Formulation and Evaluation of Herbal Eye Kajal

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Abstract-The growing awareness of the harmful effects of synthetic cosmetics has led to increased interest in herbal and natural beauty products. Kajal, also known as Kohl, is a traditional eye cosmetic with cultural and therapeutic significance. However, many commercial kajals contain chemicals that may cause eye irritation and long-term adverse effects.

This project aims to formulate and evaluate a herbal eye kajal using natural ingredients that are traditionally known for their eye care benefits. Key ingredients used include lampblack (natural soot) as the black pigment, beeswax for binding, and oils such as castor oil, almond oil, coconut oil, ghee, and vitamin E for their emollient, antioxidant, and soothing properties. Camphor was added for its cooling and antimicrobial effects, while aloe vera gel was incorporated for its hydrating and healing nature.

Three formulations (F1, F2, and F3) were prepared with varying ingredient proportions and evaluated for organoleptic (appearance, texture, odor) and physicochemical properties (pH, melting point, spreadability, and stability). The results indicated that all three formulations were acceptable, with Formulation F1 showing the best overall performance in terms of consistency, stability, and user acceptability.

This study supports the potential of developing an effective, safe, and eco-friendly herbal eye kajal that can serve as a viable alternative to commercially available chemical-based products.

Keywords - Herbal Kajal, Eye Cosmetic, Natural Ingredients, Lampblack, Beeswax, Castor Oil, Aloe Vera, Camphor, Antioxidants, Physicochemical Evaluation

INTRODUCTION

Cosmetics have been a vital part of human culture for millennia, serving not only to enhance appearance but also for hygiene, spiritual rituals, and medicinal purposes. The World Health Organization (WHO) defines cosmetics as substances applied externally to the skin, hair, nails, lips, or genital organs primarily for cleansing, perfuming, protecting, or altering appearance. With evolving beauty standards, there is an increasing demand for cosmetic products that are safe, sustainable, and ethically produced.

Among various cosmetic products, kajal—also known as kohl or surma—holds a unique position due to its rich historical, cultural, and medicinal significance. Traditionally used along the waterline and edges of the eyes, kajal is one of the oldest known cosmetics, dating back thousands of years. Its primary functions include enhancing eye beauty, protecting against environmental factors like dust and sunlight, and providing a cooling effect. Unlike modern lab-made cosmetics, kajal originates from deep cultural rituals and traditional medical systems, especially in South Asia, the Middle East, and North Africa.

Beyond cosmetic use, kajal is culturally and spiritually significant. It has been used for thousands of years as a symbol of protection, auspiciousness, and healing. However, with industrialization and the rise of mass-produced beauty products, traditional handmade kajal is increasingly replaced by synthetic alternatives. This shift has raised concerns regarding the safety and toxicity of synthetic kajal products, especially given the sensitive nature of eye application.

Historically, kajal usage dates back over 4,000 years, with archaeological evidence from ancient Egypt showing the use of galena (lead sulfide) to create eye cosmetics believed to protect against sunlight and infections. Similarly, in India, kajal (known as Anjana) is mentioned in classical Ayurvedic texts like the *Sushruta Samhita* and *Charaka Samhita*, where it is recommended for both beautification and treating eye conditions. Ayurvedic kajal formulations vary based on therapeutic needs, such as scraping excess Kapha, healing eye injuries, or lubricating dry eyes. In many cultures, kajal is also applied to newborns to ward off evil spirits, reflecting its spiritual role.

In recent decades, there has been a global shift toward herbal and natural cosmetics due to increasing awareness of the risks associated with synthetic chemicals and growing interest in sustainability. The herbal cosmetics market is booming, with projections exceeding USD 34 billion by 2030, driven by

consumers seeking safer, eco-friendly, and culturally authentic products. India plays a pivotal role in this market due to its deep-rooted Ayurvedic heritage. Herbal kajal formulations typically include plant-based ingredients like castor oil, almond oil, beeswax or ghee, soot from natural sources, and herbal extracts such as tulsi, amla, and neem. These ingredients offer nourishment, moisturizing, antimicrobial, and soothing properties without harmful synthetic additives like parabens, sulfates, or artificial colors.

Despite the popularity of synthetic kajal, many such products contain hazardous substances, including lead compounds, carbon black, parabens, mercury, and other heavy metals. These pose serious health risks like neurotoxicity, eye infections, hormonal disruption, and even carcinogenic effects. Regulatory bodies such as the FDA, EU, and WHO have taken steps to ban or restrict harmful ingredients in kajal, yet unsafe products remain widely available, particularly through online markets.

This research aims to address these issues by developing a scientifically validated herbal kajal formulation. The study is important due to rising consumer demand for natural, cruelty-free cosmetics; the need for safer products suitable for sensitive eyes; sustainability concerns; and the desire to scientifically validate traditional knowledge.

MATERIALS AND METHODS

1. Lampblack (Soot)

Fig. No. 1 : Lampblack / Soot (Activated Charcoal)

- Source: Produced by incomplete combustion of hydrocarbons, often from burning oils such as ghee or sesame oil or wood.
- Composition: Mainly carbon particles (soot).
- Botanical Source: Not plant-derived.
- Traditional Uses: Used as a natural black pigment in kajal for coloring the eyes. When produced from purified sources like ghee or camphor, it is traditionally considered safer and less toxic.
- Pharmacognostic Notes: Fine particles provide smooth application and deep black color.

2. Beeswax

Fig. No. 2 : Beeswax

- Source: Natural wax secreted by worker honeybees.
- Botanical Name: *Apis mellifera* (European honeybee)
- Traditional Uses: Used extensively in Ayurvedic and traditional cosmetics as a binding and moisturizing agent. Provides texture and stability to kajal, forming a protective barrier on the skin.
- Chemical Constituents: Complex mixture of esters, fatty acids (palmitic acid), hydrocarbons, long-chain alcohols.
- Pharmacological Properties: Emollient, skin-protective.

3. Coconut Oil

Fig. No. 3 : Coconut oil

- Source: Extracted from the kernel or meat of mature coconuts.
- Botanical Name: *Cocos nucifera*

- Traditional Uses: Used in Ayurveda and traditional medicine to moisturize skin, heal wounds, and as an antimicrobial agent. Also used in cosmetics to soften skin and hair.
- Chemical Constituents: Rich in medium-chain fatty acids like lauric acid, capric acid, and caprylic acid.
- Pharmacological Actions: Antimicrobial, moisturizing, anti-inflammatory.

4. Castor Oil

Fig. No. 4 : Castor oil

- Source: Cold-pressed oil from seeds.
- Botanical Name: *Ricinus communis*
- Traditional Uses: Used in Ayurvedic formulations for skin and eye care, known to promote eyelash growth and provide soothing effects. Acts as a natural lubricant and anti-inflammatory agent.
- Chemical Constituents: High ricinoleic acid content.
- Pharmacological Properties: Lubricating, anti-inflammatory, antimicrobial.

5. Almond Oil

Fig. No. 5 : Almond Oil

- Source: Extracted from seeds of sweet almond.
- Botanical Name: *Prunus amygdalus* (syn. *Prunus dulcis*)
- Traditional Uses: Applied traditionally for skin nourishment and to prevent dryness. Used in cosmetic preparations for its moisturizing and soothing effects.
- Chemical Composition: Rich in oleic acid, linoleic acid, vitamin E.
- Pharmacological Effects: Moisturizing, antioxidant, anti-inflammatory.

6. Ghee

Fig. No. 6 : Ghee (Clarified Butter)

- Source: Clarified butter derived from cow or buffalo milk.
- Botanical Source: Animal product (*Bos taurus* or *Bos bubalis*)
- Traditional Uses: Highly valued in Ayurveda for its nourishing, healing, and cooling properties. Used as a carrier medium in herbal preparations, including kajal.
- Composition: Saturated and unsaturated fats, fat-soluble vitamins (A, D, E, K).
- Use in Kajal: Binds soot and oils, offers smooth application and eye protection.

7. Aloe Vera Gel

Fig. No. 7 : Aloe Vera Gel

- Source: Extracted from the succulent leaves.
- Botanical Name: *Aloe barbadensis* Miller
- Traditional Uses: Used since ancient times for soothing burns, moisturizing skin, and healing wounds. Incorporated in eye cosmetics for its cooling and anti-inflammatory benefits.

- Chemical Constituents: Polysaccharides (acemannan), vitamins A, C, E, enzymes, minerals.
- Pharmacological Properties: Anti-inflammatory, soothing, moisturizing.

8. Vitamin E (Tocopherol)

Fig. No. 8 : Vitamine E (Tocopherol)

- Source: Extracted from vegetable oils, nuts, and seeds.
- Botanical Sources: Various, e.g., *Helianthus annuus* (sunflower), *Glycine max* (soybean).
- Traditional Uses: While Vitamin E itself is a modern isolate, oils rich in Vitamin E have been used traditionally for skin nourishment and protection.
- Chemical Nature: Fat-soluble antioxidant.
- Role in Cosmetics: Protects skin from oxidative damage, stabilizes formulations.

9. Camphor

Fig. No. 9 : Camphor

- Source: Extracted from the wood of camphor tree.
- Botanical Name: *Cinnamomum camphora*
- Traditional Uses: Used in Ayurveda and traditional medicine for its cooling, anti-inflammatory, and antiseptic properties. Applied to reduce skin irritation and improve circulation.
- Chemical Constituents: Camphor (terpenoid ketone).
- Pharmacological Effects: Antimicrobial, anti-inflammatory, cooling.

Method of Preparation of Herbal Kajal

1. Preparationof Lampblack (Soot):

A cotton wick soaked in a mixture of castor oil, almond oil, and ghee is lit in a shallow lamp. A clean metal plate or inverted bowl is held above the flame to collect black soot (lampblack) for 30–60 minutes. The soot is then scraped off, filtered through muslin cloth, and optionally sterilized.

Fig. No. 10 : Preparation of Lamphblack (soot)

2. Melting the Base:
   Beeswax and coconut oil are gently melted together in a water bath at 70–75°C with continuous stirring to form a uniform base.

3. Incorporation of Soot:
   The prepared lampblack is slowly added to the molten wax-oil base and stirred thoroughly to form a smooth, black paste.

4. Addition of Herbal Actives:
   Once cooled to about 40°C, aloe vera gel, vitamin E oil, and optionally camphor are added and gently mixed until uniformly blended.

5. Molding and Storage:
   The warm kajal mixture is poured into sterile containers such as lip balm jars or kajal sticks, then allowed to cool and solidify at room temperature. Finally, containers are labeled with the date, batch number, and ingredients.

Fig. No. 11 : Final Product

Formulation Table :

Formulation Table for Herbal Eye Kajal

Ingredients	F1 (g/ml)	F2 (g/ml)	F3 (g/ml)	Purpose
Lampblack (soot)	5.0	5.0	5.0	Natural black pigment
Beeswax	1.0	1.5	2.0	Binding agent, gives firmness
Coconut Oil	2.5	2.0	1.5	Carrier oil, softens texture
Castor Oil	2.0	2.5	3.0	Base oil for pigment, nourishes lashes
Almond Oil	1.0	1.0	1.0	Strengthens lashes, adds shine
Ghee	1.0	0.5	0.5	Cooling, moisturizing, traditional base
Aloe Vera Gel	1.0	1.5	2.0	Soothing, moisturizing for the eye area
Vitamin E (Tocopherol)	0.5	0.5	0.5	Antioxidant, natural preservative
Camphor (optional)	0.2	0.2	0.2	Cooling effect, anti-inflammatory

Table No. 1: Formulation Table

How Herbal Eye Kajal Works

1. Natural Pigmentation and Optical Enhancement

Main Ingredient: Lampblack (Soot)

- Action: The carbon particles in lampblack act as the black pigment. When applied to the eyelids or waterline, this pigment creates a sharp contrast around the eyes, making them appear larger, more defined, and expressive.
- Mechanism: The fine, non-irritating soot particles adhere smoothly to the lash line and eyelid margin without entering the eye, reducing the risk of discomfort or blurring.
- Benefit: Provides deep, natural black coloration without artificial dyes or heavy metals commonly found in synthetic kajal.

2. Lubrication and Emollient Protection

Key Ingredients: Coconut Oil, Castor Oil, Almond Oil, Beeswax, Ghee

- Action:
  - These oils serve as emollients, occlusives, and humectants, moisturizing the sensitive skin around the eyes.
  - They prevent dryness, itching, and cracking by forming a protective film.
- Mechanism:
  - Castor Oil: Rich in ricinoleic acid, it has anti-inflammatory and antimicrobial properties. It supports eyelash growth by nourishing hair follicles.
  - Coconut Oil: Contains lauric acid, which hydrates and has mild antibacterial effects.
  - Almond Oil: High in vitamin E and unsaturated fats, it soothes the skin and prevents oxidative stress.
  - Ghee & Beeswax: Provide thickness to the kajal, help hold ingredients together, and act as cooling and healing agents.
- Benefit: Enhances comfort during wear, protects the skin barrier, and supports healthy eyelid tissue.

3. Antioxidant and Anti-inflammatory Protection

Key Ingredients: Vitamin E (Tocopherol), Aloe Vera Gel

- Action:
  - Vitamin E: A potent antioxidant that neutralizes free radicals and oxidative damage caused by pollution, UV light, or other environmental stressors.
  - Aloe Vera Gel: Contains acemannan and vitamins A, C, and E. It calms irritated skin, reduces redness, and promotes healing of microabrasions.
- Mechanism:
  - Antioxidants help prevent cellular damage and aging.
  - Anti-inflammatory effects reduce puffiness, burning, and eye fatigue.
- Benefit: Protects delicate under-eye skin, maintains freshness, and reduces signs of irritation or fatigue.

4. Cooling and Antiseptic Effect

Optional Ingredient: Camphor (Cinnamomum camphora)

- Action: Camphor provides a cooling sensation upon application, which refreshes tired eyes and helps soothe minor irritations.
- Mechanism: Camphor stimulates nerve endings in the skin, producing a mild cooling or tingling

effect. It also has antiseptic properties that help prevent minor infections.

- Benefit: Enhances the sensory experience of the kajal, relieves eye strain, and contributes to hygiene by reducing microbial load.

5. Barrier Against Environmental Pollutants

- All oil-based ingredients, especially beeswax and ghee, create a semi-occlusive layer on the skin.
- This layer acts as a barrier against dust, wind, pollen, and airborne irritants, especially helpful in urban or dry climates.

6. No Harmful Chemicals

- Herbal kajal is free from:
  - Heavy metals (lead, mercury, arsenic)
  - Artificial colors and preservatives
  - Parabens and phthalates
- Mechanism of Safety: Being plant- and food-based, the ingredients are non-toxic, biodegradable, and biocompatible with the eye and skin tissues.

7. Psychological and Cultural Wellness

- Kajal application is associated with rituals, traditions, and personal care routines that promote psychological well-being and a sense of identity and grooming.
- Traditional beliefs (e.g., warding off the evil eye) add cultural meaning, enhancing emotional comfort and self-care habits.

Evaluation of Herbal Eye Kajal

Organoleptic evaluation

Parameter	Observation
Color	Deep black to jet black; F3 had glossier appearance
Odor	Pleasant herbal; F3 had strongest herbal aroma
Texture	Smooth, non-gritty; all formulations acceptable
Consistency	Semi-solid, homogeneous, easy to apply
Appearance	Opaque, no lumps, no phase separation
Feel on Skin	Soothing, non-irritating; F3 had a slightly cooling effect
Stickiness	Slight initially, settles quickly

Table No. 2 : Organoleptic Evaluation

Physicochemical Evaluation of Herbal Eye Kajal

1) PH Measurement

- Purpose: To ensure the formulation is compatible with the skin and eyes.
- Method:
  - Mix 1 g of kajal in 10 ml of distilled water.
  - Stir well and filter.
  - Measure pH using a digital pH meter.
- Ideal Range: 6.0 to 7.5 (close to natural tear pH).

2) Melting Point

- Purpose: Indicates stability and consistency at varying temperatures.
- Method: Use capillary tube method or melting point apparatus.
- Expected Range: 35–45°C, depending on beeswax content.

3) Spreadability

- Purpose: To evaluate how easily kajal spreads upon application, indicating the smoothness and ease of use.
- Method:

1. Place a known amount of kajal between two clean glass slides.
2. Apply a fixed weight (e.g., 500 g) over the top slide.
3. Allow the weight to remain in place for 5 minutes.
4. Carefully remove the weight and measure the diameter (in cm) of the area over which the kajal has spread.

- Formula:

$$\text{Spreadability} = \frac{Weight \times Time}{Distance\ Spread}$$

  - Weight in grams (g)
  - Time in seconds (s)
  - Distance spread in centimeters (cm)

- Interpretation of Results:
  - A higher spreadability value indicates a better ease of application.
  - This suggests the kajal will glide more smoothly over the skin or eyelid surface.

4) Smudge Resistance Test

- Purpose: To evaluate the kajal's ability to resist smearing.
- Method:
  - Apply kajal on the forearm or paper strip.
  - Allow to dry for 10 minutes.
  - Rub gently with a cotton swab.

- Observation: Minimal smudging is preferred.

5) Eye Irritation Test (if applicable)

- Purpose: Ensures safety on the eyes.
- Methods:
  - In vitro: HET-CAM test (ethical model).
  - In vivo (optional): Patch test under dermatologist supervision.
- Observation: No redness, burning, or irritation.

6) Microbial Load Test

- Purpose: Ensure microbiological safety.
- Media:
  - Nutrient agar for bacteria
  - Sabouraud dextrose agar for fungi
- Tests for:
  - Total viable count
  - Presence of *E. coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*
  - Acceptance Limits: As per USP/IP guidelines.

8) Stability Testing

- Purpose: Determines shelf-life and storage conditions.
- Conditions:
  - 25°C ± 2°C (Room temp)
  - 40°C ± 2°C (Accelerated)
  - 4°C ± 2°C (Refrigerated)
- Parameters Monitored:
  - Color, odor, texture
  - Phase separation
  - pH changes
- Duration: 30, 60, 90 days

Parameter	Observation
PH	6.0 – 7.5
Melting Point (°C)	35 – 45°C
Spreadability (cm)	Higher is better
Smudge Test	Minimal smudge preferred
Microbial Load	Within USP/IP limits
Stability (30 days)	No phase separation or changes

Table No. 3: Physicochemical Evaluation

Future Scope:

The future scope of herbal eye kajal is highly promising, driven by increasing consumer demand for natural, safe, and multifunctional cosmetic products. As awareness grows around the potential side effects of chemical-based eye cosmetics, herbal kajal offers a safer alternative enriched with plant-based ingredients that provide both cosmetic appeal and therapeutic benefits. Future developments may include rigorous clinical studies to validate long-term safety and efficacy, enabling greater trust and wider acceptance among users. Incorporating additional herbal extracts like triphala, turmeric, and rose water could further enhance its anti-inflammatory, antimicrobial, and soothing properties. Innovations in formulation technology, such as nanoemulsions and sustained-release systems, may improve the bioavailability and performance of active ingredients. Moreover, the move toward preservative-free and environmentally sustainable products presents opportunities to develop kajal that aligns with clean beauty and eco-friendly trends. Scaling up production while maintaining quality, coupled with attractive and sustainable packaging, can support commercialization and global market reach. Overall, herbal eye kajal is well-positioned to evolve as a multifunctional, holistic product blending tradition with modern cosmetic science.

5.RESULTS

The prepared herbal eye kajal formulations (F1, F2, F3) were successfully developed using natural ingredients such as lampblack (soot), castor oil, coconut oil, almond oil, beeswax, ghee, camphor, vitamin E (tocopherol), and aloe vera gel. Each formulation was subjected to detailed evaluation, and the following results were obtained:

5.1 Organoleptic Evaluation

Parameter	F1	F2	F3
Color	Deep black	Jet black	Deep black
Odor	Mild herbal	Pleasant herbal	Slightly stronger aroma
Texture	Smooth	Very smooth	Soft, waxy
Consistency	Semi-solid	Firm semi-solid	Slightly firmer
Feel on skin	Cooling, smooth	Very smooth, soft	Soft, slightly oily

Table No. 4 : Result of Organoleptic Evaluation

5.2 Physicochemical Evaluation

Test	F1	F2	F3	Standard Limit
PH	6.8	7.0	6.6	6.0 – 7.5
Melting Point (°C)	38°C	40°C	42°C	35 – 45°C
Spreadability (cm)	4.5 cm	4.2 cm	3.8 cm	Higher is better
Smudge Resistance	Slight	Minimal	None	Minimal or no smudging
Microbial Load	Nil	Nil	Nil	No contamination (USP/IP)
Stability (30 days)	Stable	Stable	Stable	No phase separation or degradation

Table No. 5 : Result of Physicochemical Evaluation

CONCLUSION

The present study successfully formulated and evaluated herbal eye kajal using natural ingredients such as lampblack, castor oil, almond oil, coconut oil, beeswax, ghee, camphor, vitamin E, and aloe vera gel. Among the three formulations developed, Formulation F2 exhibited the most favorable characteristics, including optimal texture, spreadability, pH compatibility with the eye environment, and excellent stability.

Organoleptic and physicochemical evaluations confirmed that the herbal kajal was safe, aesthetically acceptable, and microbiologically stable over the testing period. The natural antioxidant and antimicrobial components contributed to the product's safety and shelf life.

Overall, the herbal eye kajal prepared in this study represents a promising alternative to conventional synthetic kajal, offering potential benefits such as reduced risk of eye irritation and toxicity. Further studies, including clinical evaluation and large-scale production, are recommended to validate and commercialize this natural cosmetic product.

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