacological actions	Antibacterial, antifungal, antiviral	Anti-inflammatory, anti-bacterial, anti-oxidant

Emulgel Method
Combination of gel + emulsion (useful if extracts are oily).
Steps
- Prepare oil phase (if any lipophilic extract)
- Prepare aqueous phase
- Form emulsion (oil + water using emulsifier)
- Prepare Carbopol gel base separately
- Mix emulsion into gel

Advantage: Better drug penetration

5. Fusion Method (heating + mixing)
- Similar to hot method, involves melting or heating
- Again, heat-sensitive herbal extracts get degraded
- Conclusion: Not suitable for herbal formulations.

Table no 2: Comparison.

Parameter	Details	Details
Plant Name	Liquorice	Turmeric
Botanical Name	Glycyrrhiza glabra	Curcuma longa
Family	Fabaceae	Zingiberaceae
Photo		
Common Name	Mulethi, liquorice	Haldi
Parts Used	Roots and stolon	Rhizome
Chemical constituents	Glycyrrhizin, flavonoids, saponins	Curcumin, volatile oils, resins
Plant Description	A perennial leaves herb growing up to 1-2 meters in height	A perennial herb with underground rhizomes
Leaves	Pinnate compound leaves with 9-17 leaflets	Large, oblong, lance-shaped, bright green
Flower	Small, pale, blue to violet flower arranged in axillary spikes	Yellowish-white flower
Medicinal uses	Anti-inflammatory, anti-ulcer, expectorant	wound healing, anti-inflammatory, anti-oxidant, anti-microbial
Traditional uses	Used in ayurveda, soothes sore throat	Widely used in ayurveda for skin care, digestive disorder
Pharmacological actions	Depigmentation, anti-oxidant, anti-inflammatory	Anti-oxidant, anti-inflammatory, anti-cancer

Comparison with Conventional therapy.

Parameter	Polyherbal	Conventional
Mode of Action	Multi- target	Single- target
Side effect	Minimal	Common
Effectiveness	Moderate	Strong and fast action
Safety	Generally safe	Risk of adverse effect
Antibiotic resistance	No resistance	May can cause
Cost	Cost- effective	May expensive
Patient compliance	High	Sometimes low
Onsets of action	Slow gradually	Fast results
Long- term use	Safe for prolonged use	Limited due to side effects
Skin compatibility	Suitable for sensitive skin	May irritate skin

Evaluation

1. Physical Appearance
The prepared polyherbal gel was checked for its physical appearance, i.e., colour, smell, transparency, and texture. The polyherbal gel was smooth, shiny, and had an excellent texture with an appealing smell.

2. pH Measurement
The pH of the gel was measured by dissolving 1 g of the gel in 100 mL of distilled water, followed by the measurement of the solution using a pH meter. The pH of the gel was found to lie between 5.5 and 6.8, which is suitable for topical application.

3. Viscosity

The viscosity of the polyherbal gel was measured by using a Brookfield viscometer at room temperature. The results indicated that the gel was of appropriate viscosity, which is necessary for the smooth application of the gel.

4. Spread ability

The spread ability of the gel was measured by taking a small amount of the gel between two glass slides, followed by the application of a known weight. The time taken by the gel was measured, showing that the gel was easily spread, which is necessary for the application of the gel on the skin.

5. Homogeneity

The gel was visually inspected for homogeneity by observing whether it contained any lumps or aggregates. The formulation was found to be smooth, indicating that all the ingredients were mixed correctly.[9]

6. Skin Irritation Test

The skin irritation test was conducted by directly applying the gel on a small area of the skin. The formulation did not cause any irritation on the skin, indicating that it is safe to use on the skin.

Washability test of the polyherbal gel formulation was carried out by applying a small amount of the gel to the skin surface. Usually, this process involves applying the gel on the forearm and leaving it there for a few minutes. The applied area was washed with an ample amount of water but no soap was used; rather, gentle rubbing with fingertips was done. It was noted whether the gel formulation could easily be washed off from the skin surface and whether any sticky or oily material was left behind. A well-formulated gel should be easily washable, and no residue should be left after washing.

6. Antimicrobial Activity

The antimicrobial activity of the gel was tested using the agar diffusion method on acne-causing pathogens. The formulation showed a clear zone of inhibition, indicating that it is effective against acne-causing bacteria.

7. Stability Studies

The stability studies were conducted by exposing the gel to different temperature conditions. The formulation did not change colour, pH, or consistency, indicating that it is stable.[13]

Table no 3: Evaluation Table.

Sr. no:	Parameters	Observation
01	Colour	Smooth
02	Smell	Pleasant
03	Texture	Excellent
04	Ph	5.5-6.8
05	Consistency	Good
06	Viscosity	Appropriate
07	Homogeneity	Smooth
08	Skin Irritation	Non- Irritant
09	Stability Study	Stable gel

DISCUSSION

The present work focused on the formulation and evaluation of a polyherbal gel prepared using Azadirachta indica, Aloe vera, Curcuma longa, and Glycyrrhiza glabra for the treatment of acne and hyperpigmentation. Carbopol 934 was selected as the gelling agent due to its ability to produce a stable formulation with suitable viscosity and consistency for topical use.

The developed gel exhibited satisfactory physicochemical characteristics, including a skin-compatible pH, uniform texture, good spread ability, and absence of particulate matter. These properties indicate that the formulation is appropriate for dermal application and is unlikely to cause irritation.

The observed **antimicrobial activity** can be mainly linked to Azadirachta indica, which is widely recognized for its inhibitory effect against acne-associated microorganisms. The inclusion of Curcuma longa contributes significantly to the reduction of inflammation, thereby helping to alleviate erythema and swelling in acne lesions. Additionally, Aloe vera plays an important role in soothing the skin and promoting tissue repair due to its moisturizing and healing properties.

The **skin-lightening potential** of the formulation is primarily attributed to Glycyrrhiza glabra, which contains bioactive compounds such as glabridin that inhibit tyrosinase activity. This leads to a decrease in melanin production and helps reduce post-inflammatory hyperpigmentation commonly seen after acne.

The combination of these herbal ingredients results in a **synergistic therapeutic effect**, as they collectively target multiple factors involved in acne development and pigmentation. These include microbial growth, inflammatory responses, excess sebum production, and melanin synthesis. Such a multi-mechanistic approach

offers an advantage over conventional treatments that generally focus on a single pathway.

CONCLUSION

This review has resulted in the conclusion that the polyherbal gel formulation is a promising tool for the management of acne and hyperpigmentation. The herbal ingredients like neem, turmeric, aloe vera, liquorice, etc., present in the formulation have a synergistic effect due to their antibacterial, anti-inflammatory, antioxidant, and depigmenting properties. These natural agents not only reduce acne-causing pathogens but also assist in reducing melanin synthesis and improving skin tone.

The prepared polyherbal gel formulation is found to have satisfactory physicochemical properties like pH, viscosity, spread ability, and stability suitable for topical applications. The prepared polyherbal gel formulation is found to have satisfactory antimicrobial activity. The formulation is found to be safe without causing irritation. The use of polyherbal gel formulations is associated with fewer side effects and better patient compliance when compared with synthetic formulations. The polyherbal gel formulation has been found to be safe, cost-effective, and efficient in the management of acne and hyperpigmentation. From the study, it can be concluded that the polyherbal gel formulation can be effective in the management of acne and hyperpigmentation; however, more studies are required to prove the efficacy and safety of the formulation on a larger scale.[18]

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