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## REFRESHING EYES: A COMPREHENSIVE REVIEW OF UNDER-EYE COOLING GEL

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### ABSTRACT

By producing a cooling effect and supplying active ingredients that support skin renewal, cooling under-eye gels are intended to address periorbital skin concerns such as puffiness, dark circles, and tiredness. These formulations usually consist of a light gel matrix formed by water-based polymers such hydroxyethyl cellulose or carbomer. To improve microcirculation, lessen oedema, and provide antioxidant effects, ingredients like menthol, caffeine, and cucumber extract are used. While prolonged hydration helps to reduce fine wrinkles and enhance skin texture, the gel's quick cooling effect provides instant relief. Using a focus on user acceptability, bioavailability of active chemicals, and thermoregulatory qualities, we created and characterized a novel cooling under-eye gel in this study. Skin temperature maintenance with the gel was verified by differential scanning calorimetry (DSC) for up to thirty minutes after applying. Studies on the in vitro skin penetration of active ingredients in particular, caffeine showed that they diffused effectively through artificial membranes. Forty-odd participants in a randomized, double-blind clinical experiment conducted over four weeks reported a significant improvement in skin firmness and a significant reduction in under-eye puffiness, with eighty-five percent of them reporting satisfaction with the gel's cooling effect. By combining the advantages of temperature control with the focused administration of active cosmeceuticals, this cooling under-eye gel offers a novel approach to providing instant periorbital relief.

**Keywords: Cooling Gel, Anti-Aging, Dark Circles, Hydration, Wrinkles**

## INTRODUCTION

The periorbital region, the delicate layer of skin around the eyes, is especially susceptible to the negative effects of stress, exhaustion, and the environment. These variables often result in puffiness, dark circles, and fine lines [1, 2]. Topical treatments, such cooling gels beneath the eyes, have garnered a lot of interest because of their capacity to provide both short-term and long-term relief for this sensitive area [3]. In order to reduce oedema and even out skin tone, cooling under-eye gels are formulated using hydrophilic polymers to generate a gel matrix that contains active ingredients and produces a cooling sensation [2, 3]. The cooling effect, often induced by the

use of substances such as peppermint oil or menthol, causes vasoconstriction [4]. In the short term, this can reduce the amount of fluid that accumulates beneath the eyes. Considering both the physiological and aesthetic aspects of periorbital problems, bioactive ingredients like caffeine and antioxidants aid in promoting microcirculation, reducing oxidative stress, and enhancing collagen synthesis. Since these gels are typically non-greasy, lightweight, and rapidly absorbed, they are suitable for everyday usage on a variety of skin types [5]. Following **Figure 1** shows the structure of the gel [6].

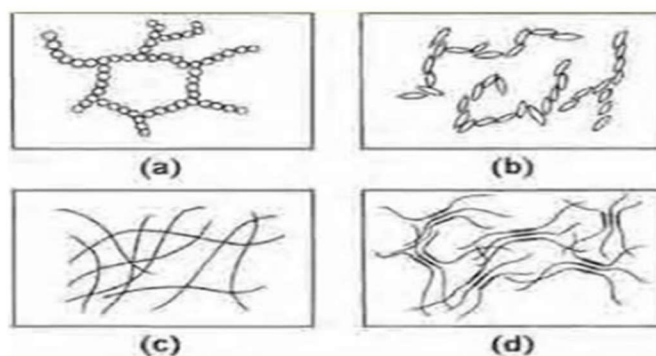


Figure 1: Representations of gel structures. (a) Flocculated particles in a two-phase gel structure. (b) Network of elongated particles or rods forming a gel structure. (c) Matted fibres as found in soap gels. (d) Crystalline and amorphous regions in a gel of carboxymethyl cellulose [6]

## Ideal Properties of Cooling Under-Eye Gel

### 1. Calm and Anti-Inflammatory Properties:

For the gel to lessen puffiness and soothe irritated skin, it should have components with anti-inflammatory properties. Cucumber

extract and aloe vera are frequently used because of their anti-inflammatory, calming, and antioxidant qualities [6, 7]

### 2. Consuming water

The skin beneath the eyes is thinner and more likely to get dry. Glycerine and other

humectants, which extract moisture from the surroundings to keep the skin hydrated and smooth without leaving a greasy residue, are therefore essential components of the gel [7].

### 3. Sensation of Cooling

The rapid cooling feeling that cooling under-eye gels provide is a vital aspect. It helps reduce puffiness and offers the tired eye area a refreshing feel. This effect is achieved by activating the skin's cold receptors with menthol or other cooling substances [8].

### 4. Non-greasy and Quickly Absorbing

The gel ought to be light and non-greasy in order to provide comfort and avoid clogging of pores. Rapid absorption without residue should be possible with this formulation. A gelling chemical called Carbopol 940 aids in achieving the ideal consistency for rapid skin penetration [8, 9].

### 5. Compatibility of pH

Since the skin around the eyes is delicate, the pH of the best cooling under-eye gel should be in the neighbourhood of the skin's normal range, which is between 5.5 and 6.5. This guarantees that the product won't irritate the skin or interfere with its defences [9].

### 6. Consistency

Under typical storage circumstances, the product must remain stable and not deteriorate over time. This entails keeping the gel's texture, look, and effectiveness constant. By

regulating pH and avoiding constituent separation, stabilizers such as triethanolamine (TEA) are utilized to guarantee the stability of the gel [10].

### 7. Hypoallergenic and non-irritating

Given how sensitive the eye area is, the formulation needs to be hypoallergenic and devoid of common irritants such as harsh preservatives, perfumes, and parabens. Dermatologists and ophthalmologists must test the substances for safety [10, 11].

### 8. Antioxidant Characteristics

Vitamin C and cucumber extract are two examples of substances with antioxidant activity that help shield the sensitive skin beneath the eyes from environmental harm and oxidative stress. As well as preventing premature aging, this can also reduce dark circles [11].

### 9. Transparency of Gel

In order to demonstrate purity and the lack of extraneous dyes or artificial colouring agents, the under-eye gel should preferably be colourless and transparent. This increases user confidence and improves its visual appeal [8, 9].

### 10. Non-Comedogenic

To prevent bumps (little white cysts) under the eyes, the gel should be non-comedogenic, which means it doesn't obstruct pores. This characteristic guarantees the product's long-

term usability and safety, particularly for those with sensitive skin [9, 11].

## **Uses of Cooling Under-Eye Gel**

### **1. Reduced puffiness and edema**

The puffiness or swelling under the eyes, which is frequently brought on by fluid retention, sleep deprivation, or allergies, can be effectively reduced with cooling under-eye gels. In order to reduce oedema and swelling around the eyes, cooling substances like menthol and botanical extracts like cucumber constrict blood vessels [12].

### **2. Dark Circles Reduction**

By increasing microcirculation and dissolving pigmentation deposits, cooling under-eye gel ingredients such as vitamin C, caffeine, and antioxidants help to lessen the appearance of dark circles. The cooling qualities of the gel contribute to this effect by increasing blood flow and lymphatic drainage in the area [13].

### **3. Calming Weary and Furious Eyes**

These gels provide immediate relief for eyes that are fatigued and irritated, particularly after extended use of screens, allergies, or environmental pollutants. Redness and discomfort are lessened by the calming and anti-inflammatory effects of the cooling sensation that components like peppermint and aloe vera provide [14].

### **4. Skin Moisturization and Hydration**

Dehydration is a risk for the delicate skin surrounding the eyes. The gels' humectants, which include glycerine and hyaluronic acid, draw in and hold onto moisture to provide sustained hydration. This prevents dryness, minimizes the look of fine wrinkles, and plumps the skin [12, 13].

### **5. Fine Line Reduction and Anti-Aging**

Cooling under-eye gels' moisturizing and antioxidant-rich ingredients can reduce the visibility of wrinkles and fine lines by increasing collagen synthesis and skin suppleness. Antioxidants that guard against oxidative stress, a known cause of early aging, including vitamin E and green tea extract [13].

### **6. Relief from Eye Strain**

Gels that cool the eyes significantly reduce eye strain, especially for people who spend a lot of time on computers. In addition to promoting relaxation, the cooling feeling lessens pressure on the muscles surrounding the eyes [14].

### **7. Environmental Stress Resistance**

Antioxidants and anti-inflammatory ingredients included in cooling under-eye gels shield the delicate skin beneath the eyes from harm brought on by free radicals, UV rays, and environmental contaminants. By scavenging free radicals, the formulation's green tea extract or vitamin C helps shield the skin from oxidative damage [13, 14].

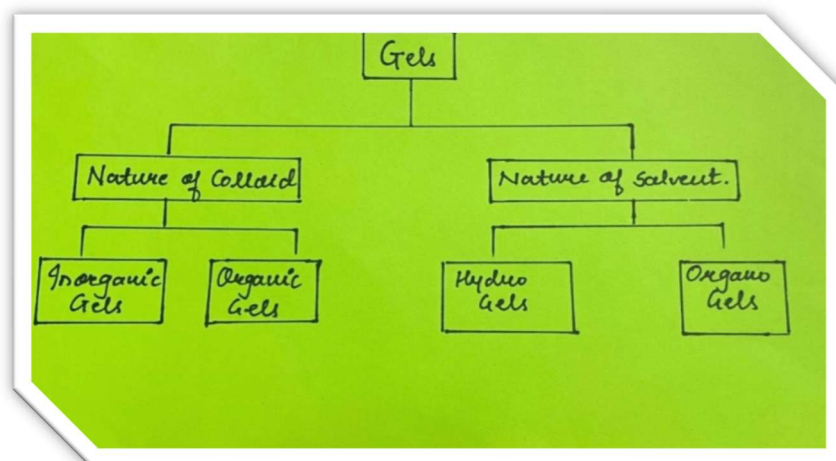


Figure 2: Classification of Gels [14]

## MATERIAL AND METHODS

**Aloe Vera Gel:** hydrates by holding onto moisture, reduces puffiness and irritation with anti-inflammatory substances, and encourages skin repair with antioxidants like vitamins C and E [15].

**Cucumber Hydrosol:** Offers anti-aging antioxidant protection, a cooling effect, and a reduction in puffiness and inflammation [16]. In order to minimize fine wrinkles and maintain a smooth under-eye area, hyaluronic acid plumps and deeply moisturizes the skin [17].

Through vasoconstriction, caffeine powder brightens skin, reduces puffiness and dark circles, and offers antioxidant protection [18]. **Essential oils:** Provide antibacterial protection, ease inflammation, and lessen weariness brought on by stress [16, 17].

### Methods of preparation of gel [6, 11]

1. **Fusion method:** This technique blends the medication, gelling agents, carriers, and additives at a high temperature until no semi-solid texture forms.

2. **Cold method:** In this process, every component aside from the medication or active pharmaceutical ingredients heated and blended at the same time. The formulation's temperature is then lowered, and the drug is added. Blending is then continued until the gel is not formed.

3. **Dispersion method:** This procedure involves agitating the gelling agent with water until it swells up, after which the medicine dissolves in the medium and is mixed with it. If required, add buffer solution to change the gel's pH.

**Gelling agent:** The polymers that give gels their structure or texture are known as gelling agents. The following categories apply to gelling agents:

Natural ingredients include collagen, pectin, guar gum, xanthine, gelatin, and Cassia tora.

Synthetic: polyvinyl alcohol, poloximers, carbopol 934, and carbopol 940, among others.

Hydroxypropyl methyl cellulose, carboxymethyl cellulose, and hydroxyethyl cellulose are examples of semi-synthetic cellulose.

### Additives used in formulation

Preservative: Preservatives, such as propyl and methyl paraben, are used to prolong the gel's shelf life and keep it from spoiling.

In the event that a medicine has low solubility, a drug solubilizer is used. Drug solubilizer aids in the dissolution of certain medications that are poorly soluble in the medium. For instance, PVP (polyvinylpyrrolidone) and triethyl-o-amine.

Chelating compounds, such E.D.T.A. (ethylene diamine tetra acetic acid), stabilize certain gels that include heavy metals and other substances.

Table 1: Formulation table of cooling under eye gel

| Composition                                       | Concentration |
|---------------------------------------------------|---------------|
| Aloe vera gel                                     | 20ml          |
| Cucumber hydrosol                                 | 10ml          |
| Hyaluronic acid solution                          | 5ml           |
| Caffeine powder                                   | 1g            |
| Essential oil (chamomile, lavender essential oil) | 5drops        |

### Physical methods of Evaluation

Looks and consistency Visual assessment was utilized to survey homogeneity and physical allure.

pH of the gel: An advanced pH meter was utilized to degree the gel's pH. A pH meter is utilized to check the 1 g of gel that has been broken up in the medium [19].

**Viscosity:** The Brookfield viscometer was utilized to degree the gel's consistency [19, 20].

**Spreadability:** A moment glass plate was put on beat of the 0.5 g of gel that had been

connected inside a 2 cm distance across circle that had been already stamped on the glass plate. A weight of 500 g was placed on the upper glass plate for 10 minutes. As the gel spreads, the diameter increases [21].

Extra durability was tested by applying a firm push to the wrinkled end of a shut collapsible tube filled with gel. Gel catapulted till the weight scattered at the minute the beat was depleted. The weight in grams required to evacuate a 0.5 cm gel lace in 10 seconds was calculated. It was detailed what the regular

removal weight was in gm was operated [21, 22].

**Skin Disturbance Test:** Guinea pigs (400–500g) of either sex and the Swiss pale skinned person mouse strain were utilized as creature models for the skin disturbance test. Three mice are utilized, and ordinary saline, clear gel, and definition are connected to the mice to check for creature distress after the skin evacuation cream evacuates the hairs and cleans the skin with soul. Stability Considers: In understanding with ICH proposals, the gel's soundness was inspected. It was stored at  $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$  (60% RH) and  $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  (75% RH)  $\pm 5\%$ . The formulation's changes in thickness, pH, spread capacity, and physical appearance were inspected [22].

**In vitro Dissemination considers:** Topical gel disintegration and discharge are considered utilizing Franz dissemination cells. 0.5g of the gel test was set in a film, and the disintegration discharge was performed at  $37 \pm 1^{\circ}$  utilizing 250ml of phosphate buffer with a pH of 7.4. 5 ml tests are taken out at interims of 1, 2, 3, 4, 5, 6, 7, and 8 hours, and each test is supplanted with an break even with volume of modern buffer arrangement some time recently being analyzed in utilize phosphate buffer as a clear reagent in a spectrophotometer [22, 23].

## CONCLUSION

Under-eye cooling gels are a valuable addition to any skincare routine, especially for those dealing with puffiness, dark circles, or fatigue. The variety of formulas available ranging from natural ingredients to advanced botanical extract allows for personalization based on individual needs and skin types. The immediate cooling sensation can provide not only relief but also a boost to your overall appearance. However, it's essential to choose a product that aligns with your specific concerns and to be mindful of ingredients that may irritate sensitive skin. With consistent use, the right under-eye gel can effectively refresh and rejuvenate the delicate skin around the eyes, leaving you looking more awake and revitalized.

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