

# A review of toxic chemicals in cosmetics that harms the environment and mankind

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## ABSTRACT:

Humans have used cosmetics since ancient times, but advances in the cosmeceutical industry have led to the development of cosmetic products that are pollutants for the environment and toxic for humans. This review is an attempt to highlight the cosmeceutical ingredients and the impact they have had on the environment and humans. The use of preservatives, UV filters, skin lightening agents, and heavy metals in cosmetics is specifically emphasised. Further in the review, a sustainable perspective for the cosmetics is taken into consideration. The natural and sustainable development of cosmetics is discussed. This review aims to provide a summary of cosmetic pollution and its alternative solutions

**Index Terms:** cosmetic pollution, plastic microbeads, sustainable cosmetics, toxic chemicals, health and environmental impact of cosmetics

## INTRODUCTION :

Cosmetic pollution can occur at various stages in the lifecycle of these products. During production, the manufacturing process may generate wastewater or air emissions that contain toxic substances. When consumers use these products, the chemicals can enter the environment through various pathways, such as washing down the drain or being absorbed into the skin and later released into the environment. Finally, when these products are disposed of, they can accumulate in landfills or water bodies, contributing to long-term pollution.

The impacts of cosmetic pollution can be significant. For example, chemicals such as microplastics, parabens, and phthalates have been found in water bodies and can harm aquatic life. These chemicals can also accumulate in the food chain, potentially affecting human health. Additionally, the use of cosmetics can contribute to air pollution, which can exacerbate respiratory and other health problems.

Overall, cosmetic pollution is an important issue that requires greater attention from both consumers and manufacturers to reduce the environmental and human health impacts of these products.

Studying cosmetic pollution is important for several reasons. First, the widespread use of cosmetics and personal care products has led to the release of a large number of chemicals into the environment. These chemicals can have negative impacts on ecosystems, wildlife, and human health. By studying cosmetic pollution, researchers can better understand the extent and severity of the problem, and develop strategies to mitigate its impacts.

Second, the cosmetics industry is a large and growing market, with an increasing number of products being developed and marketed globally. Understanding the environmental and health impacts of these products is crucial for ensuring sustainable production and consumption practices.

Third, cosmetic pollution is a complex issue that requires a multidisciplinary approach to address. Researchers from a range of fields, including environmental science, chemistry, toxicology, and public health, are needed to understand the various pathways through which cosmetic pollution occurs and to develop effective solutions to minimize its impacts.

Finally, addressing cosmetic pollution requires a coordinated effort from multiple stakeholders, including government agencies, industry, and consumers. By studying cosmetic pollution, researchers can inform policies and regulations that promote sustainable production and consumption practices, and help raise awareness among consumers about the environmental and health impacts of their personal care choices.

### **METHODOLOGY:**

A literature search was conducted. The research was carried out on electronic databases such as PubMed and google scholar. The results included 25 references which were research studies, news reports and cosmetics committee reports.

### **RESULT & DISCUSSION:**

#### **Heavy metals**

Heavy metals are used in cosmetics for various cosmetic products as colourants and pigments. Thiomersal is widely used in the manufacture of mascara. In 2008, Minnesota in the United States became the first state to ban the intentional use of mercury in cosmetics.<sup>7</sup> The result of a study showed that the range of Pb levels for lipsticks is higher in concentration than that for local eyeliners. Comparative amounts of Pb were found in the local eyeliners and pencils. The World Health Organization review on mercury in skin-lightening products revealed that mercury is a common ingredient found in skin-lightening soaps and creams as well as other cosmetics such as eye makeup, cleaning products and mascara. The study investigated the levels of heavy metals, including lead, cadmium, arsenic, and mercury, in hair samples of children in Riyadh, Saudi Arabia. The researchers found that certain cosmetics, such as kohl and henna, contributed to the presence of these heavy metals in the hair samples. In a study, various cosmetic products, including lipsticks, eyeliners, and face powders, were analyzed for the presence of heavy metals. The researchers detected lead, cadmium, arsenic, and other metals in some of the tested cosmetics, emphasizing the importance of monitoring and regulating heavy metal concentrations in these products<sup>24</sup>. Another study investigated the presence of heavy metals, phthalates, and bisphenol A in various cosmetic products available on the Korean market. The researchers found that some cosmetics contained lead, arsenic, mercury, and other heavy metals, highlighting the potential exposure of consumers to these contaminants.

#### **Parabens**

Parabens are the preservatives added to cosmetics. They have a broad spectrum of activity against various yeast moulds and bacteria. Although many regulatory authorities in Europe and other such countries have imposed stricter regulations regarding the use of parabens as preservatives in cosmetics they are still in extensive usage in the cosmetic industry. Among the list of parabens, propylparaben and methylparaben are the most frequently identified paraben compounds in surface waters due to their frequent utilization in cosmetics. Parabens undergo biodegradation to produce chlorinated by-products.<sup>4</sup>

#### **Microplastics**

Microplastics are used in cosmetics for scrubbing, exfoliation or simply as a means of visual aesthetic pleasing purpose. Various abrasive products utilize microplastics such as toothpaste, cleansers, and body and face scrubbers causing the removal of dead skin cells. A study reported that 93% of the microplastics used in cosmetics are for decorative purposes.

#### **UV filters**

Uv filters protect the skin from the damage caused due UV rays. 20% of sunscreen products have UV filters in them. These Uv filters are of two types they are organic and inorganic. They undergo photolysis to generate reactive oxygen species. Currently, the most commonly detected organic filters in sediment are octocrylene (OC), Ethylhexyl methoxycinnamate (EHMC), octyl dimethyl-p-aminobenzoic acid (OD-PABA), butyl methoxydibenzoylmethane (BMDM), and benzophenone derivatives.<sup>4</sup> The inorganic filters used are zinc oxide and titanium oxide.

#### **Triclosan**

Triclosan is a lipid-soluble antimicrobial used not only in cosmetics but different types of packaged products. Triclosan and triclocarban are commonly used antimicrobial agents found in antibacterial soaps and detergents,

Tooth paste and tooth whitening products, antiperspirants, deodorants, shaving products, creams, and colour cosmetics.<sup>14</sup>

### **Hydroquinone**

Hydroquinone is a bleaching agent. The popularity and use of hydroquinone as a skin-lightening agent have been on the rise. Various surveys and studies have been conducted in a wide range of geographical locations such as Kampala and Korea to investigate the use of hydroquinone as a skin-lightening agent.<sup>26</sup>

### **1,4-dioxane**

It's an organic compound that works as an emulsifier in cosmeceutical products. 1,4-dioxane is used to give fine texture to foaming products shampoos, shaving creams and body washes.<sup>14</sup>

### **Impact the on Health and Environment**

A survey conducted in Nigeria investigated the effects of chronic use of skin-lightening creams. It was reported over the period third of respondents experienced yellowing of skin while other respondents reported thinning of the skin, stretch marks and rashes. Amongst them, a major part of the respondents reported worsening of the existing conditions.<sup>7</sup>

A study conducted in Dhaka Bangladesh reported that the heavy metals used in skin fairness creams such as cadmium, chromium, lead and mercury were exceeding the limits of the regulation<sup>1</sup>

Heavy metals get easily absorbed by dermal and mucosal exposure as well as through inhalation. Heavy metals are carcinogenic, however not in trace amounts. Chronic deposition of heavy metals causes their accumulation in the body beyond the permissible amount.

Heavy metals used in eyeshadows and mascara can bind to retinal epithelium over long-term exposure.

UV filters which form 20% of sunscreen products are the emerging pollutants. The recommended application of sunscreens while on beaches causes their wash-off during recreational activities, which adds to marine pollution. Organic UV filters undergo photodegradation later on and generate reactive oxygen species. The by-products of this degradation have estrogenic activity and it disrupts the sexual outcome of marine fishes. On the other end the inorganic UV filters accumulate and generate hydrogen peroxide. Hydrogen peroxide has a bleaching effect on coral reefs and human skin<sup>4</sup> There were traces of organic UV filters detected in human breast milk samples in 75% of the cases demonstrating that it has significant exposure to suckling neonate.

Parabens used as preservatives are linked to endocrine-disrupting activity, and carcinogenic activity however currently there is no scientific evidence supporting it. Although various in-vitro studies show that paraben stimulates the epidermal growth factor responsible for carcinoma. The authors of a study indicated that there has been a substantial increase in the amount of paraben in water resources which clearly shows that the use of paraben has increased over the years, even though waste treatment plants are efficient in treating paraben.

Plastic microbeads used in cosmetics are insoluble in water as well as non-biodegradable. It has been observed that microplastics easily escape the sewage treatment. They are smaller and thus cannot be trapped.

These plastic microbeads further add to the plastic landfills. Plastic microbeads are made up of low-density and high-density plastic the former remains in the marine sediment and the latter floats on water as there is no effective method of removing it from the environment completely, there are reports on consumption of these by aquatic animals.<sup>12</sup>

Owing to its broad spectrum activity it is widely used in cosmetics. Although studies indicate it to be amongst the topmost emerging pollutants. A study conducted in Japan stated that rivers of that region contain triclosan in

nanograms per litre. While chlorinated water in swimming pools converts it into its yet more toxic chlorinated derivative. Triclosan has high lipophilicity and due to this bioaccumulation in algae and other aquatic animals. Exposure to TCS can produce negative effects on human health, including thyroid function impairment, endocrine disruption, oxidative stress, and liver carcinogenesis <sup>12</sup>

There is elevated usage of skin-lightening creams in the last decade and most of them contain hydroquinone as their active ingredient. Hydroquinone has varied side effects depending on the sensitivity of the skin and the term of exposure. Yellowing and discolouration of the skin have been reported. <sup>7</sup> Hydroquinone is toxic to animals as it retards their growth and causes irreversible oxidative damage.

It is employed in most cosmeceutical foaming products. Reports are stating that overexposure to this particular molecule causes genotoxicity and various types of cancers. In a study, it has been found that mice exposed to 1,4-dioxane-containing water developed skin cell carcinoma and hepatocellular carcinoma. <sup>4</sup>

### **Recommendation- A sustainable perspective**

In the above discussion, the use and harmfulness of cosmetic ingredients have been emphasized. However, the fact that the cosmetic industry is growing and expanding implies that the burden of environmental and human toxicity will be ever-increasing. The development of sustainable cosmetic products can pave a pathway for the future cosmetic industry and cosmeceutical researchers.

Sustainable cosmetics prioritize the use of natural and organic ingredients that are responsibly sourced, ensuring minimal harm to ecosystems and promoting biodiversity. They also focus on using renewable resources and reducing the consumption of non renewable materials. In addition, sustainable cosmetics emphasize eco-friendly packaging, such as recyclable or biodegradable materials, to minimize waste and reduce pollution.

Furthermore, sustainable cosmetics promote ethical practices throughout the supply chain, including fair trade, cruelty free testing, and responsible manufacturing processes. They prioritize transparency and Consumer education, providing clear information about ingredients, sourcing, and manufacturing practices. The adoption of sustainable cosmetics supports a more Conscious and responsible approach to personal care, aligning with the principles of environmental conservation and social well-being. By choosing sustainable cosmetics, consumers contribute to the preservation of natural resources, reduction of waste, and support for ethical and socially responsible initiatives within the beauty industry

Sustainable cosmetic products are derived from natural ingredients and the life-cycle of such a product is environment friendly. The raw material is extracted from natural resources and then transformed into a product that is well tolerated by humans.

Owing to the wide variety of natural cosmetic products available in tropical Asian countries such as India, Shri Lanka and Vietnam researchers can work on quality control parameters of this material to develop a sustainable yet a reliable quality product

S. Bom. et al, stated various natural plants, their extracts with their cosmeceutical use. Authors have looked into each category of cosmeceutical and suggested their natural alternative. The multifunctional capabilities of these natural products add more benefits to the consumer for example, rice and walnuts should be used for exfoliation instead of plastic microbeads. There are various ingredients as carrot seed oil that can be used to prevent sun damage instead of UV filters.<sup>2</sup>

However, the efficiency and sustainability of these natural ingredients are to be assessed so

As to develop a product that is sustainable throughout its lifecycle.

Considering the shift towards green consumerism and a sustainable lifestyle, sustainable cosmetics could play a pivotal role in this era. Sustainable cosmetics can reduce cosmetic environmental pollution.

In a study conducted on Sri Lankan herbal cosmetic ingredients by Dehel Gamage Nadeeshani Dilhara Gamage. et al, it was found that herbal cosmetics have quite a potential of serving the purpose of varied cosmeceutical requirements. The authors have also explained the growing demand for herbal cosmetics in Western countries.<sup>13</sup>

## CONCLUSION:

As the cosmetic industry is growing and so is the need for looking into damage caused due to it. Consumers as well as the environment are at high risk of increasing cosmetic pollution. Analytical studies should be carried out to assess the pollutants levels in the natural water bodies and sediments. Systematic surveys should be carried out to understand the usage and level of exposure to cosmeceuticals. There should be mandatory adherence to the restriction level imposed by regulatory authorities concerning the use of heavy metals and preservatives. Simultaneously, alternative research should be carried out to work on the quality, efficiency and sustainability parameters of naturally occurring cosmeceutical ingredients. Sustainable cosmetics have the potential to benefit consumers, industries and the environment. It also has enormous scope for cosmeceutical formulation scientists for developing and analysing sustainable cosmetic

Mrs Sakina Yusuf Punjab ethnically

## Author's Biography-

Mrs. Sakina Punjab, an extraordinary Indian cosmetic maven whose passion for beauty and cosmetics transcends boundaries. Clad in her enchanting lab coat, she dances amidst test tubes and formulas, infusing her creations with love and a touch of magic. But there's more to her than meets the eye.

Mrs. Punjab is not just any cosmetic enthusiast; she is an ardent environmentalist. With an unwavering commitment to preserving our planet, she tirelessly seeks out beauty products that leave the lightest footprint on Mother Earth. It is this burning desire that led her to embark on a remarkable journey as a PhD student at European international university- Paris. Driven by her unyielding passion, Mrs. Punjab has become a beacon of inspiration for aspiring cosmetologists all across India. Through the magnificent Abyss Institute of Cosmetic Science, a sanctuary of innovation and artistry, she nurtures and empowers future generations of cosmetic connoisseurs. Her love for the field knows no bounds.

Within these pages, Mrs. Punjab passionately speaks about a pressing issue: the relentless march of cosmetic pollution. She urges us all to listen, for the clock is ticking. Let us heed her wise words and embrace a more sustainable and mindful approach to beauty. Together, we can make a world of difference

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