

Formulation and Evaluation of Polyherbal Under Eye Gel

Vaishnavi Narayan Athshere¹, Miss.Ghule U.V², Dr. V.A. Kashid³,
Darshan S. Pagar⁴, Pagar Pratik Suresh⁵

^{1,2,3,4,5}MABD Institute of Pharmaceutical Education & Research, Babhulgaon, Yeola (423401) Maharashtra

Abstract—The under-eye area is one of the most delicate and sensitive parts of the face, often showing early signs of aging, fatigue, and stress, such as dark circles, puffiness, fine lines, and wrinkles. These conditions are primarily caused by oxidative stress, dehydration, and poor microcirculation. Synthetic cosmetic formulations, though effective, often lead to irritation, allergic reactions, or long-term skin damage. To overcome these drawbacks, herbal-based formulations are gaining significant attention due to their safety, biocompatibility, and multiple therapeutic actions. This review focuses on the formulation and evaluation of polyherbal under-eye gels that combine multiple herbal extracts with antioxidant, anti-inflammatory, and depigmenting properties. Key herbal ingredients such as *Aloe vera*, *Cucumis sativus* (Cucumber), *Camellia sinensis* (Green Tea), *Glycyrrhiza glabra* (Licorice), and *Rosa damascena* (Rose Water) play an important role in reducing under-eye pigmentation, improving skin elasticity, and providing hydration. The gel base—typically prepared using Carbopol or HPMC—offers a non-greasy, soothing, and easily absorbable texture suitable for delicate under-eye skin. Evaluation parameters such as pH, viscosity, spreadability, homogeneity, antioxidant activity, and stability are essential to ensure the product's safety, effectiveness, and consistency. The synergistic combination of natural actives in a gel formulation provides a holistic approach to rejuvenating under-eye skin and preventing signs of aging. Therefore, polyherbal under-eye gels represent a promising, safe, and effective alternative to synthetic cosmetic preparations for maintaining skin health and appearance.

Index Terms—Under-eye gel, Polyherbal formulation, Herbal cosmetics, Antioxidant, Dark circles, Skin rejuvenation.

I. INTRODUCTION

Dark circles under the eyes are a common dermatological and cosmetic concern that affect individuals of all age groups. They are characterized

by a uniform, circular darkening of the skin beneath or around the eyes, medically known as periorbital hyperpigmentation (POH) or infra-orbital dark circles. Although not a serious medical condition, dark circles can significantly affect facial aesthetics, giving the appearance of fatigue, stress, or illness. This condition often leads to reduced self-confidence and has a psychological impact due to its effect on facial appearance.

A polyherbal gel can be defined as a semi-solid formulation composed of multiple herbal extracts dispersed in a suitable aqueous base. It encloses a condensed mass of herbal actives within a liquid medium and provides sustained topical delivery. Such formulations are safe, lightweight, and suitable for regular use without the adverse effects associated with chemical cosmetics. In conclusion, polyherbal under-eye gels represent an innovative, safe, and effective natural solution to address dark circles, puffiness, and signs of fatigue. They combine the ancient wisdom of herbal medicine with modern pharmaceutical formulation techniques to deliver optimal skin benefits. Owing to their antioxidant, anti-inflammatory, and rejuvenating properties, these formulations provide a holistic approach to restoring the delicate under-eye area, making them a promising alternative to synthetic preparations in modern cosmetology.

The skin under the eyes is thin and sensitive, making it more prone to dark circles, puffiness, and early aging. Dark circles occur due to factors like pigmentation, poor blood circulation, skin thinning, stress, lack of sleep, and lifestyle habits. Although not harmful, they affect appearance and confidence. Polyherbal under-eye gels have become popular because they combine multiple herbal extracts that work together to reduce dark circles naturally. Herbs such as Aloe vera, cucumber, mint, licorice, turmeric, and amla provide cooling, antioxidant, depigmenting, and soothing effects. The gel base allows easy

absorption, a non-greasy feel, and better delivery of active compounds. Herbal gels are safer than synthetic creams and suitable for long-term use. With increasing interest in natural skincare, polyherbal under-eye gels offer an effective and gentle solution for improving the under-eye area.

The human eyes are often referred to as the “windows of the soul”, and the delicate skin surrounding them is particularly susceptible to damage, dehydration, and pigmentation. The under-eye skin is extremely thin and contains very little subcutaneous fat, making blood vessels and pigmentation more visible. When the skin becomes thinner due to aging or environmental factors, it allows the bluish tint of blood flowing through the subdermal veins to become more prominent, thereby giving rise to dark shadows or circles. Excess melanin production around the eyes can further darken the area, resulting in a dull or tired look.

Dark circles are a multifactorial condition, influenced by both intrinsic and extrinsic factors. Intrinsic causes include genetics, aging, vitamin deficiencies (particularly vitamins B12, E, K, and D), and poor blood circulation. Extrinsic factors include stress, inadequate sleep, dehydration, smoking, excessive sun exposure, and environmental pollution. Deficiency of essential vitamins and minerals can weaken skin structure and microcirculation, while lack of hydration causes the skin to appear dull and pigmented. Excessive ultraviolet (UV) radiation stimulates melanin synthesis, worsening hyperpigmentation. The condition manifests in several distinct forms, classified as vascular, structural, pigmented, and mixed dark circles:

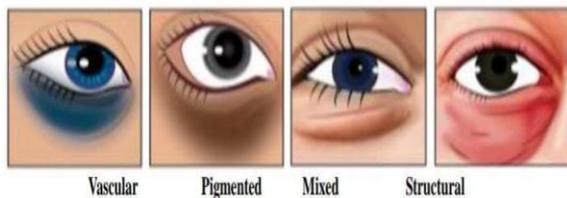


Fig 1: Types of under eye circles

Bluish or Purple Tone / Vascular Dark Circles – These occur due to dilated veins or poor blood circulation beneath thin under-eye skin. The use of stimulants such as caffeine or certain medications can dilate blood vessels, enhancing the bluish appearance.

Structural Dark Circles – Caused by skin laxity, fat

loss, or under-eye bags, these are primarily due to shadows cast by changes in facial structure with age.

Brownish Tone / Pigmented Dark Circles – Resulting from post-inflammatory pigmentation, excess melanin accumulation, or chronic rubbing, these are more common in individuals with medium to dark skin tones.

Mixed Dark Circles – A combination of two or more of the above types, frequently observed in individuals exposed to multiple contributing factors.

Several studies have demonstrated that aging, one of the primary causes, leads to thinning of the dermis and reduced collagen content, making underlying blood vessels more visible. Similarly, stress and sleep deprivation impair oxygenation of blood, leading to vascular congestion and a dull under-eye complexion. Moreover, sun exposure accelerates melanin production, and oxidative stress caused by free radicals results in damage to collagen fibers and skin pigmentation.

Given the sensitivity of the periorbital area, treatment must be both gentle and effective. Conventional formulations containing synthetic ingredients such as hydroquinone, kojic acid, or retinoids may provide temporary results but often cause irritation, redness, or allergic reactions with long-term use. As a result, the demand for natural, herbal, and polyherbal cosmetic formulations has significantly increased in recent years.

A polyherbal under-eye gel represents an advanced herbal cosmetic formulation that combines multiple herbal extracts and essential oils, offering synergistic therapeutic benefits. The gel base provides a lightweight, non-greasy texture that is rapidly absorbed and suitable for delicate skin. Typically, gelling agents like Carbopol 934, HPMC, or xanthan gum are used to achieve the desired consistency and spreadability.

Objectives:

- To reduce the appearance of dark circles and puffiness.
- To minimize fine lines and wrinkles caused by aging.
- To hydrate and nourish the delicate under-eye area.
- To enhance microcirculation and improve skin elasticity.
- To soothe tired eyes and rejuvenate the skin’s natural glow.

Advantages

Natural and safe ingredients
Synergistic therapeutic effect
Antioxidant and anti-inflammatory properties
Improves skin hydration and elasticity
Non-greasy and easily absorbable formulation
Reduces puffiness and wrinkles
Cost-effective and eco-friendly
Free from harsh chemicals and preservatives
Provides holistic skin care benefits

Disadvantages

Variable potency and lack of standardization
Shorter shelf life
Slower onset of action
Possible allergic reactions in sensitive individuals
Difficulty in maintaining formulation stability
Limited scientific and clinical validation
Requires careful storage conditions

Benefits

Reduces dark circles
Minimizes puffiness
Provides anti-inflammatory action
Rich in antioxidants
Hydrates and moisturizes
Improves skin texture
Reduces fine lines
Brightens under-eye area
Safe for sensitive skin
Refreshes and soothes tired eyes

II. PLANT PROFILE OF HERBS USED IN POLYHERBAL UNDER EYE GEL

1. Aloe vera:



Fig 2: Aloe vera

- a. Kingdom: Plantae
- b. Family: Liliaceae
- c. Biological Source: Aloe gel is obtained from the parenchymatous tissue of the leaves of Aloe barbadensis Miller.
- d. Common Name: Aloe, Ghritkumari
- e. Active Constituents: Aloin, Aloesin, Barbaloin, Polysaccharides (acemannan), Vitamins (A, C, E), Minerals, Enzymes, and Amino acids.
- f. Uses: Aloe vera acts as a natural moisturizer, anti-inflammatory, antioxidant, and anti-aging agent. It helps to soothe and hydrate the skin, promote collagen synthesis, reduce puffiness and fine lines, and rejuvenate the under-eye area by improving elasticity and blood circulation.

2. Cucumber:



Fig 3 : cucumber

- a. Kingdom: Plantae
- b. Family: Cucurbitaceae
- c. Biological Source: It consists of the fresh fruit of Cucumis sativus Linn.
- d. Common Name: Cucumber, Kheera
- e. Active Constituents: Flavonoids, Caffeic acid, Ascorbic acid, Silica, and Tannins.
- f. Uses: Cucumber is widely used for its cooling, soothing, and astringent properties. It reduces puffiness, hydrates the under-eye skin, lightens dark circles, and helps in tightening the delicate skin around the eyes. It also provides instant freshness and relieves tired eyes.

3. Green Tea



Fig 4: Green tea

- a. Kingdom: Plantae
- b. Family: Theaceae
- c. Biological Source: Dried and processed leaves of *Camellia sinensis* Linn.
- d. Common Name: Green Tea, Thea
- e. Active Constituents: Polyphenols (Catechins, EGCG–
- f. Epigallocatechin gallate), Caffeine, Theanine, and Flavonoids.
- g. Uses: Green tea is a rich source of antioxidants that protect the skin from oxidative stress and UV damage. It improves blood circulation, reduces inflammation, minimizes pigmentation and puffiness, and delays signs of aging around the eyes.

4. Licorice:



Fig 5: licorice

- a. Kingdom: Plantae
- b. Family: Fabaceae (Leguminosae)
- c. Biological Source: Dried roots and stolons of *Glycyrrhiza glabra* Linn.
- d. Common Name: Mulethi, Licorice Root

- e. Active Constituents: Glycyrrhizin, Glabridin, Liquiritin, Flavonoids, and Saponins.
- f. Uses: Licorice has strong depigmenting and anti-inflammatory properties. It inhibits tyrosinase enzyme activity, thereby reducing melanin production and lightening dark circles. It also soothes irritated skin and provides antioxidant protection to the under-eye area.

5. Turmeric:



Fig 6 : Turmeric

- a. Kingdom: Plantae
- b. Family: Zingiberaceae
- c. Biological Source: Rhizomes of *Curcuma longa* Linn.
- d. Common Name: Turmeric, Haldi
- e. Active Constituents: Curcumin, Demethoxycurcumin, Bisdemethoxycurcumin, Volatile oils (turmerone, atlantone).
- f. Uses: Turmeric is renowned for its anti-inflammatory, antioxidant, and skin-brightening effects. It reduces pigmentation, improves microcirculation, and helps achieve an even skin tone. Curcumin aids in reducing puffiness and prevents premature aging of the under-eye skin.

6. Rose:



Fig 7: rose

- a. Kingdom: Plantae
- b. Family: Rosaceae
- c. Biological Source: Fresh petals and essential oil of *Rosa damascena* Mill.
- d. Common Name: Rose, Gulab
- e. Active Constituents: Citronellol, Geraniol, Nerol, Phenolic compounds, and Flavonoids.
- f. Uses: Rose water and oil have soothing, toning, and anti-inflammatory effects. They calm the skin, reduce redness, and refresh tired eyes. Their pleasant aroma and mild astringent action make them suitable for sensitive under-eye areas.

7. Mint:



Fig 8: Mint

- a. Kingdom: Plantae
- b. Family: Lamiaceae
- c. Biological Source: Leaves of *Mentha piperita* Linn.
- d. Common Name: Peppermint, Pudina
- e. Active Constituents: Menthol, Menthone, Menthyl acetate, Flavonoids, and Tannins.
- f. Uses: Mint provides a cooling and refreshing sensation that helps soothe puffy and tired eyes. Its antioxidant and antimicrobial properties protect

the delicate skin under the eyes and improve blood flow, promoting a brighter appearance.

8. Amla:



Fig 9: Amla

- a. Kingdom: Plantae
- b. Family: Phyllanthaceae (formerly Euphorbiaceae)
- c. Biological Source: Dried or fresh fruit of *Embolica officinalis* Gaertn.
- d. Common Name: Indian Gooseberry, Amla
- e. Active Constituents: Ascorbic acid (Vitamin C), Tannins, Polyphenols, Gallic acid, and Ellagic acid.
- f. Uses: Amla is a potent antioxidant that helps in collagen synthesis, rejuvenates skin, and provides protection from oxidative stress. It improves skin tone, reduces pigmentation, and supports overall under-eye skin health.

III. FORMULATION OF POLYHERBAL UNDER EYE GEL

Materials Used:

Sr.no	Ingredients	Quantity (% w/w)	Role
1	Aloe vera gel	25	Skin rejuvenator Moisturizer
2	Cucumber extract	10	Cooling, anti-inflammatory
3	Green tea extract	5	Antioxidant, anti-aging
4	Licorice extract	5	Depigmenting and skin lightening agent
5	Turmeric extract	2	Anti-inflammatory, antioxidant
6	Rose water	15	Skin toner and refreshing agent
7	Mint extract	3	Cooling and refreshing effect

8	Amla extract	5	Antioxidant and rejuvenating agent
9	Carbopol 934	1	Gelling agent
10	Propylene glycol	10	Humectant and co-solvent
11	Glycerin	10	Moisturizer and soothing agent
12	Triethanolamine (TEA)	q.s	pH adjuster and neutralizer
13	Distilled water	Up to 100	Vehicle

IV. METHOD OF PREPARATION

Preparation of Herbal Extracts: Fresh plant materials such as cucumber, mint, amla, and turmeric are washed, shade-dried, and finely powdered. Each powdered material is subjected to extraction using ethanol or distilled water by maceration or Soxhlet method. Extracts are filtered and concentrated under reduced pressure, then stored in airtight containers.

Preparation of Gel Base: Carbopol 934 (1% w/w) is dispersed in a small quantity of distilled water and allowed to soak for 4–6 hours for complete swelling. The dispersion is stirred slowly with a mechanical stirrer to form a uniform gel base.

Incorporation of Humectants: Glycerin and propylene glycol are added to the hydrated Carbopol gel with continuous stirring until a homogeneous mixture is formed.

Addition of Herbal Extracts: Pre-prepared extracts of Aloe vera, cucumber, green tea, licorice, turmeric, rose water, mint, and amla are added one by one to the gel base under gentle stirring. Mixing is continued until all the components are uniformly blended.

Adjustment of pH: The pH of the gel is adjusted between 6.0–6.5 using triethanolamine (TEA) to ensure compatibility with the skin and stability of the formulation.

Final Processing: The prepared gel is allowed to stand for 24 hours to remove entrapped air bubbles. It is then transferred to suitable glass containers or collapsible tubes, labeled, and stored at room temperature for evaluation.

V. EVALUATION OF POLYHERBAL UNDER EYE GEL

- Physical Appearance and Color**
 - Objective: To visually inspect the gel for its appearance, color, and clarity.
 - Procedure: The formulated gel is examined against a white and black background under natural light.
 - Observation: The gel should appear smooth, homogeneous, transparent to translucent, and free from lumps or air bubbles.
- Odor**
 - Objective: To check the acceptability and presence of any unpleasant odor.
 - Procedure: A small quantity of gel is smelled directly.
 - Observation: The gel should have a pleasant, mild, characteristic herbal fragrance without any rancid or irritating smell.
- pH Determination**
 - Objective: To ensure compatibility with the skin and to maintain stability of the formulation.
 - Procedure: About 1 g of gel is dispersed in 100 mL of distilled water. The pH is measured using a calibrated digital pH meter.
 - Acceptable Range: pH should lie between 6.0–6.5, which is suitable for the delicate under-eye region and does not cause irritation.
- Homogeneity**
 - Objective: To evaluate uniformity of the formulation.
 - Procedure: The gel is visually examined for the presence of any aggregates or phase separation.
 - Observation: The gel should be homogeneous without any visible particles, grittiness, or phase

separation.

5. Consistency

- Objective: To determine the thickness and uniformity of the gel.
- Procedure: The gel is spread between the thumb and index finger to observe consistency.
- Observation: The formulation should exhibit smooth and uniform consistency, neither too thick nor too runny.

6. Viscosity

- Objective: To determine the rheological property of the gel.
- Instrument Used: Brookfield Viscometer.
- Procedure: Viscosity is measured at room temperature using a suitable spindle (e.g., spindle no. 64) at a speed of 10 rpm.
- Observation: The gel should show moderate viscosity, allowing easy spreadability and application without dripping.

7. Spreadability

- Objective: To assess how easily the gel spreads over the skin surface.
- Procedure: A small quantity of gel (about 1 g) is placed between two glass slides. - A weight of 500 g is placed on the upper slide for 5 minutes to expel air. - The time required to separate the two slides is noted, and spreadability is calculated by the formula: $S = \text{Spreadability (g} \cdot \text{cm/sec)}$,

$$S = \frac{M \times L}{T}$$

- M = Weight tied to upper slide (g), L = Length of glass slide (cm),
- T = Time (sec).
- Observation: A lower time value indicates better spreadability, ensuring uniform application.

8. Washability

- Objective: To determine the ease of removing the gel from the skin surface.
- Procedure: A small quantity of gel is applied to the skin and washed with tap water.
- Observation: The gel should be easily washable, leaving no stickiness or residue.

9. Skin Irritation Test

- Objective: To check the safety and skin compatibility of the gel.
- Procedure: The test is conducted on a small area of the forearm of healthy volunteers. A small amount of gel is applied and observed for redness, itching, or irritation for 24 hours.
- Observation: The gel should not produce any irritation, redness, or discomfort on application.

10. Stability Studies

- Objective: To assess the stability of the formulation under different storage conditions.
- Procedure: The gel is stored at different temperatures (4°C, 25°C, and 40°C) for up to 30–60 days and evaluated periodically for changes in: Color, pH, Consistency, Phase separation, Odor
- Observation: The formulation should remain stable, without any significant change in physical or chemical characteristics.

VI. FUTURE SCOPE:

1. Clinical trials on larger populations
2. Standardization of herbal extracts
3. Use of advanced delivery systems
4. Stability enhancement of formulation
5. Exploration of new herbal ingredients
6. Detailed mechanistic studies
7. Optimization for commercial production
8. Development of multifunctional variants

VII. CONCLUSION

The formulation and evaluation of a polyherbal under-eye gel demonstrate that combining multiple plant-based extracts provides a safe, effective, and holistic approach for the management of under-eye skin concerns. Herbal ingredients such as Aloe vera, cucumber, green tea, licorice, mint, turmeric, and amla work synergistically to deliver antioxidant, anti-inflammatory, cooling, depigmenting, and moisturizing effects. The optimized gel formulation, prepared using Carbopol 934 as the gelling agent and humectants like glycerin and propylene glycol, showed desirable physicochemical properties including appropriate pH, good spreadability, homogeneity, acceptable viscosity, and stability during storage. Evaluation tests confirm that the gel is

non-irritant, aesthetically appealing, and suitable for topical application around the sensitive peri

REFERENCES

- [1] Kumar S, Yadav A, Yadav M, Yadav JP. Effect of polyherbal formulations in treatment of skin disorders: A review. *J Ethnopharmacol.* 2017; 199:169–182.
- [2] Bedi MK, Shenefelt PD. Herbal therapy in dermatology. *Arch Dermatol.* 2002;138(2):232–242.
- [3] Kumar R, Singh R, Dey A. Development and evaluation of herbal gel formulations for wound healing. *World J Pharm Pharm Sci.* 2016;5(4):1714–1730.
- [4] Nair R, Kalariya T, Chanda S. Antibacterial activity of some selected Indian medicinal flora. *Turk J Biol.* 2005; 29:41–47.
- [5] Singh A, Malviya R, Sharma PK. Formulation and evaluation of topical gel of aloe vera extract. *Int J Pharm Sci Res.* 2011;2(8):2270–2272.
- [6] Panichayupakaranant P, Tewtrakul S, Yuenyongsawad S. Antioxidant and anti-inflammatory activities of Indian gooseberry (*Emblca officinalis Gaertn.*) extracts. *Nat Prod Res.* 2011;25(19):1790–1799.
- [7] Mukherjee PK, Maity N, Nema NK, Sarkar BK. Bioactive compounds from natural resources against skin aging. *Phytomedicine.* 2011;19(1):64–73.
- [8] Nayak BS, Nalabothu P, Sandiford S, Bhogadi V, Adogwa A. Evaluation of wound healing activity of *Curcuma longa* extract on rats. *J Ethnopharmacol.* 2007;109(2):523–527.
- [9] Park K, Lee JH. The use of herbal extracts in the treatment of dark circles: A review. *Int J Cosmet Sci.* 2020;42(3):210–219.
- [10] Gupta M, Jain R, Jain S, Mehta SC. Formulation development and evaluation of herbal anti-aging cream. *Int J Pharm Sci Res.* 2012;3(12):4584–4589.
- [11] Vats S, Srivastava S. Formulation and evaluation of polyherbal cosmetic cream. *J Pharm Sci Innov.* 2014;3(4):341–344.
- [12] Mukherjee PK, Verpoorte R, Suresh B. Evaluation of in-vivo wound healing activity of herbal formulation. *Phytother Res.* 2000;14(7):568–572.
- [13] Handa SS, Khanuja SPS, Longo G, Rakesh DD. Extraction technologies for medicinal and aromatic plants. Trieste: United Nations Industrial Development Organization; 2008.
- [14] Dash S, Murthy PN, Nath L, Chowdhury P. Kinetic modeling on drug release from controlled drug delivery systems. *Acta Pol Pharm.* 2010;67(3):217–223.
- [15] Ahmad N, Fazal H, Abbasi BH, Farooq S, Ali M, Khan MA. Biological role of *Piper nigrum L.* (Black pepper): A review. *Asian Pac J Trop Biomed.* 2012;2(3):S1945–S1953.
- [16] Mishra AK, Mishra A, Chattopadhyay P. Herbal cosmeceuticals for photoprotection from ultraviolet B radiation: A review. *Trop J Pharm Res.* 2011;10(3):351–360.
- [17] Dhase AS, Bhujbal SS, Pande VV. Formulation and evaluation of herbal gel containing extract of *Cucumis sativus*. *Int J PharmTech Res.* 2014;6(2):635–639.
- [18] Sharma PP, Joshi A, Sahu S, Tripathi M. Formulation and evaluation of polyherbal under eye cream for dark circles. *J Drug Deliv Ther.* 2021;11(4):90–96.
- [19] Jain A, Rani S, Kumar P. Preparation and evaluation of herbal under eye cream. *Int J Pharm Sci Res.* 2022;13(9):3746–3753.
- [20] Yadav P, Mishra S, Jain S. Role of herbal cosmetics in skincare: A review. *Int J Pharm Sci Rev Res.* 2020;62(1):75–81.