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A REVIEW OF FORMULATION AND EVALUATION OF *CENTELLA ASIATICA* AND *AZADIRACHTA INDICA* BASED EMULGEL FOR ACNE AND SCAR THERAPY

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ABSTRACT

The present study aimed to formulate and evaluate a polyherbal emulgel containing *Centella asiatica* extract and *Azadirachta indica* (neem) oil for the effective treatment of acne and reduction of acne scars. *Centella asiatica* was collected, authenticated, and subjected to methanolic extraction, followed by phytochemical screening to identify active constituents. *Azadirachta indica* oil was incorporated into an oil-in-water emulsion, which was then combined with a suitable gel base to prepare the final emulgel formulation. The developed emulgel was evaluated for various physicochemical properties, including appearance, pH, spreadability, homogeneity, viscosity, and stability. The formulation exhibited acceptable characteristics and good consistency, indicating suitability for topical application. The presence of bioactive compounds from both herbal ingredients suggests potential anti-inflammatory, antimicrobial, and wound-healing properties, making the developed emulgel a promising and safe herbal alternative for acne management and scar reduction.

KEYWORDS: Emulgel, *Centella asiatica*, *Azadirachta indica*, Acne, Scar therapy.

1. INTRODUCTION

Cosmetics, according to the Drugs and Cosmetics Act, 1940, include any substance intended to be applied to the human body for the purpose of cleansing, beautifying, promoting attractiveness, or altering appearance.[1] They may be rubbed, poured, sprinkled, sprayed, or otherwise applied and also include components used in cosmetic formulations. Cosmetics are broadly classified into several categories such as skin care products (moisturizers, cleansers, sunscreens, serums), hair care products (shampoos, conditioners, hair oils), perfumes and deodorants, oral care products, nail care products, eye care products, baby care products, and cosmeceuticals. Among these, cosmeceuticals like anti-aging creams and acne gels play a significant role in improving both skin health and appearance.[2]

The skin is the largest organ of the human body, accounting for nearly 16% of total body weight, with an approximate area of 20 square feet. It performs vital functions such as protection, regulation, and sensation. Anatomically, the skin consists of three main layers: the epidermis, dermis, and hypodermis. The epidermis acts as a protective barrier and is composed of keratinocytes, melanocytes, langerhans cells, and merkel cells.[3] The dermis provides structural support and contains blood vessels, glands, and nerve endings, while the hypodermis is rich in fat and connective tissue, helping in insulation, energy storage, and shock absorption. The skin also regulates body temperature, prevents water loss, and allows sensory perception.

Several conditions can affect the normal structure and function of the skin, ranging from mild to severe disorders, common inflammatory conditions include acne, eczema, psoriasis, and dermatitis, which are characterized by redness, itching, and irritation. Infectious diseases caused by bacteria, fungi, and viruses also damage the skin, while pigmentation disorders such as vitiligo and melasma lead to abnormal skin coloration. Environmental factors like sun exposure, pollution, dryness, and allergies further contribute to skin damage. Among these conditions, acne vulgaris is one of the most prevalent chronic inflammatory disorders, occurring due to blockage of hair follicles by excess sebum and dead skin cells, leading to the formation of comedones, papules, pustules, nodules, and cysts, which may result in scarring and psychological distress.[4]

Emulgel is a modern topical drug delivery system that combines the advantages of both emulsions and gels. It is prepared by incorporating an oil-in-water emulsion into a gel base using suitable gelling agents such as carbopol or sodium carboxymethyl cellulose. [5] This system allows effective delivery of lipophilic drugs while maintaining a non-greasy, smooth

texture for easy application. Emulgels exhibit improved stability, better skin penetration, controlled drug release, and higher patient compliance compared to conventional creams and gels. Due to these advantages, emulgels are widely used in dermatological preparations, especially for conditions like acne, inflammation, and wound healing, making them an effective and versatile system for topical drug delivery.[6]

1.1 ADVANTAGES

- Easily delivers lipophilic drugs by incorporating them in an oil-in-water gel system.
- Overcomes solubility issues seen when lipophilic drugs are directly added to gels.
- Improves stability and drug release by combining benefits of emulsion and gel.
- More stable than other topical formulations; offers longer shelf life.
- No hygroscopic or phase inversion issues unlike powders or creams.
- Higher drug loading capacity compared to other topical and nanoparticle systems.
- Cost-effectivesimple formulation process, no special equipment needed, and inexpensive ingredients.
- Enables controlled drug release, improving the half-life of the drug.
- Requires no intense sonication, reducing risk of drug degradation or leakage.
- Provides better patient compliance due to ease of application.
- Bypasses first-pass metabolism, reducing gastrointestinal side effects.
- Allows targeted delivery and easy termination of therapy when required.

1.2 Disadvantages

- Stability problems may occur during storage.
- Phase separation can happen if not properly formulated.
- May cause skin irritation or allergic reactions.
- Short shelf life due to presence of water.
- Requires preservatives to prevent microbial growth.

2. REVIEW OF LITERATURE

❖ **Sanjana Jitendra Kurkule et al. (2025)** focused on the formulation and evaluation of a herbal anti-acne gel designed to provide a natural, safe alternative to synthetic acne treatments. Three batches were evaluated for physicochemical properties, with Batch 3 showing superior spreadability and homogeneity.[7]

❖ **Iman I. Soliman et al. (2024)** *Centella asiatica* is a traditional Asian medicinal herb valued for its dermatological benefits.[8] Its triterpenoids, asiaticoside and madecassoside, provide anti-inflammatory, antioxidant, wound-healing, and scar-improving effects.

❖ **Salwa M. Raweh et al. (2024)** developed a Carbopol 940 gel containing neem (*Azadirachta indica*) leaf extract and evaluated its anti-acne activity. Among the three formulations, the 3% neem gel showed the best physicochemical properties and the highest antibacterial activity against *Propionibacterium acnes*.[9]

❖ **Dr. Archana Gorle Ingle et al. (2024)** aimed to identify medicinal plants with antimicrobial activity against Staphylococcus aureus and to develop an herbal gel using extracts of Amla, Manjishta, and Green Coffee. Diffusion studies using a Franz diffusion apparatus confirmed effective release characteristics.

❖ **Julia Afrakoma Ansonget al. (2023)** reported that acne vulgaris is a common inflammatory skin disorder with psychological impact, and limitations of conventional therapy have led to interest in herbal alternatives. Six Carbopol-based gels were formulated and showed good physicochemical properties and antimicrobial activity.

3. *Centella asiatica* AND *Azadirachta indica* OIL BASED EMULGEL

Emulgel is a modern topical drug delivery system that combines an emulsion and a gel. It is prepared by mixing an oil-in-water emulsion into a gel base using gelling agents like Carbopol or Sodium CMC. Emulgels help in delivering hydrophobic drugs, give a non-greasy feel, improve drug penetration, stability, and provide controlled drug release. They are commonly used for acne, inflammation, pain relief, and other skin disorders.

3.1 *INGREDIENTS*

a) *Centella asiatica*

Table no.1 Plant profile of *Centella asiatica.*

Kingdom	**Plantae**
Phylum (Division)	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Order	Apiales
Family	Apiaceae (Umbelliferae)
Genus	Centella
Species	Centella asiatica (L.) Urban

Figure no.1: *Centella asiatica.*

Benefits

- Helps in treating acne and improving overall skin hydration.
- Used in products aimed at scar reduction, burn healing, and minimizing stretch marks.
- Incorporated as a key ingredient in anti-aging formulations due to its collagen-boosting and wrinkle-reducing properties.
- Enhances skin elasticity and strengthens the skin barrier.[10]

b) *Azadirachta indica* oil (Neem oil)

Table no.2 Plant profile of *Azadirachta indica*

Kingdom	**Plantae**
Phylum (Division)	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Order	Sapindales
Family	Meliaceae
Genus	Azadirachta
Species	Azadirachta indica

Figure no.2 Azadirachta indica oil

Benefits

- It helps reduce acne-causing bacteria, inflammation, and excess oil.
- Promotes collagen synthesis, reduces fine lines, and improves skin elasticity.
- It lightens pigmentation, dark spots, and uneven skin tone.
- Improves skin hydration and helps maintain the skin barrier.
- Accelerates tissue repair and helps reduce scarring.[11]

c) Carbopol 940

Chemical structure:

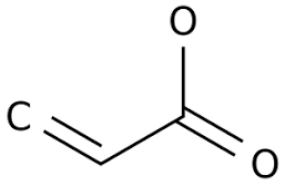


Figure no.3 Carbopol.

- **Solubility:** Soluble in water; after neutralization, they are soluble in 95%ethanol and glycerine.
- **Application in pharmaceutical formulation:** It is an extremely efficient rheology modifier capable of providing high viscosity and forms sparkling clear gels or hydro-alcoholic gels and creams.[12]

d) Triethanolamine

Chemical structure:

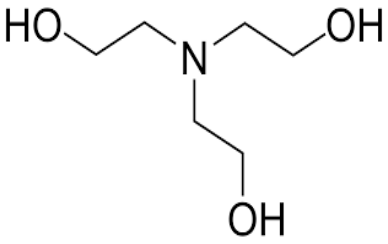


Figure no.4: Triethanolamine.

- **Solubility:** Miscible in water
- **Application in pharmaceutical formulation:** Used primarily in making surfactants, such as for emulsifier. [13]

e) Polyethylene glycol 400

Chemical structure

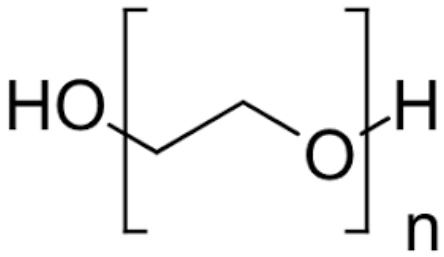


Figure no.5 Polyethylene 400.

- **Solubility:** Completely miscible in water, alcohol, acetone, and most other polar solvents
- **Applications in Pharmaceutical Formulations:** Due to its surfactant properties, PEG 400 acts as an emulsifier in both water-in-oil and oil-in-water emulsions, enhancing the stability of the formulation. It helps in creating smooth, uniform textures in creams, lotions, and ointment.[14]

f) Liquid paraffin

Chemical structure

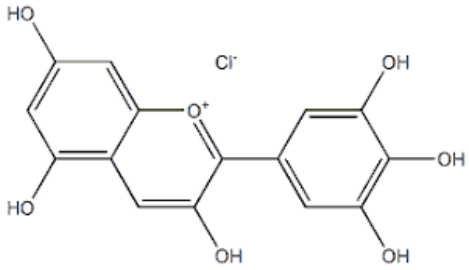


Figure no.6 Liquid paraffin.

- **Solubility:**

Insoluble in water, Soluble in non-polar solvents (chloroform, ether, benzene)

- **Applications in Pharmaceutical Formulations:**

➢ Widely used as an emollient in creams, lotions, and ointments.

➢ Forms an occlusive layer on the skin to prevent moisture loss (skin barrier protection).

➢ Used as an oil phase in emulsions (both O/W and W/O formulations).

➢ Acts as a solvent and dispersing medium for lipophilic drugs.[15]

g) Span 60

Chemical structure

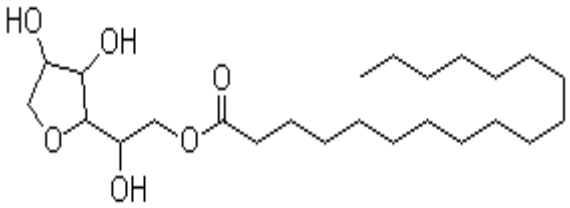


Figure no.7 Span 60.

- **Solubility:**

Insoluble in water, Soluble in ethanol, acetone, and oils, Dispersible when heated with water

- **Applications in Pharmaceutical Formulations:**

- Acts as a lipophilic surfactant (HLB ~ 4.7)
- Used mainly in the oil phase of emulsions
- Suitable for W/O emulsions
- Helps in stabilizing creams, lotions, ointments.[16]

h) Tween 80

Chemical structure

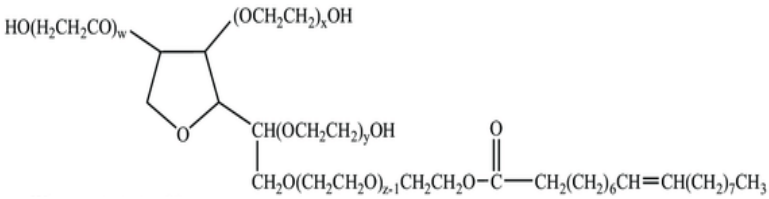


Figure no.8 Tween 80.

- **Solubility:**

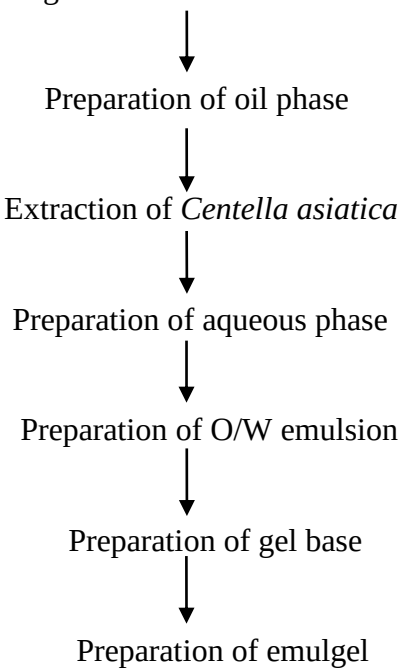
Completely soluble in water, Soluble in ethanol, Miscible with most polar solvents, Forms clear solutions

- **Applications in Pharmaceutical Formulations:**

- Hydrophilic surfactant (HLB ~ 15)
- Ideal for O/W emulsions
- Improves solubility of hydrophobic drugs
- Used in creams, lotions, gels, oral suspensions
- Enhances spreading and texture.[6]

3.2 METHOD OF PREPARATION

Collection, identification and processing of *Centella asiatica*



3.3 EVALUATION OF EMULGEL

- Appearance and Homogeneity
- pH determination
- Viscosity determination
- Spreadability Test
- Washability
- Photosensitivity
- Anti-microbial study [Agar well diffusion method]
- CAM Assay [Chorioallantoic Membrane Assay]
- Anti-inflammatory study
- Stability studies

4. CONCLUSION

The formulated emulgel containing *Centella asiatica* and *Azadirachta indica* oil proved to be a promising natural skincare formulation for acne and scar therapy. *Centella asiatica* was selected for its wound-healing, collagen-stimulating, antioxidant, and anti-inflammatory properties, while *Azadirachta indica* oil was chosen due to its potent antimicrobial, anti-inflammatory, and sebum-regulating activities against acne-causing microorganisms. The formulations exhibited optimum viscosity, good spreadability, enhanced antimicrobial

activity, controlled drug release, and minimal irritation, making it the most suitable formulation. In conclusion, the formulation was identified as the best and optimized emulgel, demonstrating promising potential as a safe, effective, and natural topical treatment for acne and scar reduction.

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