

Formulation And Evaluation of Herbal Hydrogel Eye Patches

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Abstract—The present study was aimed at the formulation and evaluation of herbal hydrogel eye patches containing Green Tea Extract and Cucumber Extract for effective under-eye care. The increasing demand for herbal and natural cosmetic products has encouraged the development of safe, biodegradable, and skin-friendly formulations for managing dark circles, puffiness, dryness, and signs of fatigue around the eyes. The herbal hydrogel eye patches were prepared using the solvent casting method with Agar Agar and Gelatin as natural polymers. Glycerin and Aloe Vera Gel were incorporated to enhance hydration, soothing action, and flexibility of the patches. Green Tea Extract was selected for its antioxidant and anti-inflammatory properties, while Cucumber Extract was incorporated for its cooling, moisturizing, and skin-soothing effects. Pre-formulation studies including organoleptic evaluation, solubility studies, pH determination, and compatibility studies were carried out successfully. The prepared hydrogel eye patches were evaluated for various parameters such as appearance, color, odor, consistency, pH, thickness, weight variation, folding endurance, moisture content, swelling index, skin irritation, and stability studies.

The formulated hydrogel patches showed satisfactory physicochemical and mechanical properties with smooth appearance, soft consistency, good flexibility, and acceptable swelling behavior. The pH of the formulation was found to be compatible with skin pH, indicating suitability for topical application. The patches exhibited good moisture retention capacity and did not show any signs of skin irritation. Stability studies confirmed that the formulation remained stable under different storage conditions without significant changes in physical characteristics.

The combination of Green Tea Extract and Cucumber Extract demonstrated promising antioxidant, anti-inflammatory, cooling, hydrating, and soothing effects which may help reduce under-eye puffiness, dark circles, and skin fatigue. The hydrogel patch system also provided prolonged contact of herbal active constituents with the skin, thereby improving effectiveness.

The results of the present study suggest that the formulated herbal hydrogel eye patches can serve as a promising, safe, effective, and economical herbal cosmeceutical formulation for under-eye care and skin rejuvenation.

Index Terms—Herbal hydrogel eye patches, Cucumber extract, green tea extract, Skin irritation test, Dark circle reduction, Puffiness reduction.

I. INTRODUCTION

The skin around the eyes is thin and sensitive, making it more prone to dehydration, dark circles, puffiness, wrinkles, and premature aging due to stress, pollution, and ultraviolet radiation. Therefore, the demand for effective cosmetic and cosmeceutical products for under-eye care has increased significantly. Hydrogel eye patches have gained attention because of their high-water content, cooling effect, flexibility, biocompatibility, and ability to provide sustained release of active ingredients. These properties help improve skin hydration and enhance the penetration of herbal bioactive compounds into the skin (Mitura et al., 2020).

Herbal ingredients are widely used in cosmetic formulations because they are natural, safe, and possess fewer side effects compared to synthetic chemicals. Cucumber extract (*Cucumis sativus*) is commonly used for its cooling, soothing, moisturizing, and anti-inflammatory properties. It helps reduce puffiness and refresh tired skin due to the presence of vitamins, flavonoids, and antioxidants. Green tea extract (*Camellia sinensis*) is rich in polyphenols and catechins, especially epigallocatechin gallate (EGCG), which exhibit strong antioxidant and anti-aging activities. It helps protect the skin from oxidative stress, reduces inflammation, and improves skin appearance (Sharifi-Rad et al., 2016).

The present study focuses on the preparation and evaluation of herbal hydrogel eye patches containing cucumber and green tea extracts using suitable polymers. The formulated patches are evaluated for physicochemical properties, stability, and cosmetic effectiveness for under-eye care.

II. MATERIALS AND METHODS

Materials Used

The materials used for the preparation of herbal hydrogel eye patches were cucumber extract (*Cucumis sativus*), green tea extract (*Camellia sinensis*), Aloe vera gel, gelatin, nutrient agar, glycerin, methyl paraben, Rose water, and distilled water.

Table 1: Formulation Table of Herbal Hydrogel Eye patches.

| Sr. No | Ingredients | Quantity |
|--------|-------------------|--------------|
| 1 | Green Tea Extract | 2g |
| 2 | Cucumber Extract | 5g |
| 3 | Agar Agar | 2.5g |
| 4 | Gelatin | 6g |
| 5 | Glycerin | 4ml |
| 6 | Aloe vera Gel | 4g |
| 7 | Methyl paraben | 0.2g |
| 8 | Rose Water | 10ml |
| 9 | Distilled Water | Q.s to 100ml |

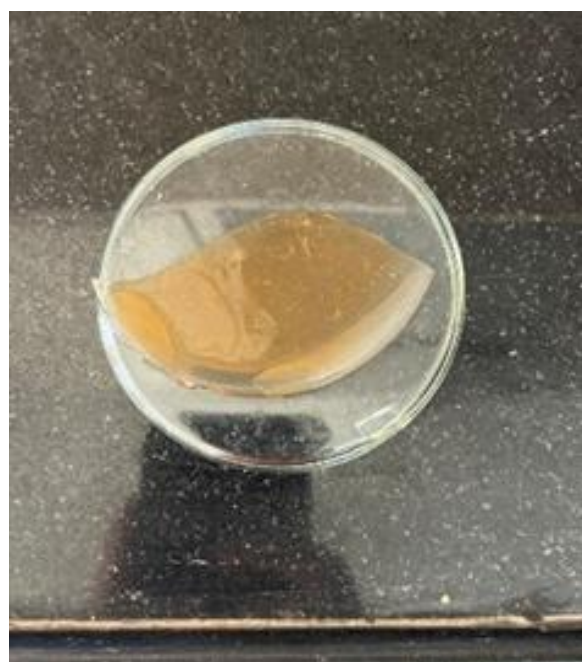


Figure 1: Prepared Herbal Hydrogel Eye Patch

Method of Preparation

The herbal hydrogel eye patches containing Green Tea Extract and Cucumber Extract were prepared by the solvent casting method using Agar Agar and Gelatin as natural gelling and film-forming agents.

Initially, the required quantity of agar agar was accurately weighed and dispersed in a sufficient quantity of distilled water. The mixture was heated at 80–90°C with continuous stirring until a clear and homogeneous solution was obtained. Agar agar acts as a natural gelling agent and provides structural strength to the hydrogel patches.

Separately, gelatin was dissolved in warm distilled water maintained at 50–60°C. The solution was stirred continuously to avoid lump formation and to obtain a smooth transparent solution. Gelatin improves the flexibility, elasticity, and film-forming properties of the hydrogel patches.

The gelatin solution was then added slowly into the agar agar solution with continuous stirring to prepare a uniform hydrogel base. After complete mixing, glycerin was added as a humectant to retain moisture and prevent drying of the patches. Aloe Vera Gel was incorporated into the formulation to provide soothing, moisturizing, and skin-healing properties.

The prepared hydrogel mixture was allowed to cool below 40°C to prevent degradation of the active phytoconstituents. Subsequently, the previously prepared Green Tea Extract and Cucumber Extract were added slowly with gentle stirring to ensure uniform distribution throughout the hydrogel matrix. Green tea extract provides antioxidant and anti-inflammatory activity, while cucumber extract imparts cooling, hydrating, and soothing effects to the under-eye skin.

Rose water was added to provide a refreshing effect and pleasant fragrance. Methyl paraben was incorporated as a preservative to prevent microbial contamination and enhance stability of the formulation.

The final homogeneous hydrogel mixture was poured carefully into clean petri plates or suitable molds and spread uniformly to obtain patches of desired thickness. The molds were then kept at room temperature or dried in a hot air oven at 40°C for approximately 24 hours until flexible hydrogel sheets were formed.

After complete drying, the hydrogel sheets were removed carefully and cut into crescent-shaped under-

eye patches using a sterile cutter or template. The prepared patches were packed in airtight containers or aluminum foil pouches and stored in a cool and dry place for further evaluation studies.

Physical Appearance and Homogeneity

The prepared herbal hydrogel eye patches showed a smooth surface with uniform thickness and good flexibility. The patches appeared translucent to light brown in color due to the presence of cucumber and green tea extracts and possessed a soft, moist, and non-sticky texture. Homogeneity studies indicated that all ingredients were evenly distributed throughout the hydrogel matrix without the presence of lumps, air bubbles, or phase separation, demonstrating uniform and stable formulation characteristics.

pH Determination

Approximately 1 g of the prepared herbal hydrogel eye patch formulation was dispersed in 10 mL of distilled water and allowed to swell completely with continuous stirring to obtain a uniform dispersion. The pH of the formulation was measured using a calibrated digital pH meter at room temperature. The observed pH was found to be within the acceptable range for topical application around the eyes, indicating good skin compatibility and suitability of the formulation for ophthalmic cosmetic use.

Thickness Measurement

Approximately three herbal hydrogel eye patches were selected randomly, and the thickness of each patch was measured at different points using a digital Vernier caliper. The average thickness was calculated to ensure uniformity of the formulation. The measured thickness was found to be uniform for all the prepared patches, indicating proper casting and consistency of the hydrogel eye patch formulation.

Folding Endurance Test

A prepared herbal hydrogel eye patch was repeatedly folded at the same position until it showed visible cracks or broke. The number of folds required to break the patch was recorded as the folding endurance value. The formulation exhibited good flexibility and elasticity without cracking, indicating suitable mechanical strength and durability of the hydrogel eye patch formulation.

Skin Irritation Test

The skin irritation test of the prepared herbal hydrogel eye patch formulation was carried out by applying the patch to a small area of skin and observing for any signs of irritation such as redness, itching, swelling, or inflammation for 24 hours. The formulation was found to produce no visible irritation or allergic reaction on the applied area, indicating that the prepared hydrogel eye patches are safe and suitable for topical application around the eyes.

Stability Study

The stability study of the prepared herbal hydrogel eye patch formulation was carried out by storing the patches in suitable airtight containers under different storage conditions, such as room temperature and accelerated conditions, for a specified period. The formulations were periodically evaluated for changes in appearance, color, texture, pH, and physical integrity. The prepared hydrogel eye patches showed no significant changes during the study period, indicating good stability and suitability of the formulation for topical application.

III. RESULTS AND DISCUSSION

Physical Appearance and Homogeneity

The prepared herbal hydrogel eye patches were visually inspected for their color, transparency, smoothness, texture, and uniformity. The formulation was found to possess a smooth surface, uniform thickness, good flexibility, and an appealing appearance without the presence of air bubbles or cracks, indicating satisfactory physical characteristics of the hydrogel eye patch formulation.

The prepared herbal hydrogel eye patch formulation was evaluated visually for homogeneity by inspecting the patches for uniform distribution of ingredients, smooth texture, and absence of lumps, air bubbles, or phase separation. The formulation was found to be homogeneous with a uniform appearance and consistent texture throughout the patches, indicating proper mixing and uniform distribution of the herbal constituents in the hydrogel matrix.

pH Determination

The pH of the prepared herbal hydrogel eye patch formulation was found to be within the acceptable range for topical skin preparations, indicating that the

formulation is safe and suitable for application around the eyes.

Table 2: pH determination of prepared eye patch

| Parameter | Observation |
|-----------|-------------|
| pH | 5.6 |

Thickness Measurement

The prepared gel exhibited moderate viscosity with good consistency. Appropriate viscosity helps in easy application and enhances the stability of the formulation. The gel remained stable without phase separation during the observation period

Table 3: Thickness Determination of prepared eye patch

| Parameter | Observation |
|-----------|-------------|
| Thickness | Uniform |

Folding Endurance Test

The folding endurance of the prepared herbal hydrogel eye patches was evaluated by repeatedly folding the patch at the same position until it showed visible cracks or breakage. The number of folds required to break the patch was recorded as the folding endurance value. The formulation exhibited good flexibility and mechanical strength without cracking upon repeated folding, indicating satisfactory durability of the hydrogel eye patch formulation.

Table 4: Folding Endurance of eye patch

| Parameter | Observation |
|-------------------|-------------|
| Folding Endurance | Flexible |

Skin Irritation Test

No redness, itching, swelling, or irritation was observed after topical application of the patch. The formulation was found to be non-irritant and safe for topical use.

Table 5: Skin Irritation Test of eye patch

| Parameter | Observation |
|-----------------|------------------------|
| Skin Irritation | No Irritation observed |

Stability Study

The stability study of the prepared herbal hydrogel eye patch formulation was carried out by storing the patches in airtight containers under different storage conditions for a specified period. The formulations were periodically evaluated for changes in physical appearance, color, texture, pH, homogeneity, and

flexibility. The prepared hydrogel eye patches showed no significant changes during the storage period, indicating good stability and suitability of the formulation for topical application around the eyes.

Table 6: Stability Study of eye patch

| Parameter | Observation |
|-----------|-------------|
| Stability | Stable |

Discussion

The present study was carried out to formulate and evaluate herbal hydrogel eye patches intended for topical application around the eyes. The prepared formulations were evaluated for various physicochemical and performance parameters, including physical appearance, pH, thickness, homogeneity, folding endurance, skin irritation, moisture uptake, and stability studies. The hydrogel eye patches exhibited a smooth appearance, uniform texture, satisfactory flexibility, and good mechanical strength, indicating successful formulation of the hydrogel matrix.

The pH of the formulation was found to be within the acceptable range for topical application, suggesting compatibility with the delicate skin around the eyes and minimizing the possibility of irritation. Thickness and homogeneity studies confirmed the uniform distribution of the formulation components throughout the patches. Folding endurance results demonstrated adequate flexibility and durability of the prepared patches during handling and application.

The skin irritation study revealed that the formulation produced no signs of redness, itching, or inflammation, indicating that the herbal hydrogel eye patches are safe for topical use. Moisture uptake studies showed satisfactory hydration characteristics, which may contribute to enhanced soothing and moisturizing effects. Stability studies indicated that the prepared formulations remained physically and chemically stable without significant changes in appearance, texture, or pH during the storage period. Overall, the evaluation results suggest that the prepared herbal hydrogel eye patches possess suitable physicochemical properties, good stability, and acceptable safety for cosmetic and topical applications.

IV. CONCLUSION

An herbal hydrogel eye patch formulation containing suitable herbal ingredients was prepared successfully using appropriate hydrogel-forming polymers and excipients. The formulation was evaluated for different parameters and showed satisfactory results with respect to physical appearance, homogeneity, pH, thickness, folding endurance, skin compatibility, and stability.

The prepared hydrogel eye patches were found to be stable, flexible, easy to apply, and non-irritant in nature. Based on the obtained evaluation results, the formulation may be considered a promising herbal preparation for topical application around the eyes to provide soothing, hydrating, and refreshing effects. Further clinical and stability investigations may help in establishing the effectiveness and long-term performance of the formulation.

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