

Pretty Poison: Carcinogenic Chemicals Hiding in Cosmetics and Personal Care Products

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ABSTRACT

Cancer occurs due to the interaction between endogenous and exogenous factors. Endogenous causes of cancer include genetic abnormalities and hormones imbalance. Exogenously, existing risk factors which include chemicals, exposure to radiation, poor dietary intake, as well as smoking, make it easier for tumours to form. Such factors contribute to cell proliferation and growth. Knowing how to prevent and detect cancer earlier is important in ensuring its successful management. With regards to the pathophysiology of cancer, various carcinogenic factors come into play. Particularly, factors such as smoking and radiation have the capacity to affect DNA, oxidize cells and induce cell changes leading to cancer. For aesthetic reasons, one can use various cosmetic and cosmeceutical products. These cosmetics include mascara, lipstick, eye shadow, foundation, nail polish and blush. However, for those who want to get long-lasting beauty effects, products referred to as cosmeceuticals can be used. This entails using creams and other products that enhance skin, hair and general appearance. In this review, certain components found in cosmetic products such as parabens, talcum powder and other chemicals that exhibit possible carcinogenic properties were discussed. These elements could play a role in the development of tumors through the harm they cause to DNA or hormone production. Cancer develops as a result of interactions between many factors, such as genetic factors, environmental issues, behavioral problems and hormones, all contributing to the formation of tumors. Not all these factors may be responsible for developing cancer; however, limiting oneself to being exposed to these factors may help, especially by adopting organic skincare. When choosing any skincare routine, it would be necessary to consider the adoption of organic products and to avoid any products containing carcinogenic ingredients.

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Introduction

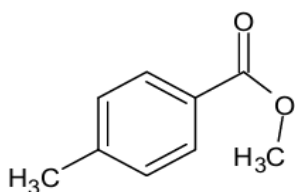
Cancer occurs due to the interaction between endogenous and exogenous factors. Endogenous causes of cancer include genetic abnormalities and hormones imbalance. Exogenously, existing risk factors which include chemicals, exposure to radiation, poor dietary intake, as well as smoking, make it easier for tumours to form. Such factors contribute to cell proliferation and growth. Knowing how to prevent and detect cancer earlier is important in ensuring its successful management [1,2]. With regards to the pathophysiology of cancer, various carcinogenic factors come into play. Particularly, factors such as smoking and radiation have the capacity to affect DNA, oxidize cells and induce cell changes leading to cancer [3,4].

Cosmetics

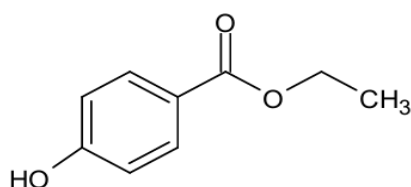
For aesthetic reasons, one can use various cosmetic and cosmeceutical products. These cosmetics include mascara, lipstick, eye shadow, foundation, nail polish and blush. However, for those who want to get long-lasting beauty effects, products referred to as cosmeceuticals can be used. This entails using creams and other products that enhance skin, hair and general appearance. In today's reality, people cannot imagine their life without applying different types of cosmetics and cosmeceuticals which sometimes include harmful elements. In this connection, the importance of the Campaign for Safe Cosmetics is related to providing information about such substances, promoting stricter regulations and encouraging manufacturers to develop safe and harmless items [5].

Parabens

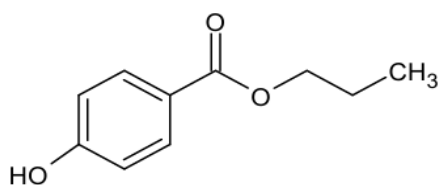
Parabens are used as preservatives in different kinds of products such as pharmaceutical items, cosmetics (foundations, eye makeup, perfumes) and personal care products (toothpaste, hair shampoo, conditioner, skin care creams). They are able to exhibit estrogenic activity, stimulate the proliferation of breast cancer cells that can cause the damage at molecular level. Industrially produced parabens (PBs) are alkyl esters of 4-hydroxybenzoic acid. This group of products is classified based on the alkyl group attached. Thus, they include methyl paraben, ethyl paraben, n-propyl paraben, n-butyl paraben, isopropyl paraben, isobutyl paraben, phenyl paraben, benzyl paraben and pentyl paraben [6].



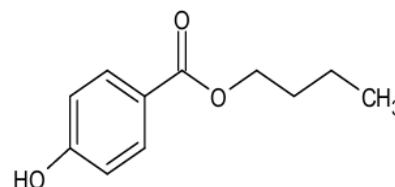
METHYL PARABEN



ETHYL PARABEN



PROPYL PARABEN



BUTYL PARABEN

The parabens are expected to have roles in the development of breast cancer through different pathways. The parabens are expected to cause damage to the DNA, which will lead to genetic mutations, leading to cancer formation. They can act as estrogens, which regulate cell proliferation. Parabens may boost the capability of cancer cells to move and invade other tissues, promoting metastasis. Research has shown that parabens can build up in breast tissue, especially in areas surrounding tumours, indicating a localised effect on cancer advancement. Since parabens are not entirely metabolised in the body, they can accumulate in tissues, including breast tissue. This accumulation of non-metabolised parabens raises alarms about their possible involvement in cancer-promoting activity [7].

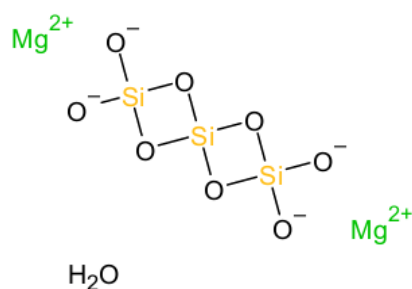
Pregnant and nursing women are exposed to parabens in stretch mark creams since these products are applied several times a day and frequently used for five to seven months. The presence of parabens has been identified in various biological samples, including breast tissue, breast milk, placental tissue, serum, seminal fluid and urine. The parent compounds of parabens, butyl paraben (BuP) and isobutyl paraben (Soup), have been found to stimulate the proliferation of estrogenic-dependent breast cancer cells via ER α signalling [8,9].

Talc

A chemical alternative term for talc powder is magnesium silicate hydroxide ($Mg_3Si_4O_{10}(OH)_2$), which refers to its mineral structure. Talc is frequently utilised in cosmetic items, such as baby powder, body and shower products, lotions, feminine hygiene items, eyeshadow, foundation, lipstick, deodorants and face masks. It is often contaminated with asbestos and there is a potential connection to ovarian cancer when it is present in personal care products. Recent studies suggest that perineal exposure to talc in personal care products may be linked to a heightened risk of ovarian cancer. Evidence indicates that the inhaled amounts of



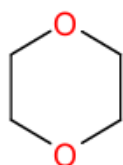
asbestos/talc found in cosmetics can lead to ovarian cancer [10-12].



Magnesium Silicate Hydrate

1,4-Dioxane

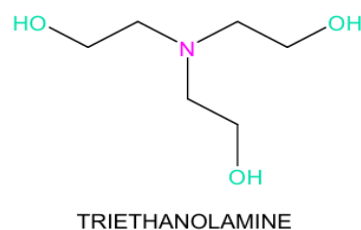
This substance is produced through ethoxylation, a process that utilises ethylene oxide. Ethylene oxide, recognised as a potential breast carcinogen, is incorporated into various chemicals to reduce their harshness. It is commonly found in shampoos, liquid soaps, dyes and bubble baths. Research shows that 1,4-dioxane can be easily absorbed into the skin. The liver and nasal cavity are identified as the main target organs for cancer when exposed orally. When the body's clearance mechanisms become overwhelmed, liver toxicity can be notably severe at elevated doses, resulting in degenerative alterations in liver tumours [13,14].



1,4-dioxane

Triethanolamine

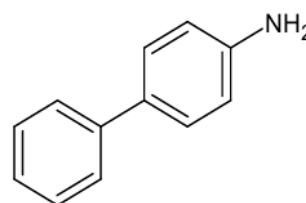
In a two-year skin exposure study, uncertain signs of cancer risk were noted in male B6C3F1 mice, as evidenced by the emergence of liver hemangiosarcoma. Furthermore, female B6C3F1 mice exhibited some indications of carcinogenicity, reflected in a higher occurrence of hepatocellular adenomas. Dermal exposure to triethanolamine led to a rise in the occurrences of eosinophilic liver foci in both male and female subjects [15].



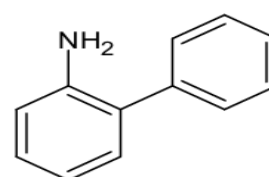
TRIETHANOLAMINE

p-Phenylenediamine - (Hair dye)

Aromatic amines found in hair dye products may be linked to an increased likelihood of developing bladder cancer. 4-aminobiphenyl (4-ABP) is an acknowledged carcinogen for the human urinary bladder and is found in commercial hair dyes. More research is needed on the skin penetration and bioavailability of 4-ABP associated with the use of hair dyes in order to determine its significance regarding the increased risk of bladder cancer associated with frequent use of hair dyes. The acetylation pathway through the skin contributes significantly to intermediary compounds like p-phenylenediamine and p-aminophenol. With aromatic amines being present in hair dyes, the discussion about the carcinogenicity of hair dyes in humans has centered around urothelial carcinoma. Increased risks have also been associated with cancers of the upper aerodigestive tract, lung cancer and colorectal adenocarcinoma. Furthermore, there is evidence that male hairdressers in the 1960s were at an increased risk for bladder cancer [16,17].



4-AMINOBIIPHENYL



2-AMINOBIPHRNYL

Table 1: Chemicals with their Carcinogenic Mechanism and Uses

Chemicals	Mechanism	Uses
Paraben [6-9]	Parabens imitate estradiol and stimulate the growth of breast cells. They interact with estrogenic receptors, promoting cell proliferation.	Shampoos and Conditioners: Particularly those with a high-water content. Moisturizers: Face and body lotions that necessitate preservation. Makeup: This includes products such as foundation, concealer and various cosmetics
Talc [10-12]	Talc can cause an inflammatory response, leading to secondary genotoxic effects and DNA damage. It may trigger carcinogenic processes via inflammatory or immune-mediated mechanisms, increasing markers of inflammation such as the tumour marker CA125.	Makeup Product Applications: Talc is commonly found in many makeup products, including Blush, Bronzer, Concealer, Eyeshadow, Foundation, Face powder, Lipstick and Mascara.
1,4-Dioxane [13,14]	This chemical exhibit cytotoxic effects and raises the occurrence of hepatocellular carcinoma in both genders.	It is primarily used in products that produce lather, including liquid soaps, shampoos and bubble baths. It contains foaming agents and ingredients with prefixes like PEG (polyethene glycol), as well as chemicals ending in 'xylol', 'oleth', and 'ceteareth'.
Triethanolamine (TEA) [15]	It has been shown to have complicated carcinogenicity in mice, especially when considered alongside other compounds. When placed in an acidic medium, TEA binds with sodium nitrite to produce mutagens. It acts as a stabilizer in several cosmetics, such as moisturizers, lotions, hair shampoos, soaps and makeup. TEA functions as an emulsifier, facilitating the blending of ingredients that typically do not mix well. It also acts as a pH adjuster, helping to regulate the acidity of cosmetic items.	TEA is commonly used in diverse products like eyeliner, mascara, eyeshadows, blushes, foundations, perfumes, hair products, hair dyes, waving treatments, shaving creams, sun blocks and cleaners.
4-aminophenyl and 2-aminophenyl [16,17]	The 4-aminophenyl and 2-aminophenyl groups have the ability to create DNA adducts at particular locations on DNA molecules. These DNA adducts are more likely to form at the hotspots of the TP53 genes.	In terms of cosmetic colour additives, these compounds were once found in D&C Yellow No. 1, a colour additive for drugs and cosmetics, but this usage was halted in the late 1970s.

Conclusion

Certain chemicals found in cosmetic products such as parabens, talcum powder exhibit possible carcinogenic properties. These elements could play a role in the development of tumors through the harm they cause to DNA or hormone production. Cancer develops as a result of interactions between many factors, such as genetic factors, environmental issues, behavioral problems and hormones, all contributing to the formation of tumors. Not all these factors may be responsible for developing cancer however, limiting oneself to being exposed to these factors may help, especially by adopting organic skincare. There is a need for further studies in terms of safety regulations. When choosing any skincare routine, it would be necessary to consider the adoption of organic products and to avoid any products containing carcinogenic ingredients.

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