CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://doi.org/10.5281/zenodo.17883080

https://www.iajps.com/volumes/volume12-december-2025/28-issue-12-december-25/

Available online at: http://www.iajps.com *Review Article*

AN OVERVIEW – FORMULATION AND EVALUATION OF HERBAL KAJAL USING TRIPHALA POWDER: A COMPARATIVE STUDY WITH MARKETED FORMULATION

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Abstract:

A cosmetic product is defined as any substance or preparations intended to be placed in contact with the various external part of human body. The eyes are delicate organs that require safe, soothing, and non-irritating cosmetic products. Kajal also known as surma or kohl is an eye cosmetic with cultural and therapeutic significance. Conventional kajal formulations often contain synthetic chemicals that may cause ocular irritation or long-term side effects. Herbal alternatives are increasingly preferred due to their natural origin, safety, and therapeutic benefits. This study aims to formulate and evaluate herbal kajal using Triphala powder (a traditional Ayurvedic blend of Terminalia chebula, Terminalia bellerica, and Emblica officinalis), known for its antioxidant, antimicrobial, and rejuvenating properties.

Keywords: *Cosmetics, Eye Kajal, Triphala Powder, Occular safety, Natural eye cosmetics.*

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QR CODE

Please cite this article in press ***Sajitha Seyath*** *et al.,* ***An Overview – Formulation And Evaluation Of Herbal Kajal Using Triphala Powder: A Comparative Study With Marketed Formulation****, Indo Am. J. P. Sci, 2025; 12(12).*

INTRODUCTION:

COSMETICS

Cosmetics can be defined as external preparation meant to apply on external part of the body i.e., nails, skin, hair for coloring, covering, softening, cleaning, nourishing, waving, setting, mollification, preservation, removal and protection etc[1] or "A cosmetic is an item intended to be rubbed, poured, sprinkled or sprayed on, introduced in to or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance". The word cosmetic is originated from Greek word "Kosmeticos" means adorn and preparation, which is used for this purpose, is known as cosmetic.[2]

Fig.1. Various cosmetics

All cosmetic preparation has their application for long or short periods to beautify the body as well as to keep the body healthy up to some extent and has psychological impact to other. The "active life" of any cosmetic preparation begins the moment it is brought in contact with the skin/hair/teeth/or nails and ends when it is removed or has evaporated. During its active life; it has intimate reciprocal relationship, which results, cosmetic changes on the body. The cosmetic product prevents its outmost layer from drying out, penetrate below the external layer and introduce active substances in to deep lying strata or adhere only superficially to change color or luster of areas. The cosmetic which are used for decorative purposes, i.e., eye lines, rouges, mascara, face masking preparations etc and also carries the inherent risk of desirable side effects. It may inhibit important physiological process, chemically modify certain skin constituents (e.g., in case of bleaching and coloring preparations), and contribute towards their removal or even give rise to certain allergic reactions.[3]

HISTORY

The history of cosmetics is present for at least 7000 years and it exists in almost every society around the world. The earliest form of human cosmetic rituals should be body art that includes cosmetics. Cosmetics were not welcome in Rome, but they were used it some aristocratic Romans of the time. It was found that some Romans invented cosmetics in ancient times for example, Kohl used to cover their eye lining. In 1888, a deodorant intended for cosmetic purposes was discovered anonymous American and was marketed trade name- "Mum". Below Even after 1900 AD, people did not accept cosmetics. Roll-on deodorant and aerosol deodorant were introduced to the market in 1952 and 1965. Russian ballet and colorful makeup were performed around the same time in 1910. It should be noted that the year was started by the current cosmetic manufacturer's production around the beginning of the 20th century.[4]

ANATOMY OF EYE [5]

The eye is one of the most fascinating and complex organs in the human body. It plays a vital role as our main organ of vision, allowing us to perceive the world through light. Because of its delicate structure and unique physiology, the eye is protected by several natural barriers that shield it from external substances and stress.

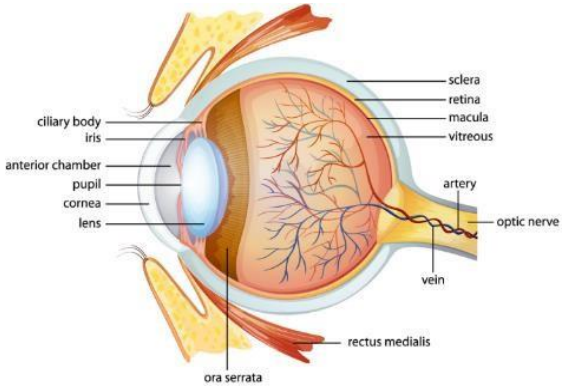

Fig.2. Anatomy of Eye

Anterior chamber: The front section of the eye's interior where aqueous humor flows in and out, providing nourishment to the eye.

Aqueous humor: The clear watery fluid in the front of the eyeball.

Blood vessels: Tubes (arteries and veins) that carry blood to and from the eye.

Caruncle: A small, red portion of the corner of the eye that contains modified sebaceous and sweat glands.

Choroid: The thin, blood-rich membrane that lies between the retina and the sclera and is responsible for supplying blood to the outer portion of the retina.

Ciliary body: The part of the eye that produces

aqueous humor.

Cornea: The clear, dome-shaped surface that covers the front of the eye

Iris: The colored part of the eye. The iris is partly responsible for regulating the amount of light permitted to enter the eye.

Lens (also called crystalline lens): The transparent structure inside the eye that focuses light rays onto the retina.

Lower eyelid: Skin that covers the lower part of the eyeball, including the cornea, when closed.

Macula: The central portion of the retina that allows us to see fine details.

Optic nerve: A bundle of nerve fibers that connect the retina with the brain. The optic nerve carries signals of light, dark, and colors to a part of the brain called the visual cortex, which assembles the signals into images and produces vision.

Posterior chamber: The back part of the eye's interior.

Pupil: The opening in the middle of the iris through which light passes to the back of the eye.

Retina: The light-sensitive nerve layer that lines the inside of the back of the eye. The retina senses light and creates impulses that are sent through the optic nerve to the brain.

Sclera: The white visible portion of the eyeball. The muscles that move the eyeball are attached to the sclera.

Suspensory ligament of lens: A series of fibers that connects the ciliary body of the eye with the lens, holding it in place.

Upper eyelid: Skin that covers the upper part of the eyeball, including the cornea, when closed.
Vitreous body: A clear, jelly-like substance that fills the back part of the eye.

EYE KAJAL

Kajal as a traditional eye cosmetic, also known as kohl or surma, traditionally made from soot, camphor, and other herbal ingredients to enhance eye beauty. It is applied along the lash line and waterline to define eyes, and can be used to create looks ranging from subtle to dramatic and smoky. Some believe traditional kajal has cooling and medicinal properties, but commercially produced kajal can contain high levels of lead, which can be harmful.

Kohl, one of the oldest known cosmetics, has been worn since the Naqada III era (around 3100 BCE) by Egyptians of all social classes.[6][7] In ancient Egypt, people believed that kohl protected their eyes from infections and from the bright desert sun.[8] It also had spiritual meaning, as the dark lines around the eyes were linked to the eye of Horus, a symbol of protection and power. Men, women, and even children used it as part of daily life and religious rituals.

Fig.3. Kajal

However, research shows that kohl was not just an Egyptian invention. Archaeological discoveries in Sudanese Lower Nubia provide the earliest direct evidence of kohl use. Scientists studying kohl samples from Nubian cemeteries at Debeira and Ashkeit, dated between 2300 and 1500 BCE, found that the Nubians were not only using kohl but also producing it themselves. Some of the materials came from local sources, while others were imported from Egypt.[9] Kohl containers and applicators found in Nubian graves older than Egypt's full control over the region suggest that Nubia played an important role in the development and spread of this cosmetic. This evidence challenges the old idea that kohl originated only in Egypt.

During the New Kingdom period, around 1500 BCE, kohl became more sophisticated. The famous female Pharaoh Hatshepsut was known to mix charred frankincense into her eyeliner the first recorded use of this resin in cosmetics. The frankincense came from the Land of Punt, which she reached through a royal expedition. Other exotic ingredients such as cinnamon, myrrh, and different spices were also used for fragrance and beauty.[10] Historical records show that copper kohl sticks and cosmetic ingredients were exported from ancient Sri Lankan ports, known as Tamraparni, to Egypt, showing how widespread ancient trade networks were.

In later centuries, kohl continued to be used in the Islamic world. The early Muslim scholar Ibn Abi Shaybah described how to apply it and mentioned its health benefits, especially when made from antimony (ithmid), which was believed to strengthen the eyes and lashes. In North Africa and the Middle East, Berber and Semitic-speaking women also used kohl to create facial markings, such as a vertical line from the bottom lip to the chin or along the nose. Originally, this line showed whether a woman was married or not. This style came from the Arabian Peninsula and spread to North Africa in the seventh century.

Even today, kohl remains an important part of many cultures across the Arab world, Africa, and South Asia. What began as a simple mixture for eye protection thousands of years ago has become a timeless symbol of beauty, tradition, and identity.

BENEFITS OF ORGANIC KAJAL FOR EYE HEALTH:

- **Natural Cooling Effect**: Many organic kajal contain ingredients like camphor and menthol, which provide a cooling sensation to the eyes. This can help reduce eye strain and discomfort, especially after long hours of screen time.
- **Hydration**: Organic kajal often contain ingredients that help keep the eyes moist and hydrated. This is crucial for individuals who experience dryness or discomfort due to excessive screen use or environmental factors.
- **Protection from Environmental Pollutants**: Organic kajal acts as a protective shield for your eyes, helping to prevent dust, smoke, and pollutants from directly affecting your ocular health
- **Enhanced Beauty**: Organic kajal enhances the beauty of your eyes naturally, making them appear more vibrant and expressive without the risk of chemical exposure.
- **Reduced Redness and Irritation**: The gentle formula of organic kajal minimizes the chances of redness or irritation associated with eye makeup, making it suitable for those with sensitive eyes.

MATERIALS USED TO FORMULATE EYE KAJAL
RAW MATERIALS AND EXCIPIENT PROFILE
All the materials used in the present study i.e., triphala powder, coconut oil, almond powder, cow ghee, honey, were purchased from local market. The details of materials used for the formulation of herbal kajal is mentioned below:

1.TRIPHALA POWDER [11]

Fig.4. Triphala Powder

Three medicinal herbs make up Triphala (in Sanskrit, "tri" means "three" and "phala" means "fruits"). It is an antioxidant-rich herbal preparation described as a Rasayana (rejuvenator) medicine by Ayurvedic practitioners. Combining the three fruits is said to be responsible for Triphala's numerous health benefits[1].
Triphala is made from the dried fruits of Amla, Bibhitaki, Haritaki

- **AMLA:[12]**

Fig.5. Amla

Synonyms: Emblica, Indian goose berry, Amla.
Biological Source:
This consists of dried, as well as fresh fruits of the plant Emblica officinalis Gaerth (*Phyllanthus emblica Linn.*)
Family: Euphorbiaceae

Chemical constituents:
It is an important dietary source of vitamin C, minerals, and amino acids. The pulpy portion of fruit, dried and freed from the nuts contains: gallic acid 1.32%, tannin, sugar 36.10%; gum 13.75%; albumin 13.08%; crude cellulose 17.08%; mineral matter 4.12%; and moisture 3.83%. Tannins are the mixture of gallic acid, ellagic acid, and phyllembin. The alkaloidal constituents such as phyllantidine and phyllantine have also been reported in the fruits.

Therapeutic uses:
Rich in vitamin C and polyphenols, amla helps neutralize oxidative stress in ocular tissues, which is a key factor in cataract formation and age-related macular degeneration.

➢ **BIBHITAKI:**[13]

Fig.6. Bibhitaki

Synonyms: Vibhitaki, Terminalia bellirica. Bhomora, Bhomra, Bhaira, Beleric, Myrobalan, Bahedam, Beheda.
Biological Source:
The medicinal part of Bibhitaki is the *pericarp of dried ripe fruits* of *Terminalia bellirica* (Gaertn.) Roxb.
Family: Combretaceae
Chemical constituents:
It involves tannic acid, ellagic acid, glycosides, chebulagic acid, gallic acid, oxalic acid, phyllemblin, β-sitosterol, mannitol, galactose, glucose, fructose, rhamnose etc.
Therapeutic uses:
Bibhitaki contributes antioxidant and anti-inflammatory effects that protect ocular tissues.

➢ **HARITAKI:**[14]

Fig.7. Haritaki Synonyms: Abhaya, Kayastha, Harad, Katukka
Biological Source:

The plant part used is dried ripe fruit of *Terminalia chebula* Retz

Family: Combretaceae.
Chemical constituents:
It is also the most abundant source of ascorbic acid. Punicalagin, triflavin A, Corilagin, galloyl glucose, ellagic acid, gallic acid, chebulic acid, chebulinic acid, and tannic acid are the most common tannins found in the fruit. At the same time, flavonoids such kaempferol, quercetin, and catechin are present. Saccharides such as quinic acid, shikimic acid, D- glucose, and D-fructose are also found in fruit.
Therapeutic uses:

Haritaki is used in Ayurvedic eye therapies like Vidalaka for conditions such as conjunctivitis and Computer Vision Syndrome, offering anti-inflammatory and soothing effects.

2.COCONUT OIL:[15]

Fig.8. Coconut Oil
Synonyms: Coconut oil, coconut butter, copra oil.
Biological Source:
Coconut oil is the oil expressed from the dried solid part of endosperm of coconut, *Cocos nucifera* L.
Family: Palmae.

Chemical constituents:
Consists of a mixture of triglycerides of saturated fatty acids. The oil contains about 95% of saturated fatty acids with 8 and 10 carbon atoms. It shows the presence of caprylic acid, 2%; capric acid, 50–80%; lauric acid, 3%; and myristic acid about 1%.
Therapeutic uses:
Coconut oil may help relieve dry eyes and reduce inflammation when applied around the eyes, but direct application into the eyes is not medically recommended without supervision.

2.ALMOND POWDER:[16]
Synonyms: Badam,Vatada,Amygdalus.

Fig.9. Almond Powder Biological Source: It is the dried seeds of *Prunus amygdalus* **Family:**Rosaceae.

Chemical constituents:
It contains 40–55% of fixed oil, about 20% of proteins, mucilage and emulsin.

Therapeutic uses:
Applying almond oil around the eyes may help reduce dark circles, puffiness, and fine lines, but it should never be applied directly into the eyes.

2.GHEE:[17]

Synonyms: Clarified Butter.

Biological Source:
Clarified butter derived from cow or buffalo milk of *Bos taurus or Bos bubalis.*

Chemical Constituents:
Saturated and unsaturated fats, fat-soluble vitamins (A, D, E, K).

Traditional Uses:
Highly valued in Ayurveda for its nourishing, healing, and cooling properties.

Fig.10. Ghee

METHOD OF PREPARATION [18]

Muslin cloth piece or cotton is used, in this triphala powder and Almond powder was taken and used as a wick and was lighted in a mud lamp containing ghee.

⇩

Now lit the lamp and put the inverted copper plate on it.

⇩

Then scrape the black soot and collected in a clean, dry porcelain dish.

⇩

Coconut oil is then added in black Soot for preparing the kajal

⇩

Make a uniform paste to get kajal.

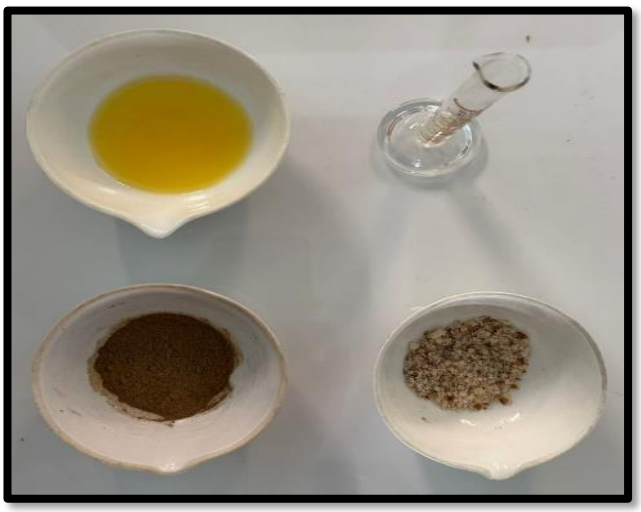

Fig.11. Ingredients used in formulation

Fig.12. Wick

Fig.13. Lamp lighten and place inverted copper plate

Fig.14. Black soot obtained

Fig.15. Soot mixed with coconut oil

Fig.16. Kajal

FORMULATION OF EYE KAJAL

SL NO.	INGREDIENTS	FORMULATION		
		A	B	C
1	Triphala Powder	4g	5g	6g
2	Almond Powder	5g	4g	6g
3	Cow ghee	15g	20g	24g
4	Coconut oil	2ml	2.5ml	3ml

EVALUATION STUDIES

1.Physical Evaluation:[19]

The formulations of herbal kajal were evaluated for organoleptic properties like color, odour, texture, and consistency.

2.p^{H} Determination:[20]

The pH of various formulation was determined by using both pH strip and pH meter. Ideal Range: 6.0 to7.5 (close to natural tear pH)

Procedure:

- Mix 1g of kajal in 10ml of carrier.
- Stir well.
- Measure pH by dipping the pH strip in the sample and also by using a digital pH meter

3.Spreadability:[21]

This is to evaluate how easily kajal spreads upon application, indicating the smoothness and ease of use. A higher spreadability value indicates a better ease of application. This suggests the kajal will glide more smoothly over the skin or eyelid surface.

Procedure:

- Place a known amount of kajal between two clean glass slides.
- Apply a fixed weight (e.g., 500 g) over the top slide.
- Allow the weight to remain in place for 5 minutes.
- Carefully remove the weight and measure the diameter (in cm) of the area over which the kajal has spread.
- Spreadability can be determined by using the formula;
  Spreadability = $Weight$ (g) × $Time$(s) / $Distance\ Spread$(cm)

4.Stability Studies:[20]

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 ± 2°C), elevated temperature (40 ± 2°C) and refrigerated temperature (4°C±2°C) observed at regular intervals. Physical parameters such as colour, odour, texture, and consistency were recorded to assess any changes during the storage period.

5.Evaluation of base:[20]

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.

i. 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

ii. 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

2. Solubility:

Herbal eye kajal is generally insoluble in water but is largely soluble in organic solvents like alcohol, ether, and especially chloroform. This is due to its primary ingredients, which are carbon black, natural waxes, oils, and various herb extracts.
Procedure:

- Weigh a small, precise amount of the kajal sample (e.g., 1 gram) into four separate test tubes.
- Add a fixed volume (e.g., 25 ml) of each solvent (water, alcohol, ether, chloroform) to a separate test tube.
- Disperse the kajal in the solvent and allow it to stand, potentially with occasional shaking or warming (if safe for the solvent) for a set period.
- Observe the extent to which the kajal dissolves. The mixture can be filtered or centrifuged to separate any undissolved residue, and the filtrate can be examined for clarity or the amount of dissolved material.

3. Resistance test:

i. Smudge Resistance Test:

This test evaluates the kajal's ability to resist smearing after application. Minimal smudging indicates good smudge resistance.
Procedure:

- Apply kajal on the forearm or paper strip.
- Allow to dry for approximately 10 minutes.
- Gently rub the applied area with a cotton swab.

ii. Waterproof Test:

The core principle involves observing the product's interaction with water under controlled conditions. The product should be tested for its ability to resist mixing with water and flowing.
Procedure:

- Apply a stroke of the herbal kajal to the back of your hand or forearm.
- Allow it to set for a few minutes.
- Gently splash or spray water onto the applied area.
- Observe whether the product runs or dissolves immediately.
- Gently rub the wet area with a finger or a cotton swab. A waterproof kajal will remain largely intact, potentially only smudging slightly, while a non-waterproof one will smear considerably or wash off.

8.Antimicrobial Activity:[20]

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.

CONCLUSION:

Kajal is a traditional eye makeup product with a rich history that spans various cultures. It is known for its ability to enhance the eyes and create dramatic, expressive looks. Kajal is available in different types, including both artificial and herbal varieties, each offering distinct benefits and characteristics. Artificial kajal, also known as commercial or kajal, is typically made with synthetic ingredients and comes in various forms, such as waterproof, smudge- proof, and colored options. It is favored for its wide range of colors and long-lasting properties. However, it may contain synthetic chemicals and preservatives, which some individuals may want to avoid.

On the other hand, Herbal kajal, made from natural and botanical ingredients, is preferred by those seeking a more natural and gentler alternative. Herbal kajal often includes oils like almond oil or castor oil, as well as herbs and other soothing ingredients. It may be free from synthetic dyes and fragrances, making it suitable for sensitive eyes. Whether you choose artificial or herbal kajal, the

type you select should align with your personal preferences, makeup needs, and any skin sensitivities you may have. Always check the product label for specific ingredients and properties to ensure it meets your requirements. Regardless of the type, kajal remains a popular and versatile makeup product, cherished for its ability to define the eyes and create stunning eye makeup looks. Its rich, cultural significance and enduring popularity make it a timeless addition to beauty routines around the world.

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 by using Triphala Powder represents a promising alternative to conventional synthetic kajal, offering potential benefits such as reduced risk of eye irritation and toxicity.

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