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Formulation And Evaluation Of Medicated Herbal Kajal

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ABSTRACT: Medicated herbal kajal is redefining eye care by blending tradition with therapeutic botanicals, offering both beauty and healing in a single stroke. However, most medicated kajal formulations overlook the risk of microbial growth and potential ocular irritation, compromising long-term safety. Inadequate herbal extract standardization further affects its therapeutic reliability. Here, we develop a herbal medicated kajal with optimized extraction, formulation, and stability to enhance therapeutic efficacy and ocular safety. Key herbal ingredients such as Triphala ghrita, Marigold, Gotu kola, Cashew kernel and botanical oils are examined for their anti-inflammatory, anti-microbial, and soothing properties. Optimized five extraction techniques, including 1) Ayurvedic Sneha Kalpana process for making triphala ghrita, 2) Steam distillation for fennel seed oil, 3) Soxhlet extraction for cashew & marigold essential oils, 4) Decoction method for extracting coleus, and 5) Microwave assisted extraction to enhance bioactive yield. The study also reviews formulation strategies, stability assessments, and safety evaluations, ensuring suitability for ocular application. Findings support the potential of herbal kajal as a safe, effective, and stable alternative to conventional eye cosmetic with added medicinal benefits.

Index terms **-** Triphala ghrita; Cashew kernel oil; Marigold oil; Coleus extract; Herbal eye care.

INTRODUCTION:

The eye is made up of three coats, which enclose the optically clear aqueous humor, lens, and vitreous body. The outermost coat consists of the cornea and the sclera; the middle coat contains the main blood supply to the eye and consists, from the back forward, of the choroid, the ciliary body, and the iris. The innermost coat is the retina, which contains photoreceptor cells that convert light into neural signals for vision. The cornea plays a crucial role in focusing incoming light onto the retina, while the sclera provides structural support and protection. The iris regulates the amount of light entering the eye by controlling the size of the pupil. Behind the iris, the lens further focuses light onto the retina to form a clear image. The vitreous body helps maintain the shape of the eye and provides a transparent medium for light transmission. These structures work in coordination to ensure optimal visual function and eye health.

EYE DISORDERS:

- **Red eyes:** It is a condition where the white part of the eye(*sclera*) appears red or bloodshot due to irritation, inflammation, or dilated blood vessels. It can affect one or both eyes and may be accompanied by other symptoms like itching, pain, discharge, or vision changes, depending on the cause.
- **Eye infection:**
  - ***Conjunctivitis* (*pink eye*) –** Bacterial, viral, or allergic inflammation of the conjunctiva.
  - ***Keratitis* -** Infection of the cornea, often due to bacteria, viruses, or fungi.
  - ***Uveitis* –** Inflammation inside the eye, affecting the uvea.
- **Irritants and allergies:**
  - Dust, smoke, chemicals, or allergens like pollen or pet dander.
  - Contact lens overuse or improper hygiene.
- **Eye strain and dryness:**
  - Prolonged screen time leading to *computer vision syndrome.*
  - *Dry eye syndrome* due to decreased tear production.
- **Injury or Trauma:**
  - Scratches, Foreign objects, or chemical exposure.
  - *Subconjunctival Haemorrhage* (small blood vessel breakage, causing red patches).
- **Underlying medical conditions:**
  - **Glaucoma –** sudden eye pressure increase, causing pain and redness.
  - **Blepharitis –** Inflammation of the eyelids, often from bacteria or dandruff.

MEDICATED HERBAL KAJAL:

Kajal, commonly referred to as Anjanam in Ayurveda, has long been valued for both its cultural significance and therapeutic properties. Traditionally applied to safeguard the eyes and enhance aesthetic appeal, it is also recognized for its potential medicinal benefits. Ayurvedic texts describe the use of herbal formulations to promote ocular health, alleviate eye irritation, and provide cooling and anti-inflammatory effects. With increasing concerns over the side effects of synthetic eye care products, there has been a renewed interest in natural and herbal alternatives. This herbal kajal not only enhances the eyes aesthetically but also serves as a protective and healing formulation, emphasizing its **dual-use function as both an eyeliner and a medicinal eye care product**.

Conventional kajal formulations often contain synthetic carbon black, heavy metals, and other chemicals that may pose risks to ocular health. Herbal medicated kajal incorporates plant-based bioactive compounds known for their ophthalmic benefits, such as antimicrobial, antioxidant, and soothing properties. Ayurveda has documented numerous medicinal plants that contribute to eye health, many of which are referenced in classical texts like Charaka Samhita, Sushruta Samhita, and Bhavaprakasha Nighantu. These formulations have historically been used for conditions such as dryness, redness, and inflammation of the eyes.

The development of medicated herbal kajal combines traditional Ayurvedic knowledge with modern scientific advancements to create a formulation that is both safe and effective. By utilizing plant extracts with proven pharmacological activities, this study aims to optimize a natural kajal formulation, assess its physicochemical stability, and evaluate its potential as a therapeutic and cosmetic eye care product. The integration of herbal medicine in ocular applications presents an opportunity to offer a biocompatible and sustainable alternative to conventional eye cosmetics.

Aim & Objectives:

Aim: To develop & evaluate a medicated herbal kajal with therapeutic benefits using Ayurvedic principles and modern scientific methods.

Objectives:

- Protects eyes from infections and irritation.
- Acts as a natural coolant, reducing eye strain.
- Potentially aid in managing insomnia.
- Provides a smooth, long-lasting, and non-irritating application.
- Serves as an alternative to chemical-based eye cosmetics.

Materials & Methodology:

Materials:

The ingredients were selected based on their medicinal benefits, ensuring safety, efficacy, and stability in the formulation. Each component contributes specific pharmacological benefits that support the intended therapeutic action of the preparation.

No.	Ingredients	Properties
1.	Bees Wax	Thickening agent , emollient
2.	Chamomile	Anti inflammatory & treat insomnia
3.	Triphala Ghrita	Treat Dry eyes & computer vision syndrome
4.	Coleus	Reduce IOP & Glaucoma
5.	Brahmi	Cognitive enhancement
6.	Tulsi	Treat infection & conjunctivitis
7.	Hibiscus	Improve blood circulation
8.	Marigold	Anti oxidant & Blue light protectant
9.	Cashew	Moisturizing agent
10.	Fennel seeds	Reduce dark circles, wrinkles
11.	Camphor	Anti Bacterial & Anti fungal
12.	Castor oil	Moisturizes & soothes the eyes

Extraction methods for different ingredients:

Each plant extract was prepared using a suitable method based on the nature of the active compounds and traditional practices.

1. Sneha Kalpana Method:

- **Triphala ghrita:**

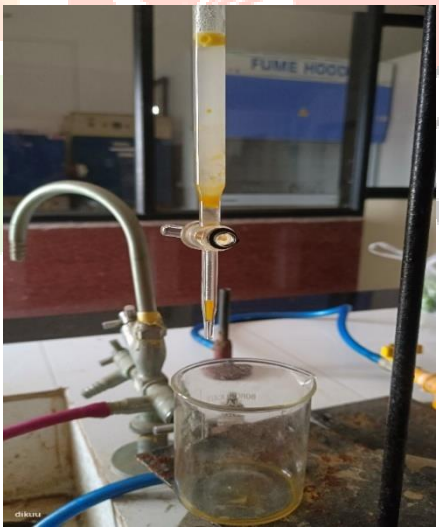
Triphala Ghrita is prepared using the *Sneha Kalpana* process in Ayurveda, specifically the *Ghrita Paka* method. Triphala Kwatha (decoction) is made by boiling Triphala powder in water until reduced to one-fourth, and Triphala Kalka (paste) is prepared separately. Pure cow ghee is then heated with the Kwatha and Kalka, ensuring uniform mixing. The mixture is heated on a low flame until all moisture evaporates, indicated by the absence of frothing, non-sticky residue, and retained ghee aroma. The final medicated ghee is filtered and stored in an airtight container.

2. Steam distillation by Clevenger apparatus:

- **Fennel seeds oil:**

Fennel seed oil is extracted using the Clevenger apparatus via hydro-distillation. Lightly crushed fennel seeds (100–200 g) are boiled with 500–1000 mL distilled water in a round-bottom flask

for 3–4 hours. The steam carries the essential oil, which condenses and collects in the Clevenger oil trap. The oil is separated, dried using anhydrous sodium sulfate, and filtered for clarity. The final essential oil is stored in an amber glass bottle to prevent oxidation.



3. Soxhlet extraction method:

- **Cashew kernel oil:**

Cashew seed oil was extracted using the Soxhlet apparatus with hexane as the solvent. Finely ground cashew kernels (45–50 g) were placed in a filter paper thimble and extracted with 100 mL of hexane at 60–70°C for 4–6 hours until the solvent in the siphon tube appeared colorless. The oil-solvent mixture was concentrated using a heating mentle at 40–50°C to remove residual solvent. The purified oil was stored in an airtight amber glass bottle for further analysis.

- **Marigold flower oil:**

Marigold flower oil was extracted using the Soxhlet apparatus with hexane or ethanol as the solvent. Shade-dried marigold flowers were finely powdered (50 g) and placed in a filter paper thimble for extraction with 100 mL of solvent at the appropriate boiling point for 4–6 hours. The solvent-oil mixture was concentrated using a Heating mentle at 40-50 to remove residual solvent traces. The extracted oil was stored in an amber glass container for further analysis.

4. Microwave assisted extraction methods:

- **Brahmi**
- **Tulsi**
- **Hibiscus**
- **Chamomile**
- **Camphor**

Microwave-assisted extraction (MAE) was used to extract bioactive compounds from Brahmi, Tulsi, Hibiscus, Chamomile & Camphor using a glycerine-water (70:30) solvent system. Dried plant powders (10–20 g) were mixed with 100 mL solvent in a glass beaker and microwaved at 300–600 W for 5–10 minutes at 50–70°C with intermittent cooling and optional stirring. The extract was cooled and filtered through Whatman No. 1 filter paper. The final extract was stored in amber glass bottles at 4°C.

5. Decoction Method:

- **Coleus leaves:**

Coleus leaves (20 g) were extracted using a double boiler to obtain water-soluble constituents. The decoction was then concentrated by heating in a porcelain dish until a thick extract was achieved. This process aligns with Ayurvedic *Kvatha* preparation or *Ghanasara* extraction by evaporation. The final concentrated extract was stored for further use.

METHODOLOGY

The herbal medicated kajal was prepared in two major phases:

(1) Soot collection

(2) Formulation of the kajal base

Using various oil-based herbal extracts and natural excipients. The process was carefully optimized to ensure consistency, stability, and therapeutic benefit.

Preparation of Soot

Materials Used: *Nigella sativa* (Kalonji) powder, camphor powder, cotton wick, copper oil lamp, castor oil, stainless steel or ceramic plate.

Method:
A uniform blend of *Nigella sativa* powder and camphor powder was incorporated into a thick cotton wick to serve as the combustion medium. The prepared wick was placed in a copper lamp filled with castor oil and ignited. A stainless steel or ceramic plate was held above the flame at a fixed distance to collect the resulting soot from the incomplete combustion of the wick. The soot, rich in carbon and bioactive residues from Kalonji and camphor, was carefully scraped from the plate and stored in a sterile, airtight glass container for further use as the primary pigment.

Preparation of Herbal Kajal Base

Materials Used: Beeswax, Shea butter, black soot (from Step 1), and herbal oils including cashew nut oil, marigold oil, fennel seed oil, chamomile oil, *Ocimum sanctum* (Tulsi) oil, *Triphala Ghrita*, *Bacopa monnieri* (Brahmi) oil, and *Coleus forskolin* extract.

Method:

A double boiler apparatus was assembled by placing a heat-resistant borosilicate glass beaker over a vessel containing simmering water, maintaining gentle heat throughout the process to prevent degradation of thermolabile ingredients.

1. **Melting Phase:**
   Approximately 5 g of pharmaceutical-grade beeswax was added to the beaker and allowed to melt completely.
2. **Incorporation of Oil Phase:**
   Once the beeswax was liquefied, 9–10 drops of each of the selected oil-based herbal extracts (cashew nut oil, marigold oil, fennel seed oil, chamomile oil, tulsi oil, Triphala Ghrita, and brahmi oil) were added to the molten base under continuous stirring to ensure homogeneity.
3. **Addition of Coleus Extract:**
   Five drops of *Coleus forskohlii* extract were incorporated into the mixture to enhance the therapeutic potential of the kajal.
4. **Pigmentation with Soot:**
   Approximately 1 tablespoon of the pre-collected black soot was slowly added to the formulation while stirring continuously to achieve a uniform dispersion and a deep black coloration.
5. **Addition of Shea Butter:**
   To enhance the texture, smoothness, and spreadability of the kajal, three spatula measures of shea butter were blended into the formulation, imparting emollient and gloss-enhancing properties.
6. **Molding and Solidification:**
   The final mixture was promptly transferred into pre-cleaned, sterile kajal containers using a glass dropper. The containers were left undisturbed at ambient room temperature to cool and allow the formulation to solidify. Once solidified, the kajal exhibited a smooth, semi-solid consistency suitable for topical ocular or periocular application.




Evaluation Tests for Herbal Kajal:

1) **Physical Evaluation:**

The therapeutic herbal kajal formulations were tested for physical parameters such as color, texture, fragrance, and consistency.

Principle: Using the senses, evaluate the color, odor, taste, size, shape, and texture of the kajal. This is a qualitative assessment of the medicine.

Procedure:

- Color: Look at the color of the kajal. It should have a black color.
- Odor: Smell the kajal to determine its odor. It should have an identifiable odor.
- Texture and Consistency: Touch the kajal between your fingertips to assess its smoothness and consistency. Herbal kajal compositions are meant to be smooth in appearance and semi-solid in consistency.
- Visually check the kajal for any anomalies in appearance. It should have a smooth, consistent texture.

2) pH determination:

The pH of the formulated kajal was determined using a calibrated pH meter. A precisely weighed 1 g sample of the kajal was dispersed in 25 mL of dimethyl sulfoxide (DMSO) and allowed to stand for 2 hours to ensure proper equilibration. The pH of the dispersion was measured three times, and the average value was recorded.

3) Antimicrobial Activity:

The antimicrobial activity of the prepared herbal medicated kajal formulation was assessed using the agar well diffusion method. Sterile nutrient agar plates were uniformly inoculated with standardized bacterial suspensions of *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative). After allowing the bacterial lawn to establish, wells of 8 mm diameter were aseptically punched into the agar using a sterile cork borer. Each well was subsequently filled with the test formulation, which had been appropriately diluted in dimethyl sulfoxide (DMSO) to ensure uniform diffusion. The inoculated plates were incubated at 37 ± 1 °C for 48 hours. The antimicrobial activity was determined by measuring the diameter of the zones of inhibition surrounding each well.

4) Skin Irritation Test:

Principle:
The skin irritation test is employed to evaluate the potential of a substance to cause reversible damage or irritation to the skin. These assessments are typically conducted without the use of animals or humans and rely on in vitro reconstructed human epidermal models. Such models offer mechanistically relevant insights into cell damage and inflammatory responses, thereby playing a critical role in ensuring product safety prior to commercialization.

Procedure:
A patch test was conducted by applying a small amount of the kajal formulation to a designated area on the volar surface of the forearm of healthy human volunteers (with prior ethical approval and informed consent). The site was observed at regular intervals over 24–48 hours for any signs of irritation, including redness, itching, or swelling. The formulation was considered non-irritant if no visible reaction was observed during the observation period.

5) Spreadability Test:

Principle:
Spreadability is defined as the ability of a formulation to uniformly spread under an applied force. It is a critical parameter that reflects the formulation's consistency, texture, and ease of application. The test determines the time required for the formulation to spread to a uniform thickness under a specified weight.

Procedure:
A fixed amount of the kajal formulation was placed between two glass slides. A weight was gently placed on the upper slide and allowed to rest for five minutes to ensure uniform spreading. Subsequently, a known weight (M) was tied to the upper slide, which was then allowed to move horizontally. The time (t) taken for the upper slide to move a specified distance (L) was recorded. Spreadability (S) was calculated using the following formula:

$$S = m * l / t$$

where
S = Spreadability (g.cm/s)
M = Weight applied to the upper slide (g)
L = Distance moved by the slide (cm)
t = Time taken (s)

6) Stability Studies:

Principle:
Stability testing is performed to evaluate the formulation's ability to maintain its physical and chemical integrity under different environmental conditions over time. This helps determine shelf life and optimal storage conditions, ensuring the product's safety, efficacy, and quality throughout its intended use.

Procedure:
The herbal kajal formulation was subjected to accelerated and room temperature conditions for a specified duration. Samples were stored at ambient room temperature ($25 \pm 2°C$) and elevated temperature ($40 \pm 2°C$) and observed at regular intervals. Physical parameters such as color, odor, texture, and consistency were recorded to assess any changes during the storage period.

7) Evaluation of base:

The oil sample used as the base in the herbal kajal formulation was evaluated for its physicochemical quality by determining its **acid value** and **saponification value**, which serve as indicators of the fat's purity, degradation, and suitability for cosmetic application.

1. Acid Value

Principle:
The acid value is defined as the number of milligrams of potassium hydroxide (KOH) required to neutralize the free fatty acids present in one gram of fat or oil. A high acid value typically indicates hydrolytic rancidity due to the presence of free fatty acids, which can compromise the quality of the base.

Procedure:
Approximately 10 g of the oil sample was accurately weighed and transferred to a 250 mL conical flask. To this, 50 mL of neutral ethanol and 1 mL of phenolphthalein indicator were added. The mixture was gently heated on a water bath, if necessary, until complete dissolution. The hot solution was then titrated with 0.1 N KOH until a stable pink endpoint was achieved. The volume of KOH used was recorded, and the acid value was calculated using the formula:

Acid Value= (V x N x 56.1) / W.

where:
v = volume (mL) of 0.1 N KOH used in titration

N**:** Normality of the standard alkali solution.

W = weight (g) of the ghee sample

2. Saponification Value

Principle:
The saponification value represents the number of milligrams of KOH required to saponify one gram of fat. It is a measure of the average molecular weight (or chain length) of all the fatty acids present. Higher values indicate shorter-chain fatty acids.

Procedure:
An alcoholic potassium hydroxide solution was prepared by dissolving 40 g of KOH in 20 mL of distilled water and diluting to 1000 mL with ethanol. This solution was allowed to stand overnight before use.

A 4 g sample of oils was accurately weighed into a 250 mL conical flask, and 25 mL of the alcoholic KOH solution was added. The flask was connected to a reflux condenser and heated on a water bath for one hour. A blank was prepared under the same conditions, omitting the ghee sample. After cooling, 1 mL of

phenolphthalein indicator was added to each flask, and the solutions were titrated against 0.5 N hydrochloric acid (HCl) until the pink color disappeared. The saponification value was calculated using the formula:

Saponification Value= (b-a) x 1000/w

where:
a = volume (mL) of 0.5 N HCl used for the test sample
b = volume (mL) of 0.5 N HCl used for the blank
W = weight (g) of the oil sample

RESULT AND DISCUSSION

Sr. No.	Evaluation Parameter	Inference
1	Color	Dark black
2	Odour	Characteristic Odour
3	Texture	Smooth
4	pH determination	6.5
5	Acid value	1.3
6	Saponification value	239.567
7	Spreadability	294 cm.gm/sec
8	Stability	No change
9	Anti-microbial Activity	No microbial growth

CONCLUSION

The present study successfully formulated and evaluated a medicated herbal kajal with the dual objective of enhancing both therapeutic efficacy and cosmetic appeal. The formulation incorporated carefully selected botanical ingredients—*Centella asiatica* (Gotu Kola), cashew nut oil, and marigold flower oil—known for their antioxidant, anti-inflammatory, and skin-rejuvenating properties. Advanced and optimized extraction techniques were employed to preserve the integrity of their bioactive constituents, ensuring maximal therapeutic value.

The resulting formulation exhibited favorable physicochemical characteristics, including a smooth and uniform texture, satisfactory spreadability, and good structural stability. These attributes are critical for consumer acceptance and consistent application in ocular regions. The pH of the formulation was maintained within the physiologically acceptable range for eye products, minimizing the risk of irritation.

Microbiological evaluation demonstrated the formulation's ability to inhibit the growth of common ocular pathogens, underscoring its antimicrobial potential. These findings suggest that the medicated kajal may not

only serve a cosmetic purpose but also act as a protective barrier, reducing the risk of microbial contamination and eye infections.

Furthermore, safety assessments, including ocular irritancy studies, confirmed that the formulation was non-irritant and well-tolerated upon application. This supports its safe use around sensitive eye tissues, a key consideration in herbal cosmetic product development.

Overall, the study provides a promising foundation for the integration of traditional herbal knowledge with modern formulation science. The medicated kajal offers a natural, safe, and effective alternative to synthetic eye cosmetics, aligning with current trends favoring clean-label and eco-conscious personal care produc**Future Perspectives:**

Further research should explore strategies to enhance the shelf life and preservative efficacy of the formulation using natural stabilizers. Clinical trials and long-term safety studies will be essential to validate the therapeutic claims and ensure broader consumer applicability. Additionally, the incorporation of novel herbal extracts with targeted ophthalmic benefits may further elevate the functional value of herbal kajal formulations.

Gaps in Existing Research:

Despite advancements, certain gaps remain in the field of medicated kajal formulation:
While medicated kajal has been explored for its potential therapeutic benefits, there is currently no conclusive scientific evidence proving its effectiveness in treating Computer vision syndrome, glaucoma or cataracts. Further research, including clinical trials and pharmacological studies, is required to establish its safety and efficacy for such medical conditions. Until then, medicated kajal should primarily be considered for cosmetic or general eye-care purposes rather than a proven treatment for glaucoma.

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