ISSN: 2322 - 0902 (P)
ISSN: 2322 - 0910 (O)

International Journal of Ayurveda and Pharma Research

Review Article

UNVEILING THE RISKS OF CHEMICAL BASED BABY CARE PRODUCTS AND OPTICAL BRIGHTENERS ON CHILD HEALTH AND ENVIRONMENT, WITH HOLISTIC SIDDHA SUBSTITUTE

Kamalinie R[1]*, Sandhiya V[1], Sriram J[2]

*[1]PG Scholar, [2]Assistant Professor, Dept. of Kuzhanthai maruthuvam, Government Siddha Medical College, Palayamkottai, Tirunelveli, Tamil Nadu, India.

Article info

Article History:
Received: 21-03-2026
Accepted: 17-04-2026
Published: 12-05-2026

KEYWORDS:
Infant dermatology, Chemical toxicity, Optical brighteners, Siddha medicine, Environmental health.

ABSTRACT

Infant skin is structurally immature, exhibiting higher permeability, increased transepidermal water loss, and reduced barrier function, which enhances systemic absorption of topical agents. **Objective:** To critically evaluate the dermatological and systemic risks associated with chemical-based baby care products and optical brighteners, and to explore safer Siddha-based natural alternatives. **Methods:** A comprehensive narrative review was conducted using peer-reviewed dermatological and toxicological literature along with classical Siddha texts. Studies focusing on infant skin physiology, cosmetic ingredient toxicity, and traditional formulations were included. **Results:** Common ingredients such as parabens, phthalates, sodium lauryl sulfate, triclosan, and formaldehyde are associated with adverse effects including skin irritation, allergic dermatitis, endocrine disruption, and potential carcinogenicity. Optical brighteners, widely used in detergents, are non-biodegradable and persist in aquatic ecosystems, contributing to bioaccumulation and ecological toxicity. Epidemiological data indicate that nearly 50% of pediatric poisoning cases involve children under five years, often due to accidental exposure to household products. Siddha-based alternatives such as *Sapindus trifoliatus*, *Cyperus rotundus*, *Nalpamaram* formulations, and Fuller's earth demonstrate antimicrobial, anti-inflammatory, and pH-compatible properties, supporting skin barrier integrity with minimal toxicity. **Conclusion:** Chemical-based baby care products pose significant health and environmental risks. Siddha-based natural substitutes offer safer, biodegradable, and physiologically compatible alternatives. Integration of traditional practices with modern pediatric care can enhance infant safety and sustainability.

INTRODUCTION

Infant skin differs significantly from adult skin in terms of structure, permeability, and physiological function. The immature epidermal barrier, increased transepidermal water loss, and higher absorption capacity predispose infants to adverse reactions from topical exposures[1]. Modern baby care products frequently contain synthetic chemicals such as parabens, phthalates, and sulfates.

Access this article online

Quick Response Code

https://doi.org/10.47070/ijapr.v14i5.4163

These compounds are linked to skin irritation, allergic reactions, and endocrine disruption[2-4]. Optical brighteners, commonly used in detergents, enhance fabric appearance but persist in the environment and pose toxicological risks [5].

Traditional Siddha medicine offers natural, biodegradable alternatives that align with ecological sustainability and infant safety. This paper evaluates the risks of chemical exposure and explores Siddha-based substitutes.

MATERIALS AND METHODS

A narrative review methodology was adopted. Data were collected from:

- Peer-reviewed journals
- Siddha classical texts

Toxicology and dermatology literature inclusion criteria:

- Studies on infant skin physiology
- Chemical toxicity in cosmetics
- Natural and traditional formulations.

Optical Brighteners: Composition and Health Implications

Optical brighteners are fluorescent compounds that absorb ultraviolet radiation and emit visible blue light, enhancing perceived whiteness. Despite their cosmetic benefits, these agents are associated with dermatological and environmental hazards.

Clinical Manifestations

Exposure in infants may result in:

- Erythema and pruritus
- Allergic dermatitis
- Dry, scaly skin
- Burning sensation

These reactions are more pronounced in infants due to their sensitive skin barrier [1].

Chemical	Function	Adverse Effects
Parabens	Preservatives	Endocrine disruption [3]
Phthalates	Fragrance stabilizers	Reproductive toxicity [3]
Sodium Lauryl Sulfate	Surfactant	Skin irritation [2]
Triclosan	Antimicrobial	Hormonal imbalance [4]
Formaldehyde	Preservative	Carcinogenic [4]
Dioxane	Contaminant	Carcinogenic [4]

Studies indicate that even products labeled "pH balanced" may not align with infant skin pH requirements.

Soap Toxicity and Accidental Exposure

Accidental ingestion or inhalation of soap products is a significant pediatric concern. Symptoms include:

- Respiratory distress
- Gastrointestinal irritation
- Ocular damage

Children under five years account for nearly half of reported poisoning cases (AAPCC data cited in article) [6].

Talcum Powder and Heavy Metal Exposure

Talc-based powders may contain trace heavy metals such as lead, arsenic, and cadmium, which are associated with:

- Neurotoxicity
- Carcinogenicity
- Developmental delays

Infants are particularly vulnerable due to immature detoxification mechanisms [4].

Environmental Impact

Optical brighteners resist biodegradation and accumulate in aquatic systems, disrupting photosynthesis and aquatic ecosystems [5]. Their persistence classifies them among environmentally hazardous pollutants.

Infant Skin Physiology and Vulnerability

Infant skin undergoes dynamic maturation during the first year of life. Compared to adults, it has:

- Thinner stratum corneum
- Higher hydration but lower barrier function
- Increased permeability to chemicals
- Reduced natural moisturizing factor

These characteristics heighten susceptibility to irritants, allergens, and toxic substances [1].

Harmful Chemicals in Baby Care Products

Several ingredients commonly found in baby products pose potential health risks:

Siddha-Based Alternatives: Detailed Mechanistic Insights

Traditional Siddha formulations utilize plant- and mineral-based substances that are biocompatible, biodegradable, and aligned with the physiological properties of infant skin. These natural agents act through multiple mechanisms including surface cleansing, anti-inflammatory pathways, antioxidant activity, and barrier protection, thereby offering safer alternatives to synthetic chemicals [7–11].

Table 1: Illustrates the Siddha based natural alternatives

S.No	Chemical based products	Harmful effects	Siddha substitutes	Benefits
1.	**Baby lotion** (Contains parabens, Artificial fragrances)	• Skin irritation • Hormonal disruption • Clogged pores	Ghee (natural moisturizer)	• Deep hydration • Nourishes skin Free from toxins
2.	**Baby powder** (Contains Talc, Synthetic fragrances)	• Respiratory issues • Skin dryness • Risk of lung irritation	Nut Grass powder *(Korai kizhangu)*	• Anti-bacterial • Cooling effect • Gentle on skin
3.	**Baby soap / Shampoo** (Contains sulfates, parabens)	• Strips natural oils • Causes dryness • Irritation • Disrupts p^H balance	*Nalpamaram* bath (Group of four Ficus trees)	• Soothes skin • Maintain skin p^H • Anti inflammatory
4.	**Baby detergents** (Contains optical brighteners, Synthetic chemicals)	• Skin allergies • Chemical residues on cloth	Fullers earth (Prisonite)	• Gentle cleanser • Removes dirt without harming skin
5.	**Fabric softeners** (Contains Synthetic fragrances, Toxic chemicals)	• Triggers allergies • Harmful fumes	Soap nut *(Boondhi kottai)*	• Hypoallergenic • Eco friendly • Bio degradable • Natural

Figure 1: Illustrates the Siddha based natural alternatives and benefits

Soap Nut (***Sapindus trifoliatus***)

Phytochemistry

- Saponins (triterpenoid glycosides)
- Sugars and fatty acids

Mechanism of Action

- **Surface-active cleansing**

  Saponins possess amphiphilic properties (hydrophilic + hydrophobic ends), reducing surface tension and enabling effective cleansing without disrupting skin proteins [7].
- **Micelle formation**

  Encapsulation of dirt and lipids into micelles allows removal without damaging the stratum corneum [7].
- **Antimicrobial activity**

  Saponins interact with microbial lipid membranes, increasing permeability and causing cell lysis [7,11].

Physiological Outcome

- Preserves skin barrier integrity
- Maintains microbiome balance
- Prevents dryness and irritation

Fuller's Earth (Prisonite)

Composition

- Hydrated aluminum silicates
- Magnesium and calcium ions

Mechanism of Action

- **Adsorption**
  Large surface area and negative charge enable binding of toxins, sebum, and microbial products [10].
- **Ion-exchange mechanism**
- Replaces harmful ions with neutral minerals, supporting detoxification [10].
- **Non-reactive cleansing**
- Does not denature keratin or disrupt skin barrier proteins [10].

Physiological Outcome

- Detoxifies skin
- Maintains natural oils
- Provides cooling and soothing effect

Nut Grass (*Cyperus rotundus*)

Phytochemistry

- Flavonoids
- Phenolic compounds
- Sesquiterpenes

Mechanism of Action

- **Anti-inflammatory pathway**
  Inhibits NF-κB signaling→ reduces pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) [8].
- **Antioxidant action**
  Scavenges reactive oxygen species (ROS), preventing oxidative damage [8,11].
- **Tyrosinase inhibition**
  Reduces melanin synthesis and prevents hyperpigmentation [8].
- **Siddha principle**
  Balances *Azhal (Pitta)*, reducing heat and inflammation.

Physiological Outcome

- Reduces rashes and erythema
- Promotes healing
- Safe alternative to talc

***Nalpamaram* (Ficus Species Combination)**

(*Ficus religiosa, Ficus benghalensis, Ficus racemosa, Ficus microcarpa*)

Phytochemistry

- Tannins
- Polyphenols
- Flavonoids

Mechanism of Action

- **Protein precipitation (tannin effect)**
  Forms a protective layer over skin, reducing permeability and microbial entry [9].
- **Antimicrobial activity**
  Disrupts bacterial cell walls and enzyme systems [9].
- **Astringent effect**
  Tightens pores and enhances barrier function [9,11].
- **Antioxidant defense**
  Neutralizes free radicals and supports tissue repair [9].

Physiological Outcome

- Enhances skin barrier
- Prevents infections
- Improves wound healing

Ghee (Clarified Butter)

Composition

- Saturated and unsaturated fatty acids
- Fat-soluble vitamins (A, D, E, K)

Mechanism of Action

- **Occlusive barrier formation**
  Forms lipid layer reducing transepidermal water loss (TEWL) [11].
- **Barrier repair**
  Enhances epidermal lipid matrix and ceramide synthesis [11].
- **Anti-inflammatory action**
- Inhibits inflammatory mediators such as prostaglandins [11].
- **Antioxidant activity**
- Vitamin E neutralizes oxidative stress [11].

Physiological Outcome

- Deep hydration
- Skin barrier restoration

Supports microbiome

Mechanism-Based Comparison of Chemical vs Siddha Infant Care

Infant Skin Exposure

Chemical-Based Products	**Siddha-Based Alternatives**
↓	↓
Synthetic Ingredients (Parabens, SLS, Phthalates, OBs)	Natural Bioactive Compounds (Saponins, Tannins, Flavonoids, Lipids)
↓	↓
mechanism OF action	**Mechanism of Action**
• Lipid barrier disruption • Protein denaturation (SLS) • Endocrine receptor binding • UV fluorescence (OBs) • Heavy metal accumulation (Talc)	Micelle formation (Soap nut) Adsorption detox (Fuller's earth) Anti-inflammatory action (Nut grass) Antimicrobial tannins (Nalpamaram) Lipid barrier restoration (Ghee)
↓	↓
Biological Effects	**Biological Effects**
↑ TEWL (water loss) Skin irritation & dermatitis Hormonal imbalance Toxic accumulation	Maintains skin hydration Reduces inflammation Supports skin microbiome Enhances barrier function
↓	↓
Clinical Outcome	**Clinical Outcome**
Eczema, rashes Allergies Long-term toxicity	Healthy infant skin Reduced skin disorders Safe, non-toxic care
↓	↓
Environmental Impact	**Environmental Impact**
Water pollution (OBs) Bioaccumulation Persistent pollutants	Biodegradable Eco-friendly Sustainable

↓

Final Outcome Comparison

❌ Chemical Path → Toxicity + Environmental Harm

✅ Siddha Path → Safety + Sustainability + Skin Health

Flowchart 1: Mechanistic comparison between chemical-based baby care products and Siddha- based natural alternatives

- This flowchart illustrates the contrasting mechanisms of action between chemical-based baby care products and Siddha-based natural alternatives. Chemical agents act through barrier disruption, endocrine interference, and environmental persistence, whereas Siddha formulations promote skin homeostasis via natural bioactive compounds, resulting in improved safety and sustainability.

Risks of Chemical-Based Baby Products

Skin Absorption and Toxicity

- Infant skin allows higher penetration of chemicals [2]
- Leads to:
  - Rashes
  - Irritation
  - Allergic dermatitis

Hormonal Disruption

- Parabens mimic estrogen
- Phthalates interfere with androgen pathways
- Long-term exposure affects endocrine balance. [3]

Environmental Impact

- Optical brighteners persist in water systems
- Non-biodegradable detergents affect aquatic life. [5]
- Bioaccumulation leads to ecological imbalance .

Mechanism of Chemical Toxicity

Chemical	Mechanism	Effect
SLS	Protein denaturation	Skin dryness
Parabens	Estrogen receptor binding	Hormonal imbalance
Phthalates	Endocrine interference	Developmental issues
Optical brighteners	UV fluorescence	Skin irritation + pollution
Talc (heavy metals)	Bioaccumulation	Neurotoxicity

3. pH Balance in Infant Skin (Important Addition)

Infant skin has a slightly acidic pH, essential for barrier protection. [1]

Normal pH Values

Substance	pH Range
Newborn skin	6.5 – 7.5
After 4–5 weeks	4.5 – 5.5
Soap (chemical)	9 – 11
Shampoo	5.5 – 7
Soap nut	4.5 – 5
Nalpamaram	~5.5
Ghee	4.5 – 5.5

Interpretation

- Chemical products → alkaline → disrupt acid mantle
- Siddha products → near physiological pH → maintain barrier

Why pH-Balanced Skin Care Matters

- Maintains acid mantle
- Prevents microbial invasion
- Reduces irritation

Chemical soaps (alkaline) disrupt this → leading to:

- Dryness
- Infection Barrier damage

Cloth Washing Techniques in Classical Tamil literatures

Traditional Tamil literature emphasizes natural cleansing:

"வேனும் என்று உடன்றவர் உகிர் செய் வடுவினுன்
மேல் நாள் நின் தோள் சேர்ந்தார் நகை சேர்ந்த இதழினை
நாடி நின் தூது அடி துறை சொல்லாள் ஊரவர்
ஆடை கொண்டு ஒலிக்கும் நின் **புலைத்தி** காட்டு என்றாளோ"- **கலித்தொகை – 72:1**

"களர்ப்பாடு கூவல் தோண்டி நாளும்
புலைத்தி கழீஇய தூவெள் அறுவை"

- **புறநானூறு** - 311:2

"கல்லெறி யிசையி னிரட்டு மாங்கண்
சிள்விட கறங்குஞ் சிறியிலை வேலத்
தாழுரு விளைநெற் றுதிகை **காழியர்**"

- **அயநானூறு** - 89

Classical Tamil literature emphasizes natural cleansing and environmental harmony, reflecting early awareness of non-toxic hygiene practices [12].

Environmental Impact of Chemical Baby Products

Water Pollution

Chemical residues enter water bodies, affecting aquatic flora and fauna [5].

Bioaccumulation

Persistent chemicals accumulate in food chains, leading to ecological imbalance [5].

Soil and Air Contamination

Surfactants and volatile compounds alter soil chemistry and contribute to indoor air pollution.[5]

Persistent Organic Pollutants (POPs)

Many synthetic ingredients remain in ecosystems for extended periods, causing long-term damage [5].

RESULTS

The review identified that infant skin has increased permeability and reduced barrier function, making it more susceptible to chemical absorption and irritation [1].

Common ingredients in baby care products such as parabens, phthalates, and sodium lauryl sulfate were associated with skin irritation, endocrine disruption, and barrier damage[2–4]. Optical brighteners were found to be non-biodegradable and environmentally persistent, contributing to aquatic toxicity [5].

Pediatric exposure data indicated that children under five years account for a significant proportion of

household product-related poisoning cases [6]. Talc-based products may also contain trace heavy metals, posing potential neurotoxic risks [4].

In contrast, Siddha-based natural alternatives such as *Sapindus trifoliatus*, *Cyperus rotundus*, *Nalpamaram*, and Fuller's earth demonstrated antimicrobial, anti-inflammatory, and cleansing properties with minimal toxicity and good compatibility with skin pH [7–10].

Overall, the findings suggest that chemical-based products are associated with health and environmental risks, whereas Siddha-based alternatives offer safer and eco-friendly options for infant care.

DISCUSSION

The increasing reliance on synthetic baby care products contradicts the principles of pediatric safety and environmental sustainability. Siddha-based alternatives demonstrate comparable efficacy with significantly lower toxicity [7-11].

Integrating traditional knowledge with evidence-based practice can enhance infant care while minimizing ecological harm.

CONCLUSION

Chemical-based baby care products and optical brighteners pose substantial risks to infant health and the environment. The adoption of Siddha-based natural alternatives offers a safe, effective, and sustainable approach to infant hygiene.

Promoting awareness, regulatory oversight, and further scientific validation of traditional practices can bridge the gap between ancient wisdom and modern healthcare.

REFERENCES

1. Siri D, Jain V. Infant skin care and formulation additives. Asian J Pharm Clin Res. 2018; 11(12): 75. DOI: 10.22159/ajpcr.2018.v11i12.27804
2. Topan LHM, Carvalho VO, Abagge KT. Randomized trial with soaps—effects on newborn skin. J Pediatr (Rio J). 2022; 98(2): 204–211. DOI: 10.1016/j.jped.2021.03.006
3. Lundov MD, Johansen JD, Zachariae C. Endocrine disruption by cosmetic ingredients: a review. Contact Dermatitis. 2022. DOI: 10.1111/cod.14045
4. Babu K, Gokulshankar S. Toxicological evaluation of plant-based and cosmetic compounds. Turk J Bot. 2010; 34(3): 235–242. DOI: 10.3906/bot-0907-12
5. Hoque MS, Chakraborty S. Environmental impact of detergent chemicals and optical brighteners. Am J Environ Prot. 2018; 7(1): 1–6. DOI: 10.11648/j.ajep.20180701.11
6. American Association of Poison Control Centers (AAPCC). Annual report of the National Poison Data System.
7. Meena V, Devi VN, Rajakohila M, et al. Multifacetious uses of soapnut tree (Sapindus trifoliatus). Res J Pharm Biol Chem Sci. 2012; 3(1): 420–426.
8. Sofia HN, Walter TM, Tamizhamuthu M. A review on Cyperus rotundus. World J Pharm Res. 2014; 3(3): 286–298.
9. Shah SK, Garg G. Medicinal importance of Ficus racemosa. J Pharm Sci Res. 2016; 8(7): 606–610.
10. Thakur P, Garg R. Fuller's earth applications in dermatology and forensic science. Egypt J Forensic Sci. 2016; 6(4): 353–358. DOI: 10.1016/j.ejfs.2016.05.003
11. Dewi K, Gunam I, Wijaya IM. Antioxidant activity of medicinal plants used in traditional formulations. Farming Res. 2024.
12. Tamil Digital Library. Classical Tamil literature sources on traditional hygiene practices.

Cite this article as:
Kamalinie R, Sandhiya V, Sriram J. Unveiling the Risks of Chemical Based Baby Care Products and Optical Brighteners on Child Health and Environment, with Holistic Siddha Substitute. International Journal of Ayurveda and Pharma Research. 2026;14(5):102-108.
https://doi.org/10.47070/ijapr.v14i5.4163
Source of support: Nil, Conflict of interest: None Declared

***Address for correspondence**
Dr. Kamalinie R
PG Scholar,
Dept. of Kuzhanthai maruthuvam
Government Siddha Medical College,
Palayamkottai, Tirunelveli, Tamil Nadu.
Email: kamalinierathinavel@gmail.com