

Cosmetics: A Dark Fantasy And Their Potential Substitutes

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Abstract

Cosmetics is a term used for substances applied to the human body for cleansing, beautifying, and to enhance the appearance. Various chemicals with potential health hazards such as heavy metals, dyes, preservatives, etc are employed for the formulation of most of the commercially available cosmetic products. These toxic chemicals on exposure may pose adverse effects on human body. Thus, there is an urgent need of some alternatives which can be used to prepare safe and healthy cosmetic products. Herbs does not have any side effects on the human body and these herbal remedies enrich the body with nutrients and other useful minerals. In this review, the harmful aspects of the different commercially available cosmetic products and their remediation have been discussed.

Keywords: Cosmetics, herbal, sunscreen, lipstick, hair colour.

1. Introduction

Cosmetics are scientifically compounded substances employed to cleanse, beautify, and enhance attractiveness of the human body, which have been used since Vedic times. Worldwide, millions of consumers use cosmetic products and their ingredients on daily basis. Various illicit substances are added to the cosmetic products to enhance their short-term effectiveness and to reduce the cost of production (Desmedt, et. al., 2014). Some of the common harmful additives which are added in cosmetic products include antibiotics (e.g., metronidazole), corticosteroids (e.g., clobetasol), sexual hormone (e.g., estrogen), prohibited preservatives (e.g., parabens), whitening agents (e.g., hydroquinone), phthalates (e.g., diethyl phthalate) and nitromusk fragrances (e.g., musk xylene) and methyl-dibromoglutaronitrile (**Figure 1.**, Jin, et. al., 2009; Fiori, et. al., 2014; De, et. al., 2009; Yang, et. al., 2010; Sheliya, et. al., 2014; Pellegrini, et. al, 2011; Sanchez-Prado, et. al., 2011). Their long-term exposure may cause adverse effects such as skin irritation, allergic reactions, and antibiotic resistance (Ma, et. al., 2016; Nohynek, et. al., 2010). Thus, there is an urgent need of some alternates which can be used to prepare safe

cosmetic products.

Recently, the herbal cosmetics have attracted the attention of researchers due to their good activity and comparatively lesser side effects as compared to their synthetic analogues. The natural contents of the herbs enrich the body with nutrients and other useful minerals (Gediya, et. al., 2011). However, scientific research has demonstrated that plants possess a vast and complex arsenal of active constituents which have the ability to calm or smooth the skin. The natural pigments are also widely used in industries such as, dyeing, printing, food, textile, pharmaceutical and cosmetic industries (Mansour, 2018). They possess different biological activities, like antioxidant, antimicrobial and food preserving capability (Singh, et. al., 2013; 2011; 2009; Ambika, et. al., 2014). Therefore the utilization of herbs in cosmetics can provide a safe and effective alternate to the existing commercially available cosmetics. In this review, the harmful aspects of the different commercially available cosmetic products and their remediation have been discussed.

2. Classification of cosmetics

Cosmetics can be classified according to the exposure framework:

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2.1 Rinsed-off product

These are the products which are rinsed-off shortly after application. For example, shampoos, soaps, toothpaste etc.

2.2 Leave on products

These products include which remain in contact with the skin for several hours. For example, body lotion, deodorant, lipsticks etc.

3. Some popular categories of cosmetics products and their harmful effects on the human body

A large number of cosmetic products are available in the market which include skin-care, lip care, nail care, hair care and many other types of products. Cosmetic products may pose harmful effects on human body. Some of the cosmetic products used in daily life have been discussed below:

3.1 Lip care cosmetics

Lip care cosmetics include lip balm, lip stick, lip brilliant, lip volumizer and lip gloss. Lip cosmetic products contain wax, oil, and coloring agents as three main ingredients along with antioxidants, preservatives, and perfumes (Fernandes, et. al., 2013). Lip gloss is employed to highlight the natural color of the lips. Lip balms are most often used to hydrate and protect the lips. Generally lip balm contains

beeswax, camphor, cetylalcohol, lanolin, paraffin, dyes, flavor, phenol, salicylic acid, fragrance, sunscreen etc (Fernandes, et. al., 2013). Lipsticks are a group of cosmetic products that have been commonly used for coloring lips. A wide range of lipsticks with different shades of colors, textures, luster are available in the market (Chattopadhyay, 2005). Lipstick consists of different components such as antioxidants, pigments, waxes, oils, and inorganics, heavy metals (Pb, Cu, Cd, Hg, Ni, Sb), etc, which pose severe toxic effects to human beings (Table 1, Liu, et.al., 2013; Atz, et.al., 2009; Piccinini, et. al., 2013; Loretz, et. al., 2005; Nourmoradi, et. al., 2013; El-Aziz, et.al., 2017; Nnorom, et.al., 2005). Coal tar is the basic ingredient for the preparation of synthetic dyes which can cause allergy, nausea, dermatitis, drying of the lips and cancer (Deshmukh, et.al., 2013). In addition to colouring agents they may contain some harmful chemicals such as formaldehyde, mineral oils etc..

3.2 Skin Care

Skin is the largest organ and plays an important role and offers a protective barrier against harmful external environment. It regulates temperature, loss of water from the body, protects against harmful radiations of the sun and harmful microorganisms.

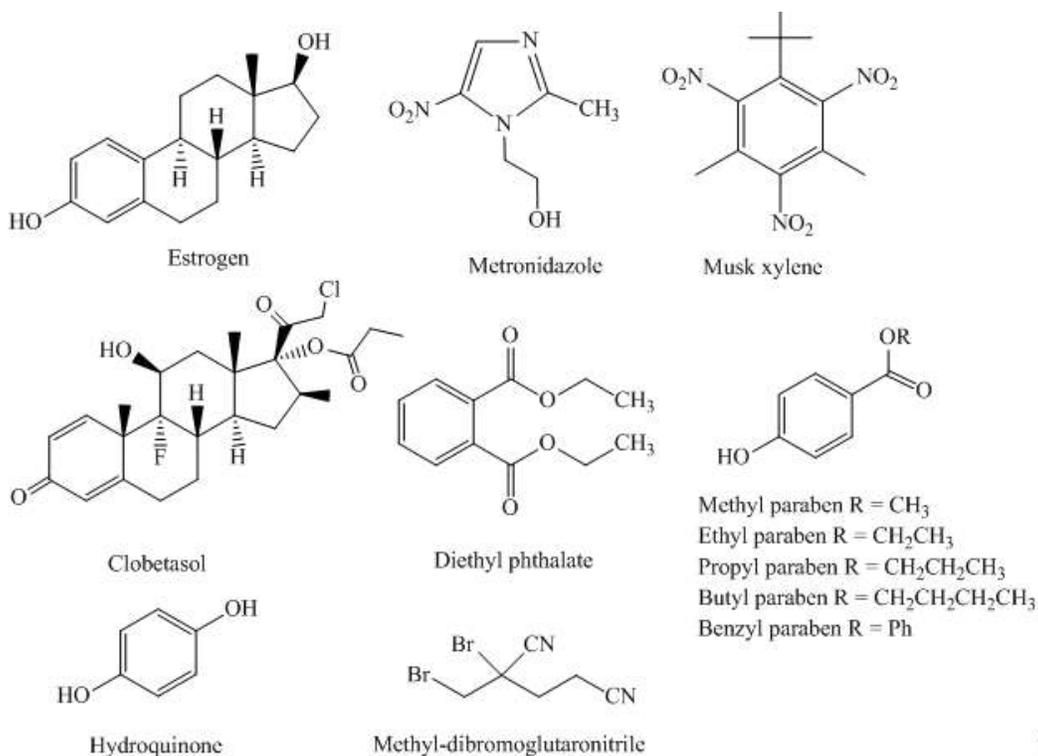


Figure 1. Some of the common harmful additives which are added in cosmetic products.

Table 1. Different types of cosmetic products and their associated health risk.

Type of cosmetic products	Name of the cosmetic product	Chemical ingredients	Role of chemical agent	Health risk
Lip care	Lipstick	Heavy metals, dyes etc.	Coloring agent	Organ damage, allergy, nausea, dermatitis, drying of the lips and cancer (Liu, et.al., 2013; Atz, et.al., 2009; Piccini, et. al., 2013; Loretz, et. al., 2005; Nourmoradi, et. al., 2013; El-Aziz, et.al., 2017; Nnorom, et.al., 2005)
		Parabens	Preservative	Reproductive toxicity, cancer (Darbre, et. al., 2008)
Skin care	Skin whitening products	Hydroquinone	Bleaching agent	Skin irritation, burning sensation and cancer (Ogbechie-Godec, et. al., 2017)
		Mercury	Whitening agent	Liver damage and kidney failure, psychiatric disorders, asthma, liver damage and severe birth defects in children (Peregrino, et. al., 2011)
	Sunscreen	Avobenzene, oxybenzone, octocrylene, octisalate, octinoxate, methoxycinnamate, PABA derivatives	Organic UV-filters	Cancer, neurotoxic effects (Kockler, et. al., 2013; Nafisi, et. al., 2017; Singer, et. al., 2019)
Eye makeup	Eye shadow	Heavy metals	Colouring agents	Brain damage, cancer and respiratory problems (Samio, et. al., 2000; Jaishankar, et. al., 2014)
		Benzalkonium chloride, parabens	Preservatives	Toxic to the epithelial cells of the eyes, allergy, reproductive toxicity, early puberty and cancer (Darbre, et. al., 2008; Choi, et.al., 2017)
	Kohl	Heavy metal	Coloring agent	Decline in intellectual and learning capacities (Parry, et. al., 1991)
	Mascara	Thiomersal and phenyl mercuric salts	Preservative	Renal, neurologic, and dermal toxicity (Taufikurohmah, et. al., 2014; Graeme, et. al., 1998)
	Eyeliner	Carbon black	Pigment	Cancer (Ramanakumar, et. al., 2008)
Hair care	Shampoo	Surfactants	Sodium lauryl sulfate, ammonium	Skin irritation and allergies (Barel, et. al., 2014)

			lauryl sulfate sodium laureth sulfate, ammonium laureth sulfate etc.	
		Zinc pyrithion	Antidandruff agent	allergic contact dermatitis(Hsieh, et al., 2010)
	Hair dyes	<i>p</i> -phenylenediamine, <i>p</i> -toluenediamine 2-naphthylamine, benzidine, 4-aminobiphenyl	Primary intermediates used in permanent hair dye	Eye injury, allergic reactions, cancer (Lewis, et al., 2013; Baan et al., 2008; IARC, 1993; Nohynek, et al., 2010)
		<i>m</i> -phenylene-diamines, <i>m</i> -aminophenols, resorcinol etc	Couplers used in permanent hair dye	Skin irritation and allergies (Lewis, et al., 2013; Baan et al., 2008; IARC, 1993; Nohynek, et al., 2010)
		Ammonia, monoethanolamine	Alkalinizing agents	Respiratory disorders and asthma (Nohynek, et al., 2010)

Type of cosmetic products Name of the cosmetic product Chemical ingredients Role of chemical agent Health risk

Table 2. Different herbs used in cosmetic formulations and their beneficial aspects

S.No	Type of cosmetic product	Herbs used in cosmetic formulation	Beneficial aspects
1.	Skin care	<i>Camellia sinensis</i> L., <i>Helianthus annuus</i> , <i>Theobroma cacao</i> , <i>Coriandrum sativum</i> , <i>Allium sativum</i> , <i>Aloe vera</i>	Enhanced sun protection against UV radiations (Sopyan, et al., 2009; Banerjee, et al., 2019; Williams, et al., 2009; Pazvar, et al., 2011; Ray, et al., 2013)
		<i>Coriandrum sativum</i>	Reduction of UVB induced skin photo-aging (Park, et al., 2012)
		<i>Persea americana</i>	Protects skin from the harmful effect of free radicals (Dreher, et al., 2013)

		<i>Theobroma cacao</i>	Inhibits skin degradation enzymes (Williams, et al., 2009)
		<i>Crocus sativus</i>	Skin <u>dipigmentation</u> and lightening agent (Mzabri, et al., 2019)
		<i>Arcostaphylos uva-ursi</i>	Metanm-mnionon (Couteau, et al., 2016; Migas, et al., 2015).
2.	Lips care	<i>Rubia cordifolia</i> and <i>Rubia tinctorium</i> . <i>Bixa orellana</i> L. and <i>Beta vulgaris</i> L. <i>Hibiscus rosasinensis</i> L., <i>Punica granatum</i>	Colouring agents (Kapoor, et al., 2007; Deshmukh, et al., 2013; Dash, et al., 2017; Kothari, et al., 2018; Jain, et al., 2018)
3.	Hair care	<i>Lawsonia alba</i> , <i>Hibiscus rosasinensis</i> <i>Nardostachys jatamansi</i> . <i>Saussurea lappa</i> .	Hair colourants (Singh, et al., 2015)
		<i>Aegle marmelos</i> , <i>Emblica officinalis</i> , <i>Centella asiatica</i> . <i>Arnica montana</i> <i>Hibiscus rosasinensis</i>	Hair cleansers, tonics, nourishers (Kumar, et al., 2012)
		<i>Cedrus deodara</i>	Anti-dandruff agents (Sah, et al., 2018)
		<i>Emblica officinalis</i> , <i>Hibiscus rosasinensis</i> . <i>Centella asiatica</i> . <i>Sesamum indicum</i> ; <i>Indigofera tinctoria</i>	Darkening of hairs (Sah, et al., 2018)

Skin care products for the body include cleansers, sunscreen, moisturizers, skin bleach etc. Visible light and near infrared radiation can have harmful effects on our skin, resulting in photo-aging and may induce cancer. Sunscreen are the cosmetic products which can absorb UV rays to protect the skin (Cantrel, et. al., 2001). Most of the conventional sunscreens consist of avobenzene, oxybenzone, octocrylene, octisalate, octinoxate, methoxycinnamate, PABA derivatives etc. that may cause cancer (Kockler, et. al., 2013; Nafisi, et. al., 2017; Singer, et. al., 2019). Various heavy metal ions such as Ni, Pb, Fe, Cr and Cd are also reported to be present in sunscreen agent which possess several toxic effects (Arshad, et. al., 2020).

Skin whitening cosmetics are one of the most popular skin care products all over the World. Skin lightening and skin bleaching is the practice used to lighten the skin color by the application of chemicals which can reduce its melanin content. Some of the most commonly used chemicals includes hydroquinone or its derivatives, kojic acid, tretinoin, α -hydroxy acids, heavy metals (Hg, Cd, Cr) etc. (Filomeno, 2017; Filomeno, 1998; WHO, 2011; Borowska, 2015; Ogbechie-Godec, et. al., 2017). Mercury (Hg) a toxic heavy metal may cause psychiatric disorders, asthma, liver damage and severe birth defects in children (Peregrino, et. al., 2011). Chemical bleaching may lead to serious skin and health problems such as dermatitis, exogenous ochronosis, steroid acne, Hg poisoning, nephrotic syndrome, neurological, skin cancer etc. (Table 1, Benn, et. al., 2016).

3.3 Eye makeup

Eye is a delicate organ in human body. Eye makeup has played an important role in highlighting the eyes. Now a days, a wide variety of eye makeup is available which includes eye shadow, eyeliner, and mascara. Skin around eyes is the most sensitive area of the face and the eye makeup layers may damage the eyes. Eye shadow is a type of makeup employed to enhance the eyes which can be achieved through different colors, shades and blending techniques. Metallic shadows consist of heavy metals such as Cd, Pb, Cr, Co and Ni etc. as the major ingredients which may pose toxicological effects (Sainio, et. al., 2000). The continuous use of these cosmetics can increase the absorption of heavy metals which may cause brain damage, lung cancer and respiratory concerns (Jaishankar, et. al., 2014). Kohl or surma is prepared by utilizing a wide variation in the Pb content.

Pb poisoning in childhood may cause long term subtle decline in intellectual and learning capacities (Parry, et. al., 1991). Eyeliner is used to enhance and elongate the size of the eye (Draelos, 1991). Mascara is used to darken, lengthen, thicken, or draw attention to the eyelashes. Regular application of mascara and eyeliner can inhibit the growth of eyelashes and becomes a breeding ground for bacteria which could lead to irritations and infections (Wilson, et.al., 1971). Cosmetic preservatives such as thiomersal and phenyl mercuric salts are employed in eye make-up cleansing products and mascara which on acute or chronic exposure may result in renal, neurologic, and dermal toxicity (Taufikurohmah, et. al., 2014; Graeme, et. al., 1998).

3.4 Hair care cosmetics

Hair care products such as shampoo, conditioner, and hair gels, hair serums, leave-on products, etc. are used for improving the appearance, and hair length, while the dermocosmetic products such as anti-hair loss and antidandruff products focus on the absorption of active compounds into the hair scalp. Extensive use of chemical based hair products may result in dandruff, scalp redness, thinning of hair, and hair loss. Shampoo is an aqueous solution of several surfactants enriched with various substances (Tadros, 2005). Surfactants may result in skin irritations and allergies (Barel, et. al., 2014). Zinc pyrithione is the active ingredient of most of the antidandruff shampoos, which possess antifungal and antidandruff properties. It may led to allergic contact dermatitis (Hsieh, et. al., 2010).

Hair dye ingredients are the most reactive chemicals used in the cosmetic industry. Permanent hair dyes are the most common type of hair dyes used for hair colouration. These type of dyes generally involves two components (primary intermediates, couplers, oxidants) which on mixing undergoes chemical reactions to generate the dye. Few example of primary intermediates such as *p*-phenylenediamine, *p*-toluenediamine 2-naphthylamine, benzidine, 4-aminobiphenyl etc. Some of the common couplers used in hair dyes include *m*-phenylene-diamines, *m*-aminophenols, resorcinol etc. (Lewis, et. al., 2013; Baan et al., 2008; IARC, 1993). These type of hair dyes may cause contact allergy, bladder cancer risk in consumers (Table 1, Nohynek, et. al., 2010; Aeby, et. al., 2009). There are reports that exposure to hair dyes and hair straightening cosmetics (HDSC) during pregnancy can be harmful for the fetus (Couto, et. al., 2013).

3.5 Sindoor

Sindoor is a traditional red or orange-red colored cosmetic powder used by Indian women. Modern sindoor consists of vermilion, which is prepared by the purification of cinnabar. It also consist of lead tetroxide (Kapoor, et. al., 2007). Sindoor made from mercury and lead tetroxide salts is toxic (Table 1).

4. Herbal Alternatives

Herbal cosmetics are prepared by utilizing the aqueous or non-aqueous plant extracts, tinctures, fatty acids or essential oils from natural products. A wide variety of plants have been utilized in medicines for the preparation of different cosmetic products such as sunscreen, skin bleach, hair dyes, lip care products etc. (Table 2, Chattopadhyay, 2005). Natural sun-filters have been used in sun-block products, along with natural rehydrants and humectants. Recently, natural extracts based conventional sunscreen formulations have been developed (Table 2). For example, *Camellia sinensis L.* leaves extract has been utilized for the preparation of sunscreen lotion with significantly enhanced sun protection factor (SPF) value (Sopyan, et. al., 2009). Similarly, the herbal oil from *Helianthus annuus* has been employed to formulate sunscreen creams for topical applications which promoted the protection against UV radiations, due to the antioxidant and anti-inflammatory nature of the natural oil constituents (Banerjee, et. al., 2019). Polyphenols derived from *Theobroma cacao* can inhibit the skin degradation enzymes. Moreover *T. cacao* pod extract can be used to protect skin from harmful effect of UV rays, which may be attributed to the presence of antioxidants such as carboxylic acid, fatty acid, phenolic acid, flavonoids and terpenoids (Williams, et. al., 2009). UVB induced skin photo-aging could be reduced by the utilization of ethanolic extract of *Coriandrum sativum* (Park, et. al., 2012). *Allium sativum* possess antioxidant properties and can protect against the harmful effect of UV rays (Pazyar, et. al., 2011). *Aloe vera* leaf extract can be employed for the absorption of UV rays due to the presence of organic compounds possessing conjugated double bonds and phenolic OH groups (Ray, et. al., 2013). The extracts of *Aloe vera*, *Cucumis sativus* and *Daucus carota* have been employed for the formulation of polyherbal cosmetic creams (Aswal, et. al., 2013). *Persea americana* can be used to protect the skin from the harmful effect of

free radicals, which could be attributed to the presence of various antioxidants like vitamins and polyphenols (Dreher, et. al., 2013). *Calendula officinalis* extract possesses antioxidant properties due to which it has been utilized for the formulation of hydrophilic creams (Bernatoniene, et. al., 2011).

Natural skin whitening agents have been employed to prepare various cosmetic products (Table 2). For example, *Crocus sativus* has been utilized as skin depigmentation and whitening agents in Ayurvedic preparations. Moreover, it helps in cell formation and repair, works as an antidepressant, minimizes the chance of high blood pressure and heart disease, treats blemishes and acne, and also aids in the production of blood cells (Mzabri, et. al., 2019). Arbutin is a hydroquinone glycoside which can be isolated from the *Arctostaphylos uvaursi* (bearberry plant). Due to the melanin-inhibiting properties of its alpha isomer, it can be used in skin lightening formulations as a safe alternate to the toxic synthetic analogues (Couteau, et. al., 2016; Migas, et. al., 2015). Also, different types of naturally occurring clays such as zeolite, bentonite, montmerollinite, kaolin etc. can be utilized to treat skin problems. These clays are rich in minerals, such as magnesium, phosphorous, calcium, potassium etc. Fuller's earth have unique property of bleaching the skin. These clays can be employed for the removal of toxins, heavy metals and poisonous compounds from the skin (Nilforoushzadeh, et. al., 2018).

Natural products can also be used to produce colouring matter (Table 2). Different red dyes from natural sources has been used for the preparation of sindoor. Sindoor can be prepared from a mixture of turmeric and alum or lime (Kapoor, et. al., 2007). *Rubia cordifolia* and *Rubia tinctorium* have also been used for the preparation of sindoor (Kapoor, et. al., 2007). The roots, bark and seeds of *Bixa orellana L.* and *Beta vulgaris L.* root have been utilized for the preparation of sindoor and lipsticks (Kapoor, et. al., 2007; Deshmukh, et. al., 2013). Various naturally occurring colouring matter from natural sources such as cocoa powder, extracts of the flowers of *Hibiscus rosasinensis L.*, mica powder, *Punica granatum* etc. can be used for the preparation of lipsticks (Dash, et. al., 2017; Kothari, et. al., 2018; Jain, et. al., 2018).

Natural hair dyes extracted from plants are of growing economic importance (Table 2).

Lawsonia alba, *Hibiscus rosasinensis*, *Nardostachys jatamansi*, *Saussurea lappa*, can be used as natural hair colourant (Singh, et. al., 2015). *Lawsonia alba* in combination with other herbal extracts, like *Aegle marmelos*, *Emblica officinalis*, *Centella asiatica*, *Arnica montana*, *Hibiscus rosasinensis* etc. has been used to formulate hair cleansers, tonics, nourishers (Kumar, et. al., 2012). Herbal hair colours are also used in various disorders such as dandruff, premature greying and head lice etc. *Cedrus deodara*, *Emblica officinalis*, *Hibiscus rosasinensis* have been utilized as anti-dandruff agents (Sah, et. al., 2018). *Centella asiatica*, *Sesamum indicum* and *Indigofera tinctoria*, can be employed for the darkening of hairs (Sah, et. al., 2018).

5. Conclusions

Cosmetics are substances employed to alter the appearance and texture of the body. Most of the commercial brands contain chemicals with potential health hazards. The herbal products offer opportunities to formulate cosmetics with no side effects along with the enrichment of the body with nutrients and other useful minerals. These herbal products can be utilized to prepare various types of safe and healthy cosmetic products such as sun blockers, skin bleach, lip care products, sindoor, eye makeup, hair care products etc. Thus, herbal cosmetics can be an effective and safe alternatives of the synthetic chemical based cosmetics.

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