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

Ms. Sajitha Seyath[1], Ms. Shinta Babu[1], Ms. Arathy C S[1], Mr. Sanjith S[1], Dr. C. D. Shaji Selvin[2], Mrs. Saranya S[3], Dr. Prasobh G R[4]

[1] B. Pharm Students, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India

[2]Professor, Head of Department of Pharmaceutics, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India

[3] Associate Professor, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India

[4]Principal, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India

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.*

Corresponding author:

Sajitha Seyath, Shinta Babu, Arathy C S, Sanjith S

B.Pharm students,

Sree Krishna College of Pharmacy and Research Centre,

Parassala, Thiruvananthapuram, Kerala, India

Email: sajithaseyath@gmail.com, shintababu2525@gmail.com, arathycs0110@gmail.com, sanjithsuba004@gmail.com

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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]

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]

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.

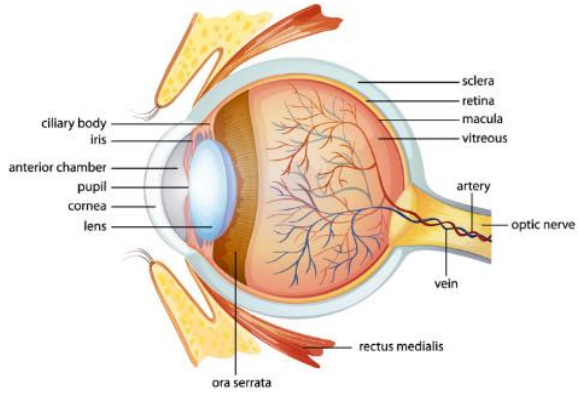

Fig.1. Anatomy of Eye

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.

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 AND METHODS

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]

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]**

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]

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]

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]

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.

3.ALMOND POWDER:[16]

Synonyms: Badam,Vatada,Amygdalus.

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.

4.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.

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.

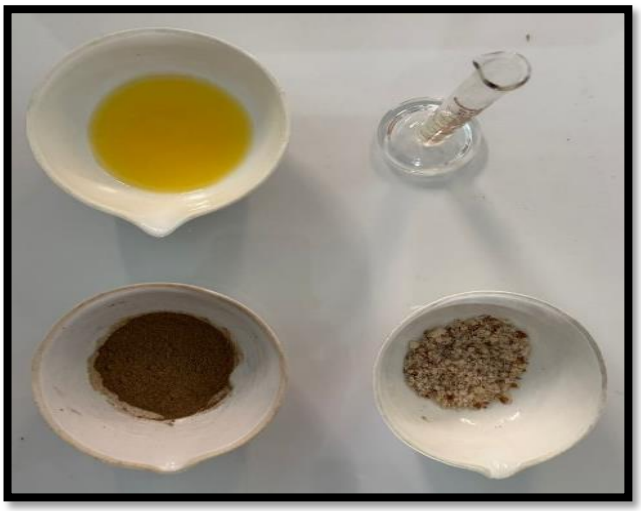

Fig.2. Ingredients used in formulation

Fig.3. Wick

Fig.4. Lamp lighten and place inverted copper plate

Fig.5. Black soot obtained

Fig.6. Soot mixed with coconut oil

Fig.7. Kajal

FORMULATION

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

Table.1. Formulation

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 pH meter.

Ideal Range: 6.0 to7.5 (close to natural tear pH).

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.

4. Stability Studies:[20]

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.

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.

6.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.

7.Resistance test:

i. Smudge Resistance Test:

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

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.

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 suspension (Escherichia coli) and incubated for 48 hours at 37 °C, 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 chloroform to ensure uniform diffusion. The inoculated plates were incubated at 37 ± 1 °C for 24 hours. The antimicrobial activity was determined by measuring the zones of inhibition surrounding each well.

RESULT AND DISCUSSION:

1. Physical Evaluation

SL.NO	PARAMETER	A	B	C	MARKETED
1.	Appearance	Glossy Black	Glossy Black	Glossy Black	Matte Black
2.	Odor	Characteristics	Characteristics	Characteristics	Characteristics
3.	Texture	Smooth	Smooth	Smooth	Smooth
4.	Consistency	Semi-solid	Semi-solid	Semi-solid	Semi-solid

Table.2. Physical Evaluation Observation

All developed formulations (A, B & C) exhibited uniformity in physical characteristics, specifically maintaining a (smooth) texture, (semi-solid) consistency, (characteristic) odour. This suggest that variations in ingredients added did not disrupt the structural integrity, while the marketed product was matte black finish and formulation A, B and C displayed a glossy aesthetic.

2. pH Determination

SL.NO	FORMULATIONS	VALUES
1.	A	6.4
2.	B	6.5
3.	C	6.1
4.	Marketed	5.7

Table.3. pH Observation

Figure.8. Physical Evaluation

The pH evaluation showed that formulations A, B, and C maintained values between 6.1-6.5, which fall within the skin-friendly range and suggest good compatibility. The marketed formulation exhibited a pH pf 5.78, also within an acceptable range for dermal application. Overall, both the developed formulations and the marketed product demonstrate suitable pH values, with the slight differences reflecting natural variation in formulation design.

3. Spreadability

SL.NO	FORMULATIONS	DIAMETER
1.	A	2.0
2.	B	2.3
3.	C	1.7
4.	Marketed	1.6

Table.4. Spreadability Observation

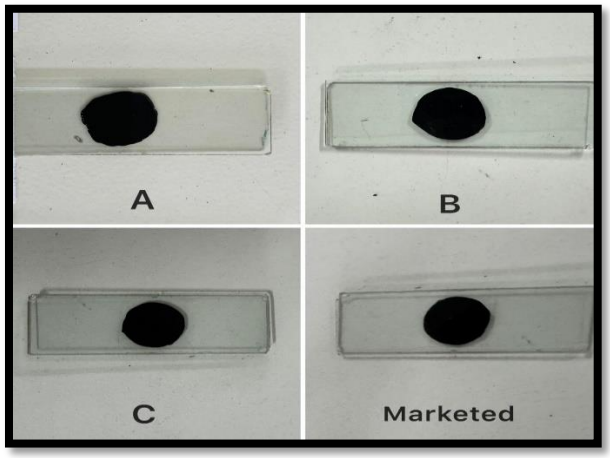

Fig.9. Spreadability

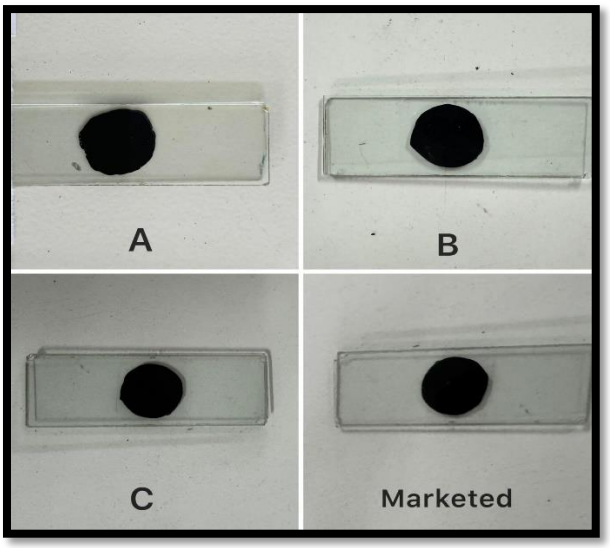

Fig.9. Spreadability

The spreadability assessment revealed that formulation B exhibited the highest spread diameter (2.3cm), indicating superior spreadability, followed by Formulation A (2.0cm), Formulation C (1.7cm), and the marketed product (1.6cm). Notably Formulation C demonstrated spreadability closely matching that of the marketed product, suggesting comparable ease of application. This similarity implies that Formulation C may offer a user experience close to the existing commercial standard.

4. **Stability study**

Sl.No	**Parameter**		**Observation**		
			Room temperature (25 ± 2°C)	**Refrigeration** (4°C±2°C)	**Oven temperature** (40 ± 2°C)
1.	Appearance	A	Black	Black	Black
		B			
		C			
		Marketed			
2.	Odour	A	Characteristics	Characteristics	Characteristics
		B			
		C			
		Marketed			
3.	Appearance	A	Good	Good	Bad
		B			
		C			
		Marketed			
4.	pH	A	6.5		
		B	6.7		
		C	6.1		
		Marketed	5.6		
5.	Spreadability		Good	Good	Bad

Table.5. Stability Studies

(Day 1)

(Day 15)

(Day 30)

Based on the stability study observations, all formulations and the marketed product maintained consistent appearance, color, and pH within acceptable ranges. The characteristics remained stable, and spreadability values showed no significant deviation over time. These findings confirm that the formulations exhibit good physical stability and are suitable for dermal application throughout the study period.

5. Evaluation of base (coconut oil)

SL.NO	TESTS	VALUES
1.	Acid value	1.297
2.	Saponification value	176.855

Table.6. Evaluation of Base

Fig.10. Acid value Determination

Fig.11. Saponification Value Determination

The coconut oil base used in this herbal kajal formulation meets the standard physicochemical benchmarks for cosmetic-grade oils. It supports the formulation's stability, safety, and performance making it a reliable choice.

6. Solubility

SL.NO	FORMULATION	SOLUBILITY			
		WATER	CHLOROFORM	ETHER	ETHANOL
1.	A	Not soluble	Soluble	Sparingly soluble	Not Soluble
2.	B	Not Soluble	Soluble	Sparingly soluble	Not Soluble
3.	C	Not Soluble	Soluble	Sparingly soluble	Not Soluble
4.	MARKETED	Not Soluble	Soluble	Soluble	Soluble

Table.7. Solubilty Observation

Fig.12. Solubilty test

The solubility study revealed that all formulations were soluble in chloroform, indicating consistent compatibility with this solvent. Their solubility was sparing across the developed formulations, while ethanol solubility was absent. Water solubility was not observed in any formulation, including the marketed product. These findings suggest that the formulations are best suited for non-aqueous systems and maintain uniform solubility behavior in selected organic solvents.

7. Resistance Test

i.Smudge Resistance test:

Minimal smudging indicates good smudge resistance.

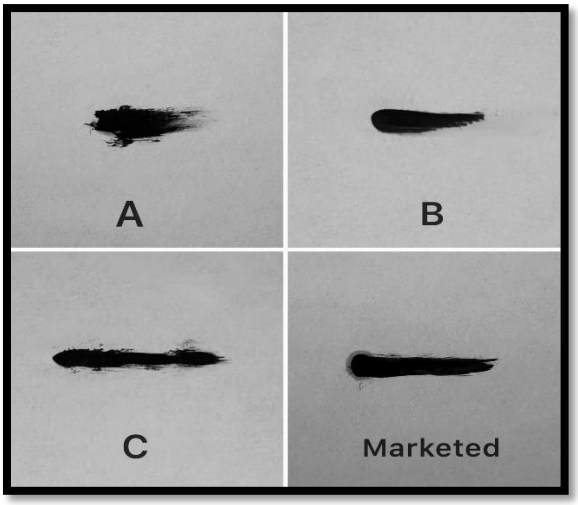

Fig.13. Samples smeared on a paper

The smudge resistance test revealed that all formulations exhibited varying degrees of smudging when applied to paper. Among them, Formulation C exhibited superior resistance, closely matching the performance of the marketed product. This suggests that the formulations possess favorable smudge resistant properties, enhancing their potential for long lasting cosmetic application.

ii. Waterproof test:

It claims of resisting water, tears, and sweat, ensuring it won't smudge or run throughout the day.

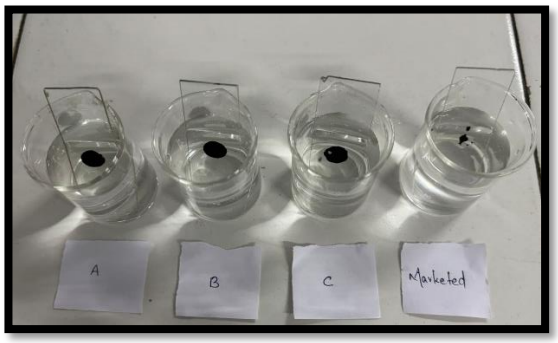

Fig.14. Samples immersed in a beaker containing water

The waterproof test revealed that Formulations A and B demonstrated strong resistance to water, ensuring long-lasting wear. In contrast, Formulation C and the marketed product showed washout, which, while indicating lower durability, also suggests ease of removal during cleansing. This dual outcome highlights that Formulation A and B are ideal for extended wear, whereas Formulation C and the marketed product may be preferred where effortless removal is desirable.

8. Antimicrobial Activity

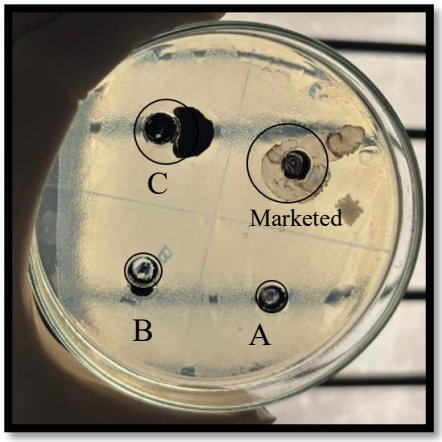

Fig.15. Result for Antimicrobial activity

The antimicrobial activity test revealed distinct zones of inhibition across the formulations, indicating varying degrees of effectiveness against microbial growth. Formulation C exhibited a zone size comparable to the marketed product, indicating similar efficacy against microbial growth. Formulations A and B also showed inhibition, though to a lesser extent. These findings support the antimicrobial potential of the herbal kajal formulations.

Among the evaluated formulations, Formulation C demonstrated solubility and stability characteristics most comparable to the marketed product, showing broad compatibility across solvents and favourable behaviour under storage conditions. Both Formulation C and the marketed product maintained good performance in room and refrigerated environments, while oven conditions led to degradation, indicating heat sensitivity. This comparison suggests that Formulation C aligns closely with the marketed product in terms of formulation, quality and consistency.

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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