



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

Review on the Pharmaceutical and Cosmetic Significance of Castor Oil, Almond Oil, and Ghee in Vedic Kajal

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ARTICLE INFO

Published: 23 Jun 2026

Keywords:

Vedic kajal, Carrier oils, Castor oil, Almond oil, Ghee, Ayurvedic cosmetics and Ocular health

DOI:

10.5281/zenodo.20815387

ABSTRACT

Vedic kajal, a traditional ocular cosmetic rooted in Ayurveda, has long been valued not only for its aesthetic appeal but also for its therapeutic properties. Central to its formulation are carrier oils, which influence the stability, efficacy, and safety of the product. This review explores the impact of three prominent carrier oils—castor oil, almond oil, and ghee—on the preparation and application of Vedic kajal. The scope includes historical perspectives, physicochemical characteristics, and modern scientific evidence supporting their roles. Castor oil, rich in ricinolein acid, is traditionally recognized for its cooling, antimicrobial, and soothing properties, making it a preferred base for ocular formulations. Almond oil, abundant in vitamin E and essential fatty acids, contributes to nourishment and antioxidant protection, enhancing both cosmetic and therapeutic value. Ghee, revered in Ayurveda, provides lubrication, soothing effects, and bioavailability of fat-soluble compounds, though its stability and shelf-life pose challenges. Comparative analysis highlights the unique contributions and limitations of each oil, while modern studies validate several traditional claims. The findings suggest that carrier oils are not merely inert bases but active components that determine the holistic impact of kajal. In conclusion, integrating traditional wisdom with contemporary research can optimize formulations, ensuring both cultural relevance and scientific credibility.

INTRODUCTION

Kajal, also known as kohl or *anjana*, has been an integral part of Vedic and Ayurvedic traditions for thousands of years. Beyond its cosmetic appeal,

kajal was historically prepared using soot from medicinal herbs and natural oils, and was believed to promote ocular health, protect against infections, and enhance vision. (1) Ancient Ayurvedic texts such as *Sushruta Samhita* and

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



Charaka Samhita describe formulations of *anjana* enriched with herbs and oils, emphasizing its dual role as a beauty enhancer and therapeutic agent (2)

Importance of Carrier Oils in Formulation:

Carrier oils serve as the base medium in kajal preparation, influencing its texture, stability, and therapeutic efficacy. In Ayurveda, oils such as castor, almond, and ghee are not considered inert but active components that deliver nourishment, cooling, and protective properties to the eyes (3). Their lipid composition allows for better solubility of herbal extracts, enhances bioavailability of fat-soluble compounds, and provides lubrication to delicate ocular tissues (4)

Rationale for Reviewing Castor Oil, Almond Oil, and Ghee:

Among the various oils used, castor oil, almond oil, and ghee are most frequently cited in Ayurvedic and modern herbal cosmetic formulations. Castor oil is valued for its antimicrobial and soothing properties; almond oil is rich in vitamin E and essential fatty acids, offering antioxidant and nourishing effects; while ghee, revered in Ayurveda, provides lubrication and cooling, though its stability poses challenges. Reviewing these oils together provides a holistic understanding of their comparative benefits, limitations, and relevance in both traditional and modern contexts. (1)

2. HISTORICAL & CULTURAL CONTEXT

2.1 Origins of Kajal in Ayurveda/Vedic Practices:

Kajal, also known as *anjana* in Sanskrit, has its roots in Vedic and Ayurvedic traditions dating back over 3,000 years. Ancient Ayurvedic texts such as the *Sushruta Samhita*, *Charaka Samhita*,

and *Kashyapa Samhita* describe *anjana* as an eye salve prepared from herbal soot and oils, used both cosmetically and medicinally (4). It was considered part of daily *dinacharya* (routine) for maintaining ocular health, protecting the eyes from dust, glare, and infections, while also enhancing beauty. In Ayurveda, the eyes are regarded as the seat of *Tejas* (radiance), making their care central to overall well-being. (5)

2.2 Traditional Preparation Methods:

Traditional preparation of kajal involved burning cotton wicks soaked in ghee or oil in an earthen lamp (*diya*). The soot collected on a metal plate was carefully scraped and mixed with carrier oils such as castor oil, almond oil, or ghee to form a smooth paste. Additional ingredients like camphor, saffron, or herbal extracts were sometimes incorporated to enhance cooling, antimicrobial, or nourishing properties. This artisanal process ensured that kajal was free from synthetic chemicals and aligned with Ayurvedic principles of purity and balance. (6)

2.3 Symbolic and Medicinal Uses:

Kajal held symbolic significance in Indian culture, often applied to infants to ward off the “evil eye” and to adults as a mark of beauty and auspiciousness (7). Medicinally, it was believed to prevent eye strain, reduce irritation, and protect against infections. Organic formulations enriched with herbs and oils were said to improve vision, soothe ocular tissues, and act as natural lubricants. Thus, kajal functioned as both a cultural ornament and a therapeutic agent, embodying the holistic philosophy of Ayurveda where aesthetics and health are intertwined. (1)

3. CARRIER OILS IN VEDIC KAJAL

3.1 Castor Oil



Chemical Composition:

Castor oil (*Ricinus communis*) is composed predominantly of ricinoleic acid (~90%), a unique hydroxylated fatty acid that imparts polarity and bioactivity. Minor constituents include oleic, linoleic, stearic, and palmitic acids. (8)

Traditional Uses in Eye Care:

Ayurveda describes *Eranda Taila* (castor oil) as cooling and soothing, often used in *anjana* (eye salves) to reduce irritation and protect against microbial infections.

Cosmetic and Therapeutic Properties

- Cooling and anti-inflammatory effects
- Antimicrobial activity against ocular pathogens
- Provides lubrication, reducing dryness and strain
- Enhances spreadability of kajal paste (9)

Synergistic: Castor Oil is unique for its ricinoleic acid, which provides strong anti-inflammatory and lubricating properties. Often synergistic with herbal soot in kajal, enhancing Spreadability and antimicrobial action.

Safety Considerations

- Safe in controlled formulations (used in FDA-approved eye drops).
- Risks: contamination in homemade kajal, potential irritation if impure.
- Misuse: Social media myths claim it cures glaucoma/cataracts, but experts warn against unsupervised use.

3.2 Almond Oil

Chemical Composition:

Almond oil (*Prunus amygdalus*) is rich in vitamin E (tocopherols), oleic acid (MUFA), linoleic acid (PUFA), and phytosterols. These compounds act as antioxidants and nourish delicate ocular tissues.

Role in Nourishing and Protecting Eyes:

Traditionally, almond oil (*Badam taila*) was applied around the eyes to reduce dark circles and oxidative stress. In kajal, it improves smoothness and provides a protective layer.

Cosmetic and Therapeutic Properties

- Antioxidant protection due to vitamin E
- Moisturizing and nourishing effect on periocular skin
- Supports ocular health by reducing oxidative damage
- Adds gloss and stability to kajal formulations (10)

Synergistic: Almond Oil is Distinct for its vitamin E content, offering antioxidant protection. Synergistic when combined with castor oil, as it adds nourishment and cosmetic appeal (smooth texture, glossy finish).

Safety Considerations

- Generally safe, but nut allergies pose risks.
- Oxidation can reduce efficacy; requires proper storage.
- Beneficial antioxidant role validated in AREDS studies for age-related macular degeneration.



3.3 Ghee

Ayurvedic Significance:

Ghee (*Ghrita*) is considered a *sattvic* substance in Ayurveda, balancing *pitta dosha* and promoting ocular health. It is frequently used in formulations like *Triphala Ghrit* for eye care.

Nutritional and Medicinal Properties:

Ghee contains saturated fats, vitamins A, D, E, and K, and conjugated linoleic acid. These compounds contribute to its nourishing and therapeutic qualities.

Cosmetic and Therapeutic Properties

- Provides natural lubrication to the eyes
- Soothes irritation and reduces dryness

- Acts as a carrier for fat-soluble herbal compounds
- Traditionally used in infant kajaI to ward off infections and the “evil eye” (11,12)

Synergistic: Ghee is Unique as a traditional Ayurvedic base, considered *sattvic* and spiritually purifying. Synergistic with herbal extracts (e.g., *Triphala*), as it enhances bioavailability of fat-soluble compounds.

Safety Considerations

- Safe in Ayurvedic formulations like *Triphala Ghrit*.
- Risks: rancidity, microbial contamination if improperly stored.

Traditional infant kajaI use raises hygiene concerns without standardization

Table 1: Comparative Analysis of Carrier Oils in Vedic KajaI (13,14,15)

Property / Aspect	Castor Oil (<i>Ricinus communis</i>)	Almond Oil (<i>Prunus amygdalus</i>)	Ghee (<i>Ghrita</i>)
Main Constituents	Ricinoleic acid (~90%), oleic & linoleic acids, antioxidants	Vitamin E (α -tocopherol), oleic acid, linoleic acid, phytosterols	Saturated fats, CLA, vitamins A, D, E, K
Traditional Role	Cooling, antimicrobial, soothing in <i>anjana</i>	Nourishing, antioxidant, protective for periocular skin	Lubricating, soothing, balances <i>pitta dosha</i>
Modern Evidence	Used in eye drops for dry eye; anti-inflammatory	Antioxidant protection against oxidative stress; supports retinal health	Improves lubrication, used in <i>Triphala Ghrit</i> for ocular therapy
Limitations	Risk of contamination; myths about curing glaucoma/cataracts	Possible nut allergy; rancidity if not stored properly	Short shelf-life; prone to rancidity; microbial growth risk

4. SCIENTIFIC EVIDENCE FOR CARRIER OILS IN VEDIC KAJAL

4.1 Modern Pharmacological Studies on Castor Oil, Almond Oil, and Ghee

- **Castor oil (*Ricinus communis*):** Modern cosmetic safety reviews note its widespread use and general safety profile when properly

refined, highlighting ricinoleate esters and low irritancy in formulations intended for periocular application.

- **Almond oil (*Prunus amygdalus*):** Recognized for antioxidant-rich composition (notably vitamin E) in consumer health contexts; while widely used in skincare, robust ocular-specific pharmacology is limited and often

extrapolated from skin antioxidant and emollient properties.

- **Ghee (Ghrita):** Contemporary Ayurvedic product literature and marketplace documentation emphasize traditional ocular use (e.g., Triphala Ghrita) and lubrication, but peer-reviewed pharmacological trials specific to the eye remain sparse, underscoring a reliance on historical practice more than modern mechanistic validation.

Overall, the modern literature for direct ocular pharmacology of these oils is developing; castor oil has the strongest safety dossier in cosmetics, almond oil's evidence is more dermatologic than ophthalmic, and ghee's support is largely traditional and product-level rather than clinical trial-based

4.2 Clinical or Experimental Data on Ocular Health

- **Castor oil in ocular use:** Reports within professional optometry outlets caution against unsupported claims but acknowledge castor oil's inclusion in some lubricating eye products, reflecting its emollient and tear film-stabilizing roles when properly formulated; clinical-grade purity and formulation are critical to safety and efficacy.
- **Antioxidant support (almond oil, vitamin E):** Nutrition-focused sources connect vitamin E intake with protection against oxidative stress related to ocular conditions, framing almond oil's relevance via vitamin E content; however, direct clinical trials of almond oil applied to the eye are limited.
- **Ghee-based ocular preparations:** Commercial and traditional materials cite use in Ayurvedic eye therapies and products (e.g.,

Triphala Ghrita) for lubrication and comfort; rigorous randomized clinical trials specific to modern ophthalmic endpoints are not well documented in accessible sources

4.3 Gaps Between Traditional Claims and Modern Validation

- **Standardization and purity:** Traditional kajal preparation varies widely by method and ingredients, creating variability in particle size, microbial burden, and oil purity; modern cosmetic safety guidance stresses standardized, refined inputs (e.g., castor oil) to mitigate contamination and irritation risks.
- **Clinical endpoints:** Many cultural and marketplace claims (e.g., improved vision, disease prevention) are not supported by controlled clinical trials. Expert commentary warns against using castor oil to treat glaucoma or cataracts, highlighting the need for evidence-based indications and ophthalmologist-guided care.
- **Mechanistic clarity:** While plausible mechanisms exist—lubrication (tear film support for castor oil), antioxidant effects (vitamin E in almond oil), and emolliency (ghee)—direct ocular mechanistic studies (corneal epithelium, meibomian function, oxidative biomarkers) remain limited, calling for preclinical and translational research.
- **Safety and allergy:** Nut allergies (almond oil), rancidity risks (ghee), and contamination in homemade kajal underscore safety gaps; validated manufacturing, preservative strategies, and ophthalmic-grade testing are needed for routine ocular application (16)

5. APPLICATIONS IN MODERN FORMULATIONS



5.1 Use in Herbal Cosmetics and Pharmaceuticals

Castor oil, almond oil, and ghee are widely incorporated into herbal cosmetics due to their emollient, antioxidant, and stabilizing properties. Castor oil is used in ophthalmic lubricants and cosmetic formulations because of its ricinoleic acid content, which provides anti-inflammatory and antimicrobial effects. Almond oil is valued for its vitamin E and fatty acid profile, making it a common ingredient in under-eye creams, kajal pencils, and baby-safe cosmetics. Ghee is traditionally used in Ayurvedic formulations such as *Triphala Ghrita* for ocular therapy, acting as a soothing and lubricating base. These oils not only serve as carriers but also actively contribute therapeutic benefits, aligning traditional Ayurvedic wisdom with modern cosmetic science.

5.2 Potential for Commercialization

The global demand for natural and herbal cosmetics has created strong commercialization opportunities: Castor oil is already a major export commodity from India, used in pharmaceuticals, cosmetics, and industrial applications. Almond oil enjoys high consumer demand in skincare and haircare markets, with cold-pressed variants marketed as premium products. Ghee-based Ayurvedic eye formulations are increasingly available in e-commerce platforms, marketed for their cultural authenticity and holistic benefits. The commercialization potential lies in combining traditional formulations with modern packaging, safety validation, and global marketing strategies.

5.3 Sustainability and Ethical Sourcing

Sustainability is critical for modern herbal formulations: Castor oil supply chains are increasingly adopting sustainable farming practices, with initiatives ensuring traceability and

fair trade for farmers. Almond oil production faces challenges of water-intensive cultivation, making ethical sourcing and organic certification important for eco-conscious consumers. Ghee producers emphasize native sourcing, traditional processing, and quality checks to ensure purity and reduce contamination risks. Ethical sourcing not only ensures product safety but also strengthens consumer trust in Ayurvedic-inspired cosmetics.(17-25)

6. CHALLENGES AND FUTURE DIRECTIONS

6.1 Standardization of Formulations

Traditional kajal varies widely in raw materials (herbal soot sources), carrier oils (castor, almond, ghee), particle size, pH, viscosity, and hygiene practices, leading to inconsistent safety and performance. Recent academic work on herbal kajal highlights the need for defined specifications and validated methods for physico-chemical testing (e.g., pH, Spreadability, stability, microbial limits) to enable reproducible outcomes and regulatory acceptance. Establishing pharmacopeial monographs for Vedic kajal and its carrier oils—covering identity, purity, contaminants (heavy metals, PAHs), and shelf-life—would support safer home and commercial production (26)

Core Needs

- **Raw material standards:** authenticated botanicals, refined food/cosmetic-grade oils, and controlled soot generation to minimize contaminants.
- **Process controls:** validated SOPs for soot collection, milling, dispersion, and preservative systems.



- **Quality testing:** standardized assays for microbiology, heavy metals, peroxide values (oils), and stability under Indian climatic conditions.

6.2 Need for Clinical Trials

Despite widespread traditional use, ocular claims (lubrication, soothing, protection from irritation) for kajal prepared with castor oil, almond oil, or ghee lack robust, controlled clinical validation. Dedicated study designs—ophthalmic safety (ISO 10993 eye irritation), tear film metrics (TBUT, osmolarity), meibomian gland function, and patient-reported outcomes—are required to translate cultural practice into evidence-based indications. India's growing clinical research infrastructure and contract research expertise can enable *in vitro*, *ex vivo*, and randomized trials tailored to cosmetic-ophthalmic products, but kajal-specific protocols remain scarce. Given the ongoing clinical use of ghee-based eye therapies (Netra/Netra Basti) in Ayurveda clinics, pragmatic trials comparing traditional methods versus standardized, sterile, oil-based kajal systems could generate real-world evidence and safety data.(28)

Priority trials

- **Safety:** ocular tolerability of standardized kajal bases with castor/almond/ghee; microbial and preservative adequacy.
- **Efficacy:** endpoints for dryness relief, comfort, and visual strain reduction; antioxidant biomarkers for periocular protection.
- **Comparative:** traditional ghee basti versus modern sterile formulations incorporating the same carrier oils.

6.3 Integration of traditional knowledge with modern science

Bridging Ayurveda and contemporary pharmaceuticals requires mapping classical concepts (e.g., anjana, ghrita, dosha balance) to measurable pharmacological and materials-science parameters. Editorial and review scholarship emphasizes using phytochemical profiling, analytical characterization (GC-MS for oils, PAH screening for soot), nano-delivery, and bioavailability enhancement to modernize traditional formulations without losing cultural integrity. Methodological frameworks that combine Ayurvedic doctrine with GMP, risk assessment, and translational research can streamline regulatory dialogue and product development; integrative reviews advocate harmonized protocols, interdisciplinary teams, and knowledge translation from classical texts to lab and clinic(IJCRT+1).

Action points

- **Analytical:** comprehensive compositional and impurity profiles for oils and soot; rheology and dispersion science for paste stability.
- **Formulation innovation:** lipid micro/nano-carriers to improve ocular retention while maintaining Ayurvedic oil bases.
- **Translational pathway:** classical indications → preclinical models → human feasibility trials → standardized consumer products with clear, non-therapeutic claims. (27)

7. CONCLUSION

Carrier oils significantly influence the quality, therapeutic efficacy, and cosmetic performance of Vedic Kajal. Among castor oil, almond oil, and ghee, castor oil appears to be the most suitable carrier oil due to its superior viscosity, excellent



pigment dispersion, prolonged retention, lubricating properties, and inherent antimicrobial activity. These characteristics enhance both the stability of the formulation and user comfort during application. Almond oil contributes valuable antioxidant and nourishing properties, supporting the health of the delicate periocular skin, while ghee provides traditional Ayurvedic benefits, including soothing and cooling effects on the eyes. However, compared with almond oil and ghee, castor oil offers a more balanced combination of pharmaceutical functionality and cosmetic performance. Therefore, based on available evidence, castor oil can be considered the preferred carrier oil for Vedic Kajal, although combining it with almond oil or ghee may further enhance the formulation by providing additional nutritional and therapeutic benefits.

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HOW TO CITE: Nikita Gidde, Kalyani Gaikwad, Mahek Attar, Randhir Patil, Uzma Muttwali, Review on the Pharmaceutical and Cosmetic Significance of Castor Oil, Almond Oil, and Ghee in Vedic Kajal, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 6, 6002-6011. <https://doi.org/10.5281/zenodo.20815387>

