

## **An Insight into Chemicals Toxicity in Cosmetics and Their Health-Related Perceptions**

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### **ABSTRACT**

Cosmetics has been used, since ancient times, for enhancing the beauty and self-care. But the difference lies in the chemicals that have been constantly used for the manufacturing of cosmetics in the present time concerning the natural cosmetics that were been in use in ancient civilization and still used by many people. Many controversies arose in past years targeting the companies the company to ban the use of such chemicals but none seem to lead to any result. Cosmetics manufactured today are added with a load of chemicals to increase their shelf life, to enhance their quality, for selective and assorted colors or any other desired property. But no one could have ever thought of how these would affect the humans and the environment too. The cosmetics lead to prolonged exposure to chemicals and indirect ingestion that give rise to health-related issues like allergy, hypersensitivity and some are even be reported to have carcinogenic effects. Many experimental pieces of evidence have supported the presence of substances like phthalates, coal tar, heavy metals, parabens etc. in the cosmetics. They have been reported to have dangerous impacts on biological things. Apart from this, the cosmetics are also tested on animals in such an inhuman way that can't be imagined of and set out for sale, keeping the fact at a corner that animal and humans have different issues and body build-ups and effects won't be the same. This also gives rise to animal related ethical issues. Safety evaluation for cosmetics

needs to be updated. This review is a compilation of information from the reviewed literature related to cosmetics. More strict safety evaluation rules, banning for such harmful chemicals, giving break to excessive animal abuse in the industry and use of more and more natural products and herbal formulations should be encouraged.

**KEYWORDS:**Chemicals; Cosmetics; Hazards; Implications; Metals.

## 1. Introduction

Cosmetics are very widely used products on a daily basis by every being. Usually, a cosmetic product is adopted in the treatment of the exterior surface of the human body to perform the following 4 functions: (1) change in appearance; (2) maintenance in good condition; (3) alteration of body odor and (4) protection. It includes makeup for self-grooming and even hygiene related product that meet the daycare needs. The word 'cosmetics' attribute to all kind of products adopted to maintain and glorify ones outer personality while beautifying it. The purpose they serve includes better conditioning of appearance, safeguarding from the harmful effects of the environment (UV rays from sun, dust and pollution), helping in ageing processes and adding a fragrance to prevent body odour. All the cosmetics manufactured by industries in some or the other way carry heavy loads of chemicals in them that are capable of causing many kinds of ailments to the human body as well as the environment. Carcinogens are a type of compound that could be thought of; they tend to initiate tumor or cancer in living cells. Each product consists of carcinogen in one or the other way but still, it's not banned because the laws governing personal care and cosmetic products are bounded and validly allow use of carcinogens in cosmetics and daily care products (Siemer, 1991; Jacob et al., 2018).

Cosmetics industry has grown day by day on an average 4.5% approximately per year from the last 20 years. The industry has emerged as capable to be the most suitable industries despite of the economic deterioration this could be linked directly with increasing demand all over the world. In the 1970s, tentative data pointing towards a cancer-causing risk provoked reinstatement of simple aromatic diamines in semi-permanent dyes (Lopaciuk and Loboda, 2013). Cosmetics industry has grown day by day on an average 4.5% approximately per year from the last 20 years. The industry has emerged as capable to be the most suitable industries in spite of the economic deterioration this could be linked directly with increasing demand all over the world. In the 1970s, tentative data pointing towards a cancer-causing risk provoked reinstatement of simple aromatic diamines in semi-permanent dyes (Shafer and Shafer, 1976). Supporting epidemiological data including personal use of hair dyes as a "possibly cancer-causing element to humans" has been procured along with the use of talc-based body powder as conceivably cancer-causing to humans. Other such data including toxicity and harms caused by other products has been reported in experimental basis but no such epidemiological data has been found to support the evidence (Booth et al., 1989; Straif et al., 2014).

## **2. What is Cosmetics?**

'Cosmetics' word originates from the Greek "Kosmtikos" which denotes 'expert in decoration' or 'to embellish' (Barel et al., 2006). The Council of EU regulation provided the following definition for cosmetic: "A cosmetic product means any mixture or substance envisioned to be placed in contact with the external parts of the human body (hair system, epidermis, lips, nails, and external genital organs) or with the mucous membranes and the teeth of the oral cavity with a view exclusively or mainly to perfuming them, cleaning them, protecting them, changing their appearance, keeping them in good condition, or correcting body odors" (Butler, 1993; Shai et al., 2009).

Cosmetics can be classified as rendering to their use, functions, consumer's gender or age, form of preparation, among others. The greatest opposite classification is as follows :(1) cosmetics for the hair, skin and integument care (2) cosmetics for personal cleansing ( deodorants, soaps, shampoos); (3) protective cosmetics ( anti-wrinkle products, solar products); (4) cosmetics for embellishment ( lip colors, perfumes); (5) remedial cosmetics (hair dyes, beauty masks); and (6) active cosmetics (antiseptics fluoridated toothpastes) and (7) maintenance cosmetics (moisturizing creams, shaving cream) (Mitsui, 1997). Another concept related to cosmetics in 'cosmeceutics'. The word cosmeceutics was commercialized by the aesthetic doctor Albert Kligman . This word means a mixture of pharmaceuticals and cosmetics, used to define cosmetic products that can possess a suitable effect on skin but cannot be measured as having a pure biological therapeutic effect. Though, the cosmeceutic word remains contentious without lawful status and has not been usually acknowledged by all researchers (Dureja et al., 2005).

## **3. Most Common Chemicals Found In Cosmetic Products**

Day to day we are unaware of loads of chemicals we are getting exposed to in face of cosmetics. A detailed description of such compounds has been given below and Table 1 describes the cause of these chemicals and toxicants in commonly used cosmetics lays on us.

### **3.1 Coal Tar Dyes**

Coal tar is an amalgamation of a variety of chemicals that constitutes petroleum. Colors obtained from coal- tar have been widely used in cosmetics, usually recognized by a five-digit Color Index (CI) number. One of the most important coal-tar dye is p- phenylenediamine which is used in most hair-dyes. Darker the color of hair dye more is the amount of phenylenediamine that it contains. Coal tar is found to be linked with cancer and they probably could lead to cancers, whether these colors are produced by coal tar or synthetically. Either these colors are mixed with harmful heavy metals or to some extent with aluminum substrates and these compounds could lead to brain damage also. Few of these colors have not been accepted as food additives and hence are not safe to be ingested, but still, they are being used in lipsticks (Darbre, 2005; Rollison et al., 2006).

### **3.2 Diethanolamine (Lauramide DEA and Cocamide DEA)**

DEA associated elements are used in the formation of cosmetics, cream, or as a pH stabilizer to maintain the acidity of other constituents. They are also been used in shampoos, soaps and cleansers. Nitrosamines are formed when DEA acts on nitrites present in cosmetics. Nitrites can either be used as anti-oxidizing or as a contaminant. The decomposition of different chemicals used as preservatives in cosmetics is found to produce nitrites when these products are kept in the air. In laboratory experiments, upon disclosure to excessive doses of DEA-related constituents has been evident to form liver cancers and precancerous alterations in skin and thyroids and can also root eye annoyance and moderate skin (Zhang, 2008).

### **3.3 DBP (Dibutyl Phthalate)**

Dibutyl phthalate is mainly used as a plasticizer and as a solvent that stops nail paints from being rigid and fragile. It has been evident to form developing imperfections, changes in the testes and lessens sperm counts and prostate. It has also been recognized as a probable endocrine deactivator on the fact that it affects with hormone function, and may be hazardous to the foetus and deteriorate fertility. Furthermore, Health Canada discloses that revelation to phthalates may stance health effects such as kidney and liver failure in children's of young age when products encompassing phthalates are consumed for extended periods. Phthalates are also related to less sperm count in men and reproductive deficiencies in the developing male fetus (when the mother is in contact at the time of pregnancy), among other health effects (Stahlhut, 2007).

### **3.4 Parabens**

It one of the most common constituents and preservatives in cosmetics up to an estimate of 75 to 90% of them contains parabens at very small levels. Parabens simply enter the skin and are susceptible of causing defects in hormone function. They can act as estrogens, themale reproductive and primary female functions. In addition to this, studies have indicated that the application of methyl-paraben on the skin responds to other chemicals, leading to enhanced skin and DNA destruction. Parabens occur naturally in diminishing levels in few foods, such as strawberries, barley, onions currents, vanilla and carrots while a non-natural preparation obtained from petrochemicals has been used in cosmetics. Parabens in foods are decomposed when eaten, making them less estrogenic. In contrast, when applied to the skin and absorbed into the body, parabens in cosmetics go through the metabolic process and enter the blood stream and body organs in its original form. It has been evaluated that women are exposed to at least 50 mg/day of parabens by applying cosmetics. They are related to neurotoxicity and cancer among other contrary health effects (Darbre et al., 2004; Charles and Darbre, 2014) .

### **3.5 Perfume (Fragrance)**

The very word perfume (fragrance) in the constituent's index of any cosmetic product generally signifies a composition of different varieties of chemicals. According to an estimate, almost 3,000 chemicals are being used as perfumes. The fragrance is one of the most significant additives of deodorants, perfumes and colognes. It is being used in almost every type of cosmetic and taking care product. General products labeled as "unscented" or "free of fragrance" might comprise of fragrant constituents as beating agents that stop the brain from taking notice of

fragrance (Anderson and Anderson, 1998). A lot of unpublished fragrant ingredients are termed to be irritants and can result in severe headaches, allergies and signs and symptoms of respiratory allergies like asthma. Perfume can either deteriorate asthma or by chance even contribute to its development in children. It is the second most general source of allergy and irritation in patients. Link of anti-perspirant deo and breast cancer has also been reported in studies by (Darbre, 2009).

### **3.6 Polyethylene Glycols (PEGs)**

Polyethylene glycols (PEGs) are petroleum-based complex products that are significantly been used in creams as solvents, thickeners, moisture-carriers and softeners. Depending on the progressions, PEGs can be contaminated with enhanced quantities of 1,4-dioxane. But, 1,4-dioxane has been supposed to be carcinogenic or tumor causing. It is not degraded easily and can stand in the environment for very long periods. PEGs have shown evidences of gene toxicity and if applied over damaged skin can lead to systemic toxicity and allergies (Bridges, 2002).

### **3.7 Petroleum**

Petroleum also recognized as mineral oil jelly that act as a boundary to contain moisture in skin in varied ranges of moisturizers. It is used in hair care products to give a shiny luster to hairs. Petrolatum could be contaminated with polycyclic aromatic hydrocarbons (PAHs). Researchers have shown that disclosure to PAHs – related to skin cancer, if exposure occurs for a longer period. On the basis of this evidence, the European Union categories petrolatum as a carcinogen and contains its use in cosmetics. PAHs in petrolatum can also lead to skin irritation and allergies (Ulrich, 2004).

### **3.8 Siloxanes**

These are silicone-based complexes used as constituents in cosmetics to enhance their softening, smoothing properties and to enhance quality of skin. They are commonly used in facial treatments and skin moisturizers. They are known to be toxic, tenacious and bioaccumulate in aquatic organisms as CycloPentasiloxane and Cyclo tetra siloxane. Cyclo tetra siloxane is a fatal endocrine disruptor, affecting working and functioning of human hormones, and is a reproductive toxicant, effecting fertility in humans (Xu et al., 2015).

### **3.9 Phenacetin**

used in hair color, facial hair bleach and women's depilatories phenacetin is occasionally used as a stabilizer in the products. According to the Prop 65 and IARC phenacetin is a human carcinogenic compound (Charles and Darbre, 2014).

### **3.10 Benzene**

The route of exposure to benzene is ingestion and inhalation. Benzene is occasionally used in styling lotion and hair conditioner and classified as benzene is a human carcinogenic compound (Sontag, 1981; Whitteore et al., 1988).

### **3.11 Untreated mineral oils or mildly treated mineral oils**

Mineral oils are widely used in daily use products, with lip gloss, moisturizer, eye shadow, hair color, conditioner, styling gel/lotion, blush and concealer treated or untreated mineral oil is a carcinogenic compound for humans according to Prop 65, NTP and IARC mildly (Llanos et al., 2017).

### **3.12 Heavy metals**

Cadmium and hexavalent chromium serve as a color in lip gloss and eye shadow. Arsenic are the impurity in cosmetic compounds including shampoo, facial lotion and foundation. According to NTP, Prop 65 and IARC identify arsenic, cadmium and chromium as a human carcinogen (Agency of Toxic Substances and Disease Registry, 2008).

### **3.13 Ethylene oxide**

It is widely used in fragrances and in popular brands shampoo. There are solid proofs that shows ethylene oxide can cause hematopoietic and lymphatic cancers; and some studies it has been found that increased incidence of breast cancer in uncovered or exposed workers. NIOSH concludes that ethylene oxide leads leukemia and peritoneal cancer; exposure to ethylene oxide through ingestion, inhalation, and eye and skin contact can disrupt the central nervous system, respiratory system and reproductive system (Willhite et al., 2014).

### **3.14 Silica**

silica occurs in 2 forms amorphous or crystalline. Crystalline silica is extensively used in eyeliner, eye shadow, lipsticks, lip gloss, sunscreen, foundation, shampoo and lotion. According to IARC and NTP crystalline silica of respirable size is carcinogenic compound for humans and Prop 65 also list silica as human carcinogen (Shohreh, 2015).

## **4. Health Hazards Related with Heavy Metals**

Heavy metals have been used in cosmetics frequently used by women and also in face makeups heavy metals which can accumulate in the body over time and can lead to cause various health issues, such as; cancer, developmental and different reproductive issues, neurological problems; blood, skeletal, cardiovascular, renal problems; nausea, immune system, headaches, vomiting, and diarrhoea; lung and respiratory diseases; and hair loss and brittle hair. Some are toxic to the respiratory system while others are disruptors of hormones (Popoola et al., 2013; Ramakant et al., 2014).

### **4.1 Lead (Pb)**

Lip colors can become contaminated with Pb. Pb frequently comes in contact with skin and some amount of lead gets absorbed through skin. The use of eye makeup that contains Pb has been combined with increased levels of Pb in blood in women and children's (Sprinkle, 1995). Little ones are specifically liable because it can pass through the umbilical cord with contentment and pass into the embryobrain. It can also be relocated to newborns through kept in bones and breastfeeding. Pb revelation has also been inter-linked to miscarriage, hormonal changes, menstrual irregularities, infertility in women and men, adjournments in adolescence onset in girls (Rothenberg et al., 2000). Inorganic lead compounds and lead have been classified as a suspected carcinogenic to humans (Ayenimo et al., 2010).

### **4.2 Cadmium (Cd)**

In the environment Cd present certainly. Cd exist in body and creams used in hairs are engrossed into the body over cuticular contact; deposited in the kidney and the liver, though it can be existing in around all adult cells. It is measured to be "mutagenic to humans" by the IARC and its components, characterized as known human oncogenes by the United State Department of

Health and Human Services. High levels of absorption of Cd can activate to Spartan abdominal irritation, diarrhoea and vomiting, while contact to inferior levels for a extensive time can cause bone deformity, kidney damage and the capability of bones to breakdown smoothly (Chauhan et al., 2010; Al-Saleh I and Al-Doush, 2007).

#### **4.3 Mercury (Hg)**

It is one of the very communal components which is existing in skin complexion fairing creams and soaps. Hg is also used in other cosmetic products, like as eye cleansing products and beautifying agents and mascara. Skin complexion fairing soaps and creams are widely found in specific African and Asian countries. These products are also used in North America and Europe. Hg inhibits the concentration of melanin, which results in brighter skin complexion. In cosmetics inorganic mercury and organic mercury is present. Skin lightening creams and soaps are made up of organic mercury and preservatives in eye makeups, mascara and cleaning product. The major conflicting ramification of the inorganic mercury accommodates in skin fairing creams and soaps in renal failure. Hg is used as a skin lightening agent in cosmetic products and leads skin discoloration, skin rashes and scarring as well as a contraction in the skin resistant to fungal and bacterial infections (Biebl and Warshaw, 2006).

#### **4.4 Nickel (Ni)**

Due to the affluence of this metal in the environment, everybody is bare to very less amounts, usually via air, food, soil, skin contact and portable water, including cosmetics (Sprinkle, 1995). High levels of disclosure can lead to health hazard rely on route and the type of Ni exposed to. Specific kinds of Ni are studied to be “toxic” because of their mutagenicity. Metallic alloys and nickels have been classified as conceivably cancer-causing to humans. Hypersensitivity to Ni is also common and it might be cause acute contact dermatitis. The 1<sup>st</sup> case of Ni hypersensitivity caused by eye makeup has been reported; although as one ppm of it may provoke a pre-existing allergy (Khalid et al., 2013).

### **5. Regulations Related to Chemicals in Cosmetics**

Regulatory authorities have been banned or given guidelines for use of chemicals in any form which are been followed in some countries and some don't abide to rules and regulations. Likewise, Formaldehyde is restricted in the EU ([http://www.ewg.org/skindeep/ingredient/726229/ETHYLENE\\_OXIDE](http://www.ewg.org/skindeep/ingredient/726229/ETHYLENE_OXIDE)) and banned in Japan, benzene is banned in the EU; coal tar is banned in the EU; ethylene oxide is banned in the EU; cadmium compounds are banned in Japan and the EU; chromium is banned in the EU; arsenic is banned in the EU ([http://ec.europa.eu/consumers/cosmetics/cosing/index.cfm?fuseaction=search.details\\_v2&id=29456](http://ec.europa.eu/consumers/cosmetics/cosing/index.cfm?fuseaction=search.details_v2&id=29456)).

### **6. Side Effects Caused by Cosmetics and studies related to them**

Skincare products such as nail polish, perfumes, make up, etc., can cause skin irritation and allergic reactions; these products can endure on the body for an extended period of time and cause substantial adverse reactions (Nigam, 2009). Moisturizers raise the hygroscopic stuffs of the skin specifically when the amount of these materials is high in the body. It can cause

exfoliation and irritation. Skin lessening agents such as hydroquinone (HQ) is one of the life-threatening harmful chemicals. However, there have been reports of potential mutagenicity and ochronosis. Ochronosis is an unusual contrary effect of HQ, categorized by liberal darkening of the part to which the cream holding high concentrations of HQ is useful for many years (Nigam and Saxena, 1998; Shalom et al., 2013).

Sun-screening agents can cause allergic, irritant, photo-allergic reactions or phototoxic. Benzophenones are the utmost common while dibenzoyl methane's, sensitizers, cinnamates may cause photo-allergic dermatitis and para-aminobenzoic acid (PABA) (Johansen et al., 1996).

The sensitive reactions associated with anti-perspirants / deodorants and fragrances are frequently caused by the other ingredients or fragrances. Fragrances can arrive the body through lungs, air ways, skin (adsorption), ingestion and through pathways from the nose directly to the brain and can cause dizziness, headaches, irritation to eyes, fatigue, throat and nose, forgetfulness and other symptoms. Fragrances scattered in the air or present in air can cause air-borne contact dermatitis. Chemicals like phthalenol, coumarin found in fragrances are supposed carcinogens, while phthalates are assumed hormones disrupters (Anderson and Anderson, 1998; Bridges, 2002). All the studies done are mostly done on animals like mice and rabbits before getting to final conclusion that makes it have ethical issues related to animals. More detailed discussion has been given below.

### **6.1 Allergy**

Allergy is one of the hypersensitivity disorders which is caused by our immune system and substances those are responsible of allergy are known as allergens. The major symptoms of allergy include itchiness, red eyes, eczema, contact dermatitis and may cause life threatening reaction which is known as anaphylaxis (Kay, 200). Fix testing with a wide screening arrangement, enhanced by patients' own corrective items cause contact hypersensitivity or dermatitis on face, eyelids, neck and lips have been demonstrated in different studies. Study on Undesirable Effects (UE) by beauty care products detailed that among the functions (n = 45) announced by dermatologists, 22 were analyzed as Allergic Contact Dermatitis (ACD) and 18 as Irritant Contact Dermatitis (ICD). Facial consideration items (19.7%), trailed by body care items (16.9%), aromas (12.7%) and eye care items (11.3%) were cosmetics answerable for the watched functions. Periorbital and perioral zone, brow, visual mucous film and lips, trailed by whole body (n = 9) are included in this exploration body parts which primarily influenced were face (n = 37). (Sportiello et al., 2009; Michelle et al., 2014).

In 6621 female and 3440 male patients, 1582 female (23.8%) and 611 of male (17.8%) patients had at any rate one unfavorably susceptible fix test response related with a restorative source, this has demonstrated in an examination. Females were 1.21 occasions bound to have a hypersensitive response related with a corrective source than male patients. Head and neck association was essentially higher in female (49.3%) than in male patients (23.7%) considering inside the restorative unfavorably susceptible gathering (n = 2243) (Groota and Herxheimer, 1989) A combination of methyl isothiazolinone and methyl chloro-isothiazolinone (1.5%) as their additive framework is found in assortment items, for example, saturating creams which are

the significant reason for corrective allergy. Allergy to nail makeup is less successive as contrasted and different beautifying agents. the eyelids, cheeks, sides of the neck, hands, periungual and perianal territories are influenced by the Sensitivity contact dermatitis from nail polish regularly. For this investigation at days 2 and 4 a patient with perianal, eyelid pruritus and dermatitis was fix tried and results demonstrated that +2 positive hypersensitive reactions were seen by nail finish. Mono acrylates and monometha - crylates are utilized in nail beauty care products has been shown in a research. Patient had erythema and difficult pruritic vesicles of the paronychia tissue as he was turned out to be occupationally sharpened to photobonded designed nails. Itemized fix testing and examination of the patient's nail beautifying agents containing mono (meth) acrylates explained the reason for her hand and face dermatitis. (Lazarov, 1999; Malik and Claoué, 2012)

## **6.2 Cytotoxicity**

Cytotoxicity is the nature of being poisonous to cells. Treating cells with the cytotoxic compound can bring about an assortment of cell destinies like they will close down digestion or the phones can initiate a hereditary program of controlled cell passing (apoptosis). Cells may go through corruption in which they lose film integrity and pass on quickly because of cell lysis. Nanoparticles which are progressively being utilized in cosmetic items are Titanium dioxide nanoparticles. An investigation of harmfulness of TiO<sub>2</sub> nanofibers (TiO<sub>2</sub>NFs) was assessed in human cervical adenocarcinoma HeLa cells. Presentation of HeLa cells to TiO<sub>2</sub>NFs actuated critical cytotoxicity even at portions as low as 2µg/ml. Intracellular take-up of TiO<sub>2</sub>NFs in cells was appeared by Alizarin Red S (ARS) marked nanofibers. G2/M cell cycle capture in the cells presented to TiO<sub>2</sub>NF is shown in cell cycle analysis. (Riss, 2004) Expanded articulation of proapoptotic proteins bax with an expansion in cytosolic cytochrome-C and restraint of hostile to apoptotic protein Bcl-2 is brought about by TiO<sub>2</sub>NFs treatment to HeLa cells which brings about acceptance of cell oxidative pressure as uncovered by raised ROS levels decreased cancer prevention agent levels and expanded lipid peroxidation prompting apoptosis (Ramkumar *et al.*, 2012). Some inorganic salts, for example, sodium sulfite, ammonium sulfite, sodium bisulfite, potassium bisulfite, ammonium bisulfite, sodium metabisulfite and potassium metabisulfite are available in hair care items and this have been announced by research, and that work as lessening operators in corrective details. These inorganic salts entered in vertebrates by means of ingestion, inward breath or infusion and convert sulfite oxidase to sulfate which came about in hyperplastic changes in the gastric mucosa. (Cohen *et al.*, 2013) For assessing skin poisonousness of metal oxide particles (nanoparticles) ordinarily found in restorative and dermatological arrangements an investigation tended to the natural impacts of topically applied copper oxide (CuO) nanoparticles in human skin organ societies, utilizing light and electron microscopy and biochemical tests. Nanoparticles were more poisonous than miniature estimated particles and CuO nanoparticles actuated incendiary cytokine emission and necrosis. (Nabeshiet *et al.*, 2011) Consequence of an examination recommended that the all-around scattered undefined nano silica of molecule size 70 nm (nSP70) infiltrated the skin obstruction and caused foundational introduction in mouse.<sup>15</sup> An exploration uncovered that lung changes happen in creatures

presented to powder vaporized fixations that brought about lung over-burden and granulomatous sores due to powder on careful gloves.(Wehner, 1994) health risk are caused because of Talc based beauty care products as they have quality of powder nanoparticles. In an investigation two assortments of powder nanoparticles, indigenous and commercial were evaluated for their potential in vitro poisonousness on A549 cells which shows that the two assortments of powder nanoparticles differentially prompted Lipid Peroxidation (LPO), which was corresponded with the example of Lactate Dehydrogenase (LDH) spillage, Reactive Oxygen Species (ROS) age and glutathione (GSH) depletion. Indigenous nano talc indicated moderately higher cytotoxicity credited to its higher substance of iron when contrasted with commercial nanotalc. (Akhtar *et al.*, 2010).

### **6.3 Clastogenicity and genotoxicity**

In science, a mutagenic specialist which causes interruption or breakages of chromosomes, prompting segments of the chromosome being erased, included or reworked is called a clastogen. This cycle is a type of mutagenesis and can prompt carcinogenesis as cells that are not murdered by the clastogenic impact may become cancerous.<sup>18</sup> A property controlled by certain substances that makes them harmful to the DNA, RNA and other hereditary materials present in an organism is called Genotoxicity. (Charoensinet *et al.*, 2012) Genotoxin is a substance that has the property of genotoxicity. Comet examines were completed to assess DNA harm in human lymphocytes from 20 volunteers when hair coloring. DNA harm in lymphocytes was discovered to be somewhat higher in volunteers after hair dyeing. Hair color fixings regularly produce positive outcomes in present moment in vitro genotoxicity tests. Various biomonitoring investigations of people presented to hair colors have been directed utilizing either cytogenetic modifications or DNA harm as proportions of genotoxicity or urine mutagenicity as a proportion of introduction to genotoxic compounds. The two essential regular color fixing contained in the leaves of Henna (*Lawsonia inermis*) are 2-Hydroxy-1, 4-Naphthoquinone (HNQ). Distributed genotoxicity concentrates on HNQ recommended it was a feeble bacterial mutagen for *Salmonella typhimurium* strain TA98 and all the more plainly mutagenic for strain TA2637.<sup>22</sup> TiO<sub>2</sub>-NPs are being utilized progressively for different modern also, customer items which includes makeup and sunscreens in light of their photoactive properties. (Kim *et al.*, 2013) The genotoxicity of 10nm uncoated circle TiO<sub>2</sub>-NPs with an anatase glasslike structure study was surveyed utilizing the *Salmonella* turn around change examine (Ames test) and the single-cell gel electrophoresis (Comet) assay. With the *Salmonella typhimurium* strains TA97a, TA98, TA100 and TA102 to decide the mutagenic capability of TiO<sub>2</sub> nanoparticles were come about in genotoxic nature of the designed NP-TiO<sub>2</sub> and a NP-TiO<sub>2</sub> result from a sunscreen nanocomposite.<sup>24</sup> Benzophenone-3 (BP-3) is broadly used as basic part in sunscreens and different beauty care products. In vitro investigations have demonstrated the endocrine disturbing limit of BP-3. BP-3 has demonstrated solid enemy of androgenic and hostile to estrogenic movement as well. (Jomini *et al.*, 2012).

The boundless utilization of BP-3 has brought about its delivery into the water climate and consequently sway on the amphibian environment. An investigation has demonstrated that

restorative items like lotions, creams, showers or salves applied to axilla or chest or bosom regions may cause bosom disease occurrence in females. Common item in restorative detailing to be specific p-hydroxybenzoic acid esters or parabens have been tried in vitro and in vivo and they have indicated oestrogenic impact and now have been identified in human bosom tumor tissue.<sup>26</sup> Some phthalates, for example, di 2-ethyl Hexyl Phthalate (DEHP) and Dibutyl Phthalate (DBP) and their metabolites are associated with creating teratogenic or endocrine-upsetting impacts. An investigation has been done to foresee conceivable human introduction to phthalates in beautifiers. The degrees of DEHP, Diethyl Phthalate (DEP), DBP and Butyl Benzyl Phthalate (BBP) were dictated by HPLC in 102 marked hair splashes, aromas, antiperspirants and nail shines. DBP was identified in 19 of the 21 nail shines and in 11 of the 42 scents and DEP was recognized in 24 of the 42 fragrances and 2 of the 8 antiperspirants. An Optical Brightener (OB) powder (INCI : Sodium silicoaluminate and glycidoxypropyl trimethyloxysilane/PEI-250 crosses fluorescent brightener 230 salt and polyvinyl liquor crosspolymer) that is utilized in restorative facial items were tried utilizing the Micronuclei test (MNT) which came about in their genotoxic nature. (Harvey and Dabre, 2004; Dayan *et al.*, 2011)

Conditioners and Shampoos do not have much interaction with the skin; they are only valid to the hair and as such, cause fewer adverse effect. However, they can be a problematic when they come in contact with the eyes during wash of the hair. The most communal effect of using shampoo is the matting of the scalp hair (also referred to as tangling of hair) (Wilson *et al.*, 1990). Active ingredients in hair bleaching product such as Ammonium persulfate, Hydrogen peroxide solutions, may cause Types IV and I allergic contact reactions. Table 2 given below summarizes ingredients, their effects on health and regulation rules related to them in some countries.

### **Conclusion**

Cosmetics in word itself present the function they exhibit that is 'to embellish'. Several cosmetic products have been used in daily life by most of the population around the world without being aware of the side effects they could cause in long run. Adverse effects have been observed on the recurrence basis attributed with the use of such toxic chemicals in cosmetics. Even after several cases and supporting epidemiological data to ban of such products most of the countries and companies still don't follow them. Strict rules and regulations have been implied but the need for rigorous vigilance could be still felt.

### **Conflict of Interest**

The authors have no conflict of interest.

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**Table 1: Most Common Toxic Chemicals Found in Daily Care Products and Cosmetics**

<b>Chemicals reported in Cosmetics</b>	<b>Products</b>	<b>Purpose</b>	<b>Concerns</b>	<b>References</b>
(BHA) Butylatedhydroxy anisole and (BHT) butylatedhydroxytoluene	eye makeups, lipstick	antioxidant, preservative, fragrance ingredient stabilizer	hormone disruption, skin irritation and human carcinogen	[Niel, 2014; Schrader and Cooke, 2008]
DEA (Diethanolamine)	variety of hair products and face makeup	foaming agent, pH adjuster	possible organ system toxicity, skin irritation, contamination concerns	[Zhang, 2008]
Phthalates	hair sprays, nail polish, lotions, perfumes, soaps, shampoos, iaper, sanitary napkins and tampons	solvent, plasticizer, fragrance ingredient	damage of male and female reproductive system and cause cancer	[Stahlhut, 2007; Bridges , 2002]

Formaldehyde	eyelash glue, nail products, hair-smoothing and straightening products, hair gel, color cosmetics, baby shampoo, body soap	preservative	skin irritations, rashes, carcinogenic impurity, high rates of skin allergy reactions	[Beane et al., 2009; Maneli et al., 2014; Pierce et al., 2011]
Chemicals in perfumes (Benzaldehyde, Benzyl acetate, Styrene, Ethyl acetate, etc )	most personal skincare products, mainly perfumes and cologne for desired fragrances	Used as perfumes	allergic responses, irritation in eyes, reproductive cancers, skin irritation, nausea, disrupt hormones	[Survey Cycle 1 (2007–2009), Ottawa, 2010; Anderson and Anderson, 1998]
PEGs (cetrarate or polyethylene glycol)	makeup products and a variety of skin-care	Cleaning agents and conditioning	contamination concerns and carcinogenic in nature	[Bridges, 2002]
Parabens ( isopropyl-, propyl-, isobutyl-, butyl-parabens)	moisturizers, makeup, conditioners, lotions, shampoos, shaving and facial products, shower cleansers.	preservative	hormone-disrupters	[Darbre et al., 2004; Charles and Darbre, 2014]
Sodium lauryl sulfate and sodium laureth sulfate	shampoo, handsoap, toothpaste.	emulsifying agent and cleansing	skin irritation, contamination in nature leading to biomagnification	[Bondi et al., 2015]
Synthetic colors	all product types especially in hair colors	dyes	Carcinogenic, irritating for eyes and skin, can even cause blindness	[Shafer and Shafer, 1976; Rollison et al., 2006]
Siloxane	deodorants, hair products	Moisturizing, smoothing, softening.	Hormone imbalance	[Xu et al., 2015]
Triclosan	shaving products,	antimicrobial agent	bacterial resistance	

	oral products, creams, and color cosmetics		development, disrupt thyroid and reproductive hormones	[Calafat et al., 2003; Ahn et al., 2008]
Dioxin and its derivatives		Bleaching agent	Carcinogenic, can alter metabolism, affects fetal development	[Langseth and Kjaerheim, 2004; Woo, 2019]
Fluorine and its derivatives	Toothpaste	Whitening agent	Neurotoxin and decrease bone density and leads to discoloration	[Kanduti et al., 2016]

**Table 2: Ingredients/ Contaminants with Their Side Effects**

<b>Ingredient/ Contaminant</b>	<b>Health Concerns</b>	<b>Countries Or Intergovernmental Organizations With Bans Or Restrictions In Personal Care Products</b>	<b>Status of Bans Or Restrictions</b>	<b>Source in cosmetics</b>	<b>References</b>
Pfas (Per-And Polyfluor oalkyl Substance s)	harmful for developing fetus, carcinogenic, affect the immune system and disrupt hormones	Eu Restricts Manufacturing And Sale Of One Pfas, Perfluorooctanoic Acid (Pfoa), Under The Reach Law, By 2020	No Retail Restrictions	Found In Sunscreen, Foundation, Concealer, Eyeliner, Shaving Cream And Hairspray.	[Brinch, 2018; Schultes et al., 2018]
Lead And Related Compounds	affects brain development in children and cause permanent nervous system damage, harms organ systems (cardiovascular system)	Eu, Asean and Canada has recommended max Level Of Contamination to be 10 Ppm	No Retail Restrictions	Lipsticks,lotions	[Piccinini et al., 2013; Ziarati et al., 2013]
Asbestos	carcinogenic and can cause lung	Eu and Asean has banned Asbestos	No Retail Restrictions.	Found in Talcum	[Graham and

	diseases if inhaled	(Blue Asbestos, Or Crocidolite		Powder And Talc Products.	Graham, 1976; Acheson et al., 1982; Newhouse et al., 1982]
Triclosan	affects the thyroid and reproductive hormones	Restricted in Eu, Asean, Canada, Japan, Australia, U.S. Fda	Ban For Store Brand Products ex Cvs, Rite Aid, Walgreens, Whole Foods	Is An Antimicrobial Compound Used In Deodorants, Mouthwash, Hand Sanitizer, Shaving Cream And Toothpaste	[Zorrilla et al., 2009]
Toluene	toxic to the brain and the nervous system; harms the developing fetus	Restricted by Eu and Asean	Ban For Store Brand Products ex Cvs, Rite Aid, Walgreens, Whole Foods	Used In Nail Polish, Nail Treatments And Hair Dye.	[Silvia et al., 2014]
Carbon Black	carcinogenic to humans	Restricted in Eu, Asean, U.S. Fda	No Retail Restrictions	Pigment Used In Eyeliner, Mascara, And Lipstick	[Willhite et al., 1988]
Parabens (Butylparaben, Propylparaben, Isopropylparaben)	endocrine disruptor that can harm male reproductive system development	Restricted in Eu, Asean, Japan	Ban For Store Brand Products ex Cvs, Rite Aid, Walgreens, Whole Foods	As preservatives in all kind of products	[Darbre, 2009]
Dibutyl Phthalate and Diethylhe	is an endocrine disruptor and a developmental toxicant harmful	Banned in Eu, Asean, Australia	Ban For Store Brand Products ex Cvs, Rite Aid, Walgreens,	Used As A Solvent And Fixative In Perfumes,	[Barlow et al., 2004]

<p>xyl Phthalate</p>	<p>for male reproductive system development. it can cause early puberty in boys and other changes in the reproductive system.</p>		<p>Whole Foods</p>	<p>And As A Plasticizer In Nail Polish</p>	
<p>Formaldehyde and Formaldehyde Releasers</p>	<p>formaldehyde is carcinogenic; it also causes allergic reactions and irritates the eyes and respiratory system.</p>	<p>Banned in Japan Eu, Asean, Canada, Australia</p>	<p>Ban For Store Brand Products ex Cvs, Rite Aid, Walgreens, Whole Foods</p>	<p>Used as Hair Straightener, Nail Hardener And Preservative</p>	<p>[Beane et al., 2009; Maneli et al., 2014]</p>