

Darkside of Beauty: How Certain Cosmetics May Increase Cancer Risk

Menda Gayatri¹; S. Kaberi Reddy²;
Sandya Rani Mahanty³; Dr. Patla Bhanuti Rad⁴

(Doctor of Pharmacy)¹; (Doctor of Pharmacy)²; (Doctor of Pharmacy)³;
(Head of Department)⁴ Department of Pharmacy Practic

^{1;2;3;4}Srivenkateswara College of Pharmacy

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Abstract: Cosmetics are the products that can beautify and cleanse the face and skin daily. The world is gradually increasing its usage of cosmetics, which is accompanied by an increase in the side effects caused by the ingredients present in these products. Nowadays, people are exposed to a wide range of hazardous chemicals in the form of cosmetic products, such as skin care products, which include soaps, sunscreen, powders, moisturizer, makeup foundation, and kohl. Cosmetics contain several ingredients that improve the quality of the product but may be hazardous to health. In this review paper, converse about the composition, side effects, and also alternatives of some harmful ingredients used in cosmetics based on different review papers.

Keywords: Cancer, Skin Care Products, Hazardous Chemicals, Adverse Effects.

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I. INTRODUCTION

Cosmetics are personal care products designed to beautify, cleanse, and improve the appearance of the human body, thereby enhancing its attractiveness.[1] A cosmetic product is any substance or preparation intended for external application to the human body, including the skin, hair, nails, lips, genitals, teeth, or oral cavity, with the primary objective of cleansing, perfuming, altering appearance, correcting body odor, or protecting these areas.[2] Cosmetics include a diverse range of products such as toothpaste, shampoos, conditioners, mascara, aftershave lotions, styling gels, creams, lotions, powders, perfumes, lipsticks, nail polishes (for both fingernails and toenails), eye and facial makeup, hair curlers, hair dyes, hairsprays, deodorants, and antiperspirants.[3] The skin, which covers most of the body, is susceptible to various diseases that can often be prevented. Serious conditions like skin cancer and skin irritations can result from exposure to harmful substances or environmental factors, but these can be avoided through preventive measures.[4] The relentless pursuit of eternal youth has led to a surge in cosmetic product usage among men and women globally, with many ignoring the potential health hazards.[5] The alarming rate of toxic substance absorption from cosmetics, estimated at up to 5 kg per year, highlights the critical importance of women's awareness about the potential dangers of chemical ingredients in cosmetics on reproductive

health, aging, and overall well-being.[6][7] Chronic exposure to ultraviolet (UV) radiation from the sun accumulates over time and causes harmful effects by damaging genetic material through various mechanisms, thereby raising the risk of skin cancer.[8] Research identified five main categories of products linked to cancer: talc powders, hair care products, moisturizers, cleansers, and tanning products. Additionally, a miscellaneous category was created to include other products like nail polish, oral care items, deodorants, and makeup.[9]

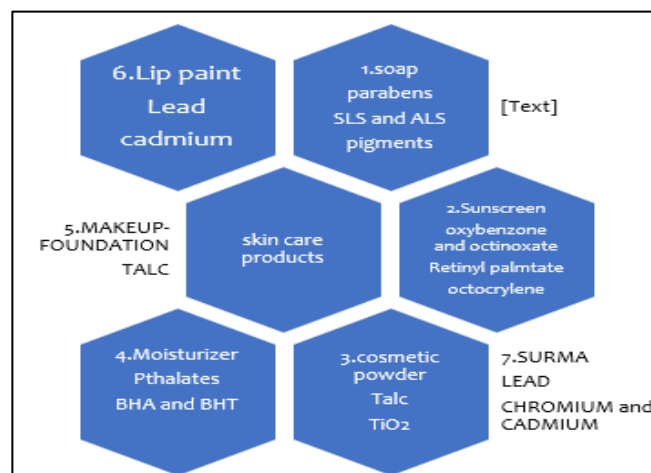


Fig 1 Research Identified Five Main Categories of Products Linked to Cancer

II. SKIN CARE PRODUCTS: INGREDIENTS CAUSING CANCER

❖ Skin Care Products:

A. Soap:

Long-chain fatty acid alkali salts with a pH between 9 and 10 make up APS. Surface-active chemicals called soaps reduce the skin's surface tension and eliminate debris, sebum, and emulsified oils derived from microbes, cosmetics, and exfoliated corneum cells.[10] The optimal cleanser should not cause skin irritation, damage, or alter the moisture barrier.[11]

➤ Ingredients that cause Side effects:

• Paraben:

Parabens are used to prevent oxidation. In the past, the public had adverse responses when parabens were used in larger concentrations. Today, the use of parabens has decreased significantly due to changes in safety regulations for hygiene and beauty goods as well as cosmetics. This is reflected in a decrease in the number of positive instances involving allergic reactions or contact dermatitis. [12]. It interferes with hormonal activity and enters the skin readily. Among other things, they are linked to cancer and neurotoxicity, negative impacts on health.[13] Originally, parabens were used in injections and eye preparations due to their antimicrobial effects, but now their use in these areas has been limited to prevent possible irritation.[14]

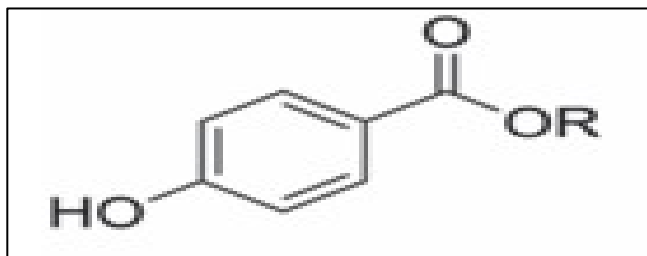


Fig 2 It Represents the Structure of Paraben.

• Sodium Lauryl Sulphate (SLS) And Ammonium Lauryl Sulphate (ALS):

Both sodium and ammonium lauryl sulfate caused the cell to degenerate, due to its capacity to denaturize proteins in membranes [15]. According to the Cosmetic Ingredient Review, SLS can cause moderate to severe irritation to the eyes and skin, particularly for those with dry, sensitive skin or skin conditions like eczema and psoriasis. Skin irritation is directly proportional to the amount of SLS in the product, with concentrations above 2% causing irritation.[16]

• Pigments:

Heavy metals found in pigments can manifest as impurities in final cosmetic products; they are a byproduct of the manufacturing process that can be created by the breakdown of ingredients or an environmental contaminant of raw ingredients; dyes can release amines, which are thought to be carcinogenic; they can cause dermatitis, anaphylaxis, and skin and lip itching and also cause allergic reactions and edema. [17][18].

B. Sunscreen:

Chemical (organic) or physical (inorganic) substances found in sunscreens work to filter ultraviolet radiation, which is light with wavelengths shorter than visible light (known as ultraviolet A [UVA]1, UVA2, UVB, and UVC) [19]. Sunscreens are cosmetic products that shield the skin from the sun's damaging rays. It shields the skin from harm.[20] This aids in preventing sunburn and, more crucially, skin cancer.[21] It has an odds ratio of 0.70, is unambiguous for the development of basal cell carcinoma, and is a clear risk factor for squamous cell carcinoma [22].

➤ Ingredients that cause Side Effects:

• Oxybenzone and Octinoxate:

Oxybenzone and octinoxate are known to induce allergies, coral bleaching, and hormone imbalances in both people and wildlife. Actually, benzophenone-3, also known as oxybenzone[23] Topical use of octinoxate affects endogenous reproductive hormones in humans. It impacts the thyroid. [24]UV radiation exposure might increase hormone production and trigger allergic reactions. Oxybenzone has been linked to contact and photoallergy reactions and may be an endocrine disruptor.[25]

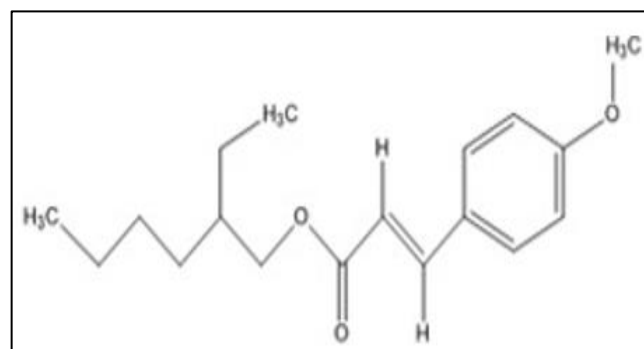


Fig 3 Represents the Structure of Octinoxate

• Retinyl Palmitate (Vitamin A):

Vitamin A has antiproliferative effects on epithelial tissue without causing dose-limiting adverse effects like skin or liver damage.[26][27]. Retinoic acid has been demonstrated to reduce proliferation markers (hTERT and cyclins D1 and 3), as well as DNA damage markers.8-oxo dGuo inhibits tumor growth, angiogenesis, and metastasis by targeting growth factors including EGFR and VEGF. [28][29][30][31][32]

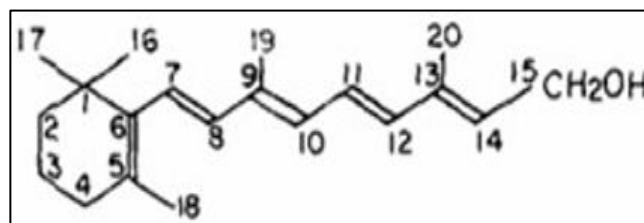


Fig 4 It Represents Structure of Retinol

• Octocrylene:

This is a UV absorber, which is a member of the cinnamate family, is UVB and UVAII. It was believed that OCT was non-allergic and that it was photostable, capable of

photostabilizing other UV filters.[33] Because it is non-irritating, it is now widely used in the production of sunscreens and cosmetics. [34][35] Despite advances in treatment, melanoma continues to be a significant concern due to its status as the most severe and aggressive type of skin cancer.[36][37][38][39] Research has revealed that octocrylene, a common ingredient in sunscreens and personal care products, often contains trace amounts of benzophenone, a known contaminant.[40][41] Benzophenone, a chemical that can cause cancer, has been found to damage DNA when exposed to UV light, leading to genetic mutations and potential tumor formation.[42][43][44]

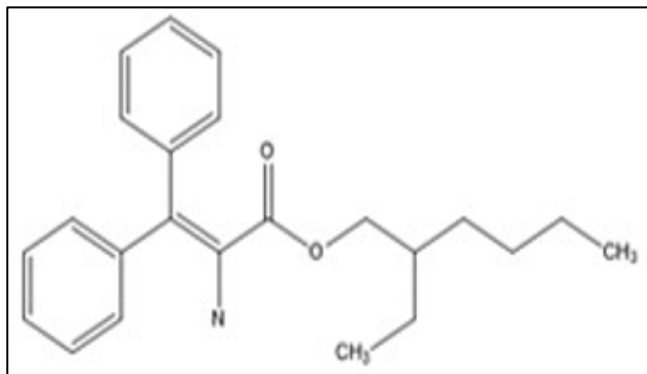


Fig 5 It Represents Structure of Octocrylene

C. Cosmetic Powders:

The cosmetic powder size is generally smaller than that of compact powders, which can impact the product's texture, absorption, and durability.[45] By incorporating these ingredients, personal care products can achieve a range of benefits, including improved adhesion, reduced friction, enhanced absorbency, increased smoothness, and a healthy, radiant appearance.[46]

➤ Ingredients that cause Side Effects:

• Talc:

Talc, a mineral composed of hydrous magnesium silicate, plays a crucial role in powder products as an adhesive agent.[47] By enhancing adhesion, talc ensures that powder stays on both the skin and the powder puff. Furthermore, its slip properties make it easier to apply the powder smoothly, providing a soft and even finish.[48] The International Agency for Research on Cancer (IARC) has classified perineal use of talc-based body powder as "possibly carcinogenic to humans" due to limited evidence. However, the agency found inadequate evidence to support a link between inhaled talc (free from asbestos and asbestiform fibers) and cancer, rendering it "not classifiable as to its carcinogenicity." [49] Studies have found that many consumer talc products contain asbestos, a known carcinogen. An examination of records from major talc producers worldwide has shown that asbestos is often present in talc products. Moreover, the process of removing asbestos from talc has proven to be ineffective, resulting in cosmetic talc products containing asbestos.[50-61] Long-term exposure to talc can cause various lung diseases, including talcosilicosis, talcoasbestosis, and talcosis. Research has also revealed that individuals working with talc, such as miners and millers,

may develop respiratory problems even when the talc is free from asbestos and silica.[62]

• Titanium Dioxide (TiO₂):

Research has shown that titanium dioxide (TiO₂), a common ingredient in many products, may be a potential carcinogen. The increasing use of nano-TiO₂ in various applications has raised concerns about its impact on human health, particularly during pregnancy and embryonic development. Environmental factors play a crucial role in shaping the development of humans and animals, and the developing embryo is especially susceptible to toxins due to its immature detoxification mechanisms.[63][64][65] [66][67] Scientists are studying the potential harm caused by tiny particles called nanoparticles when pregnant women are exposed to them, which could affect the developing baby.[68][69].

D. Moisturizer:

Moisturizers play a crucial role in preventing and treating irritant contact dermatitis (ICD), as recommended by dermatologists. Barrier creams create a protective layer on the skin in workplaces where irritant exposure is high. Although barrier creams and moisturizers share some similarities, there is no clear-cut distinction between the two.[70] Chronic use of moisturizers on intact skin may potentially compromise the integrity of the stratum corneum or disrupt endogenous lipid synthesis, thereby altering skin barrier function. This investigation assessed the long-term consequences of daily moisturizer application on normal skin, evaluating parameters such as skin barrier function, hydration status, and susceptibility to irritants.[71]

➤ Ingredients that cause Side Effects:

• Phthalates:

Phthalates are a class of high-production-volume chemicals extensively utilized as plasticizers in consumer products. [72] Specific phthalates, including diethyl phthalate (DEP) and dibutyl phthalate (DBP), are prevalent in a range of cosmetic and personal care products, encompassing applications for infants, children, and adults.[73]The pervasive exposure to phthalates has raised concerns regarding their potential impact on human health. Epidemiological studies have established associations between phthalate exposure and various adverse health outcomes, including reproductive and fertility disorders. Elucidating the molecular mechanisms underlying phthalates biological effects is essential to developing effective strategies to mitigate their harmful impacts on human health.[74]

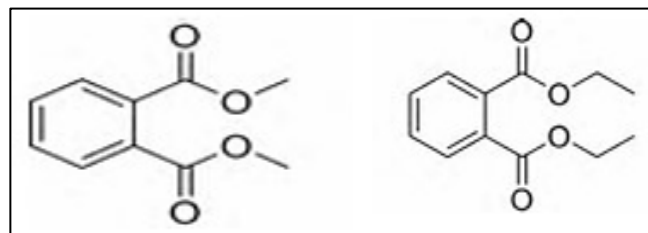


Fig 6 It Represents Structures of Phthalates (Dimethyl Phthalate, Diethyl Phthalate)

• *Butylated Hydroxy Anisole (BHA) And Butylated Hydroxy Toulene (BHT):*

Butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are synthetic phenolic antioxidants employed in the preservation of fatty foods and fats, thereby inhibiting oxidative deterioration and extending shelf life.[75] Moisturizers often contain harsh chemicals that can cause skin irritation, leading to redness, itching, and inflammation.[76][77]

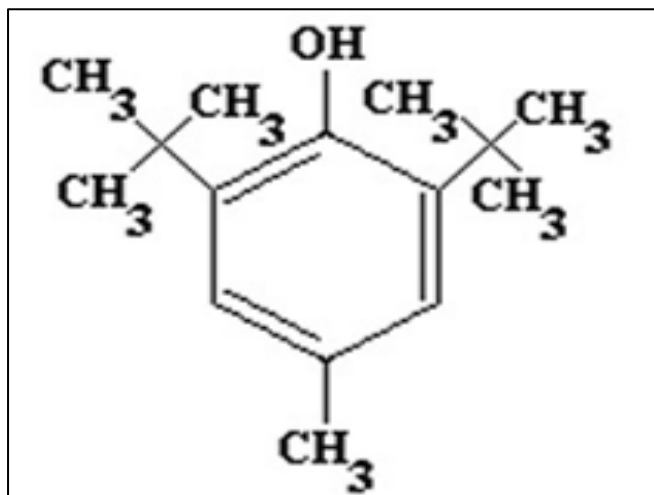


Fig 7 It Represents Structure of BHT.

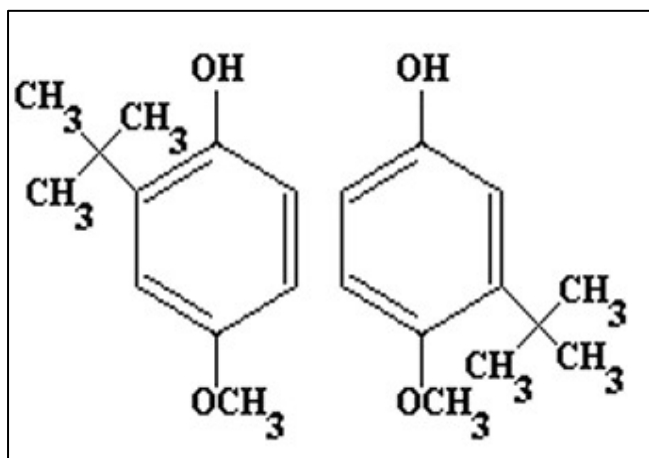


Fig 8 It Represents Structure of BHA

E. *LIP Paint:*

The global surge in cosmetic usage, particularly lipsticks, has raised concerns regarding product safety due to potential heavy metal contamination.[78][79] Lead, chromium, and cadmium are prevalent contaminants in cosmetic products, capable of accumulating in the human body via percutaneous absorption and ingestion. If we're exposed to these metals for too long, they can hurt our brains, cause cancer, and damage our organs.[80][81]

➤ *Ingredients that cause Side Effects:*

• *Lead:*

Lead (Pb) is a heavy metal possessing distinct chemical properties, including high corrosion resistance, low melting point, malleability, high density, and relatively low electrical

conductivity [82]. When lead enters the body, it can cause significant harm by interacting with essential molecules like proteins, DNA, and lipids. This can lead to widespread cellular damage and disrupt normal cellular functions. This leads to extensive cellular damage, characterized by oxidative stress, DNA damage, and disruption of normal cellular homeostasis. The systemic distribution of Pb via the bloodstream, coupled with its capacity to generate reactive oxygen species (ROS) and interfere with DNA repair mechanisms, underscores its potential role in the pathogenesis of various diseases, including cancer.[83] Exposure to lead has been linked to a range of serious health problems, including damage to the brain, kidneys, heart, blood, and reproductive and developmental systems.[84]

• *Cadmium:*

Cadmium is a toxic metal that can build up in our bodies because we lack natural mechanisms to regulate its levels.[85] Once cadmium enters the body, it is not metabolized or eliminated efficiently.[86] Notably, infants may be exposed to cadmium in utero, as it can cross the placental barrier.[87] Research has found cadmium in newborns' cord blood, as well as in their mothers' blood and placental tissue.[88] Cadmium (Cd)-induced cytotoxicity exhibits organ-specific heterogeneity, modulated by factors such as intracellular distribution, and it interacts with cellular macromolecules; genotoxic effects can disrupt normal cell functions, including growth, division, and DNA repair.[89][90] It can activate cancer-causing genes, alter DNA methylation, and disrupt normal gene expression, which can affect oxidative stress, proto-oncogene activation, altered DNA methylation patterns, and dysregulated gene expression.[91][92]

F. *Makeup—Foundation:*

The composition of make-up foundation encompasses a diverse range of materials, including mica, talc, nylon, titania, and oils. Among these components, mica and talc play a crucial role in determining the appearance of the skin surface when applied with the foundation.[93] Foundation is a cosmetic product with multifaceted applications, including color correction, texture uniformity, blemish concealment, and wrinkle reduction. Consequently, assessing the impact of foundation on skin color is crucial.[94]

➤ *Ingredients that cause Side Effects:*

• *Talc:*

Talc is a mineral found in nature, made up of magnesium, silicon, and oxygen. Its chemical formula is $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. When talc is extracted, it can contain other minerals in addition to pure talc.[95] The 1980s and 1990s witnessed the emergence of concerns regarding the potential carcinogenicity of talc.[96] This concern was sparked by a study on ovarian cancer risk and another study on carcinogenicity in rodents conducted by the National Toxicology Program.[97] Talc, being an insoluble solid, exhibits poor absorption in the gastrointestinal mucosa, and dermal absorption through intact skin is unlikely.[98] For it to possibly cause cancer in the ovaries or other reproductive organs, it would need to move from the lungs into the

bloodstream and then to those organs, where it could potentially exert carcinogenic effects.[99][100]

G. Surma (Kohl):

Kohl, also called surma, is an old eye makeup and medicine from ancient Egypt. [101]It's made from a type of antimony. The popularity of kohl extends beyond its cosmetic and cultural significance, as it is believed to possess therapeutic effects on the eyes and serve as a coagulant, including ocular benefits and hemostatic effects, particularly in neonates and infants.[102][103] However, due to the elevated cost and scarcity of antimony, lead (Pb) became a ubiquitous substitute in ancient medical practices.[104][105] [106] Kohl has been found to exhibit ophthalmic benefits, including antimicrobial activity and immunomodulatory effects, attributed to its ability to induce nitric oxide production[107]. Conversely, there is evidence suggesting that kohl poses potential health risks due to its high heavy metal content.[108]

➤ *Ingredients that cause Side Effects:*

• *Lead:*

Lead (Pb) is the primary contributor to the toxic effects associated with kohl use. When people use kohl regularly, they often have high levels of lead in their blood.[109] The high Pb content in kohl has been linked to the development of plumbism, a condition characterized by lead-induced toxicity. [110]Pb is particularly neurotoxic, exerting deleterious effects on the developing brain, rendering pregnant women and children especially susceptible to the unequivocally linked to a myriad of adverse health effects, including physical, mental, and behavioral dysfunction. Its toxicity can compromise the integrity of the nervous system, hematopoietic system, skeletal system, renal function, and reproductive health.[111] In response to these findings,

regulatory agencies have implemented measures to restrict the use of lead in various products. Luckily, many countries are now banning or limiting the use of lead in things like paint, gasoline, and other products we use every day.[112]

• *Chromium and Cadmium:*

Chromium is a common ingredient in kohl eye makeup. Exposure to excessive levels of chromium can cause a range of adverse health effects, including respiratory irritation, carcinogenesis, hepatotoxicity, and pulmonary congestion.[113][114] The toxicokinetics of chromium facilitate its entry into the human body via inhalation, ingestion, or dermal exposure, with pediatric populations exhibiting enhanced susceptibility to gastrointestinal absorption due to their developing physiology and behaviors.[115][116] Cadmium (Cd) absorption through the skin is facilitated by two primary mechanisms: covalent binding to sulfhydryl radicals in epidermal keratins and induction and complexing with metallothionein.[117] Subsequent to absorption, Cd is released into the systemic circulation, where it distributes throughout the body via binding with erythrocytes, blood albumin, or metallothioneins. Prolonged use of Cd-added cosmetics by females can lead to Cd transfer to children during pregnancy or breastfeeding.[118][119] Cd accumulation in placental tissues may disrupt nutrient passage and steroid hormone synthesis.[120]The carcinogenic potential of Cd has been implicated in various organs, including the pancreas, lungs, prostate, and kidney.[121]Cadmium levels in bathing soaps have been reported to range from 0.03 ppm to 0.04 ppm.[122] The No Observed Adverse Effect Level (NOAEL) for cadmium is 0.005 mg/kg.[123]Cadmium's effects on bone health involve disrupting the normal activation process of vitamin D, interfering with calcium, and directly affecting bone metabolism.[124]

Table 1 Skin Care Products

Skin care products	Ingredients cause side effects.	Alternatives
SOAP	SLS and ALS	Katuk leaf extract (saponins) can reduce the surface tension of the water so that it will result in the formation of foam on the surface of the water after being shaken. This property has in common with surfactants.)[125]
	PARABENS	Cinnamon extracts, oils (The bioactive compounds present in Cinnamomum extracts and essential oils have been extensively studied for their antimicrobial efficacy, demonstrating broad-spectrum activity against various microorganisms.)[126]Extracts of Lonicera japonica and Magnolia obovata [127]
SUNSCREEN	OCTINOXATE & OXYBENZONE	Scytonemin and mycosporine-like amino acids (MAAs) (128)
	RETINYL PALMITATE	Natural waxes, such as beeswax and carnauba wax (beeswax possesses anti-inflammatory, emollient, and wound-healing properties, while carnauba wax provides a protective barrier for the skin. Incorporating natural ingredients into cosmetic formulations can confer numerous skin benefits (129).
	OCTOCYLENE	Cactus extract (cactus extract possesses antioxidant properties and, furthermore, enhances the Sun Protection Factor (SPF) of sunscreen agents.)(130)
COSMETIC POWDER	TALC
MOISTURIZER		
	PHthalATES	Epoxidized sunflower oil (ESO), corn, soy, rice, wheat, and linseed. (offer a more environmentally friendly alternative, posing significantly lower risks to animal life) (131)(132)

	BHT AND BHA	BHT - halophyte plant <i>Mesembryanthemum crystallinum</i> . (family: Aizoaceae, order: Caryophyllales) BHA-coconut and palm kernel oil (antioxidant food additive as well as in cosmetics, pharmaceuticals, jet fuels, rubber, petroleum products, and electrical transformer oil.)(133,134)
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III. DISCUSSION AND CONCLUSION

In this review article, we have discussed some skin care cosmetics with their ingredients and their side effects. Cosmetics contain some hazardous chemicals such as parabens, SLS & ALS, octinoxate, oxybenzone, retinyl palmitate, octocrylene, talc, titanium oxide, phthalates, BHA & BHT, and heavy metals. It causes cancer, neurotoxicity, skin irritations, allergic reactions, and some causes endocrine disruptors and lung disease and fertility disorders, affecting the overall body. In recent years, women and men have been highly attracted to using cosmetics for enhancing their appearance. Usage of cosmetics cannot be reduced, but to avoid the damage to health, improve the use of natural ingredients, manufacturing, and marketing. And create some awareness programs regarding the dark side of beauty and their health-related problems. As a large number of populations are using cosmetic products, but they are unaware of hazardous chemicals. Cosmetovigilance is a type of health surveillance that is aimed at protecting public health. It is different from what businesses do to ensure safety products for commercial purposes as well as peer surveillance.(135) To encourage improvements in the manufacturing, marketing, and use of cosmetic products. Furthermore, one step forward is to implement the Cosmetovigilance in India, as in foreign countries, to overcome the adverse effects of cosmetic products.

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