



Endocrine disruptors and additives in cosmetic makeup products: Alert to users

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Abstract

Introduction: Cosmetic products contain a wide range of chemicals that we are exposed to daily. The aim of the study was to determine the presence of potentially hazardous substances that could cause adverse health effects by reviewing product labels facilitated by Capture images using Android phone.

Materials and methods: In total, 105 makeup products were collected in different stores in the city of Lubumbashi, mainly mascaras, nail polishes, powders, lipsticks, liquid and powder foundations, blush. eyeshadow and blush as well as eyelid pencils. Each product's label was reviewed and a list including additives, preservatives, colorings, Endocrine Disruptors and Allergens, and chemicals of concern was created.

Results: eyeshadows and blushes, foundations, and lipsticks contained the most additives and endocrine disruptors, followed by eyelid pencil and liquid foundation, nail polishes were the least supplied. This distribution seems to be the same for colorings and additives with allergic potential were numerous mainly in powders. In these makeup products; Mineral oils, parabens, black iron oxide, mica, titanium dioxide and synthetic perfumes were successively the most present. Added to this category are dyes (carbon black, brilliant red green, etc.) and additives with allergenic potential (limonene, citral, etc.)

Conclusions: The use of many of these substances is authorized within certain limits, due to their toxicity at higher concentrations. Other important aspects must be taken into account, such as the possibility of long-term effects. On the other hand, other substances can cause several acute undesirable side effects, namely contact dermatitis and allergic reactions. For these reasons, improvement in the criteria used for cosmetic formulation is necessary since many chemicals used individually or in combination are potentially dangerous.

Keywords: Additive effect; Cocktail effect; Beauty products; Health prevention

1. Introduction

Modern cosmetics include fixatives, colorants, preservatives such as parabens, formaldehyde, glutaraldehyde, aromatic amine derivatives, metal salts, UV filters, phthalates, solvents, fragrance ingredients and more again [1.]

Most manufacturers use chemical cocktails in their cosmetics and beauty products. Some of these products are toxic and can accumulate in our body over time with a risk of serious malignancies [2].

In general, three types of ingredients are included in the composition of cosmetic products: the excipients constitute the support for the active ingredients and allow their good distribution on the skin, the active ingredients give the product its properties and are partly responsible for its effectiveness, the additives enhance the product and aim to improve in particular its conservation (preservatives, antioxidants), its smell (fragrances) its color (dyes) [2] The latter (the color)

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is a real purchase trigger. Although there are several factors influencing a consumer's purchase, but largely conditioned by visual cues.

For indeed ; Certain substances such as: parabens (methyl paraben, propylparaben, butylparaben and ethylparaben), ethoxylated compounds (laureth-4, laurareth-7 or ethylene glycol polymers called PEG), formaldehyde donors (imidazolidinyl urea, quaternium 15 and DMDM hydantoin) , and ethanolamine, and their derivatives (triethanolamine and diazolidinyl urea), as well as carbon and silica have been identified as potential carcinogens [3].

Due to the sharp increase in cancer incidence and mortality, knowledge of carcinogens is currently the subject of numerous studies and articles[3].

Makeup products are used on a daily basis by many women, including those who are pregnant or planning to become pregnant. They are part of everyday consumer products that contribute to the exposure of the future mother and the unborn child to substances that can sometimes be problematic for health, such as potential endocrine disruptors[4].

To respond to this problem, the present study set itself the objectives of Identifying endocrine disruptors and harmful additives in makeup cosmetics; and assess the potential danger of their use by the population.

- Characterization of the danger of additives in makeup cosmetics;
- Determine the concentration of potentially toxic elements in makeup cosmetics;

2. Material and Methods

We carried out a cross-sectional descriptive study based on the identification and characterization of the danger of endocrine disruptors and additives in makeup cosmetics . Study carried out during the period from March to October 2023.

The study population consists of all makeup products sold in stores in Lubumbashi.

In this study we included:

- All stores that sell makeup products in the city of Lubumbashi,
- All makeup brands sold.

And we excluded

- All stores that do not sell makeup products in the city of Lubumbashi;
- All stores that sell makeup products in the city of Lubumbashi and whose managers refused to provide the information.

We used exhaustive sampling which consisted of listing all the brands of makeup products sold in stores in Lubumbashi. Around a hundred makeup brands were selected.

We used direct observation which consisted of identifying the brands of makeup products and we took the information found on the product labels. Capturing the images was made easier by the Android device.

Data collection was authorized via the research form. A letter was sent to the managers of stores that sell makeup products in the city of Lubumbashi. The anonymity of each manager was guaranteed.

During data collection we encountered the following difficulties:

- Refusal to access certain supermarkets/stores to carry out our research.
- The failure to identify additives on the labels of certain chips sold in the city.

The data collected will be processed and analyzed with Excel 2013 and Word software.

3. Results and discussion

Cosmetic products constitute an important range which exposes the body to the different substances they contain including endocrine disruptors, dyes, and other additives. It is appropriate to emphasize here that the main route of exposure is the skin. , but the main effect of exposure is endocrine disruption which may be accompanied by other allergenic processes or disruption of the local skin microflora... in this study we present the results of cosmetic products from the Lubumbashi market, while researching their possible effects on the health of the user population.

Our results are presented in the form of distribution tables of endocrine disruptors, additives according to the types of cosmetic products; whether they are powder, nail polish, powder or liquid foundation, eyelid pencil, rouge lip and eye shadow and blush.

Table 1 Distribution of additives and endocrine disruptors in cosmetic makeup products

S.N	Disruptors Endocrines and additives	Powder	Nail polish	Liquid Foundation	Eyelid Pencil	Lipstick	eye shadow and blush	Bottom Complexion	Total
1	Benzophenone		1						1
2	BHA and BHT			1	1	4	3		9
3	Parabens			14	23	11	17	13	78
4	Phenoxyethanol			4	12	2	5	7	30
5	Mineral oils			10	14	37	13	13	87
6	Quaternary ammoniums						1		1
7	Sulfates			4					4
8	Synthetic perfumes	8		5	6	6	2	3	30
9	Titanium dioxide		3	8	5	6	10	7	39
10	Cyclopentasiloxane			4					4
11	Zinc oxide	16		1					17
12	Tin Oxide						2	4	6
13	Black iron oxide		2	10	6	14	19	16	67
14	Mica	11	2		4	5	13	22	57
Total PE		35	8	61	71	85	85	85	429

It appears from this table that eye shadows and blushes, foundations, and lipsticks are richest in additives and endocrine disruptors, followed by eyelid pencil and liquid foundation, nail polishes were the least supplied with endocrine disruptors.

Among endocrine disruptors, mineral oils were most represented followed by parabens, iron oxide, mica, titanium dioxide, synthetic perfume and phenoxyethanol; benzophenone was the least present.

Indeed, mineral oils and waxes are mixtures of predominantly saturated hydrocarbons consisting of straight, branched and cyclic chain structures with carbon chain lengths greater than C14. They have been used for many decades in cosmetic skin and lip care products due to their excellent skin tolerance as well as their high protective and cleansing performance and their wide viscosity options and these oils have been used for a long time. in cosmetology and are non-allergenic because they are very stable and insensitive to oxidation or rancidity.[5]

Paraben derivatives present distinguished physicochemical properties which allow them to be compatible with the formulation of cosmetic agents in different dosage forms. In addition to their potency and effectiveness, parabens are

economically efficient because their manufacturing costs are low. Despite their desirable characteristics, the safety of using parabens is controversial after the detection of these chemicals in various biological tissues after repeated and long-term use of formulations containing them.[6] Parabens, which are considered allergologically safe biocides and classified as safe by the US Food and Drug Administration (FDA) and the Scientific Committee for Consumer Safety (SCCS) in Europe [7,8], are frequently present in cosmetics [6]. Despite extensive and increasingly widespread use worldwide, studies confirm that parabens are rarely responsible for allergic contact dermatitis to cosmetics, and that the frequency of sensitivity to parabens has been low and stable for many decades [9]. However, several studies have also demonstrated that the absorption of parabens through the skin occurs quickly and that there is an accumulation in the tissues. The results obtained through tests carried out *in vivo* and *in vitro* indicate that parabens have estrogenic activity, which can promote the proliferation of tumor cells sensitive to estrogen and involved in the occurrence of breast cancer. They are also responsible for a reduction in cell viability and a change in skin pigmentation, which can be the cause of the appearance of skin cancer[6][10].

Titanium dioxide (TiO₂) is a white powder widely used to decontaminate water and food, ensuring environmental and industrial safety, while also serving to protect the skin from harmful radiation [9, 11] due to high refractive index which reaches on average values of 2.7 in rutile and 2.5 in anatase [11].

Sunburn thus remains a known carcinogen for skin cells [12]. In this context, there is a high demand for stable photoactive chemicals called sunscreens [I], which protect skin cells from the harmful effects of ultraviolet radiation [13,14]. Titanium dioxide meets this need because it is an inorganic sunscreen, approved by the United States Food and Drug Administration [15]. The metal oxide scatters UV photons [16], thus functioning as a shield against harmful radiation [16-18]. However, the dual reactivity of titanium toward sunlight is problematic in the sunscreen industry, since absorption of light can activate the catalyst and lead to redox reactions between h⁺ + VB or e⁻ - CB and surrounding elements in sunscreen. Any structural change in the formulation matrix is undesirable due to its impact on the stability, safety and photoprotective function of the cream [18] and yet The stratum corneum cells reside in the upper layer of the skin, covering the entire human body. These cells represent an important pathway for absorption of nano-TiO₂ [19], which is incorporated into photoprotective medical makeup [20] and sunscreen formulations [16]. It has the ability to penetrate both the epidermis and the vascularized dermis and accumulate in organic tissues, leading to deleterious side effects [21,22]. Also, when applied to the skin, UV-illuminated titanium dioxide can easily come into contact with moisture in the atmosphere [23] and catalyzes the formation of reactive oxygen species from water and oxygen [24]. These include hydroxyl radicals and hydroxyl anions which act as a mutagen to dermal cells, causing DNA strand breaks and oxidative stress [25].

Phenoxyethanol, or 2-phenoxyethanol, has a broad spectrum of antimicrobial activity and has been widely used as a preservative in cosmetic products for decades. It is effective against various Gram-negative and Gram-positive bacteria, as well as yeast, and has only a weak inhibitory effect on resident skin flora[26].

Iron oxides protect the skin from environmental stressors, like pollution, UV rays and blue light emitted by screens! They act as a physical barrier to the skin, reflecting harmful rays and minimizing the damage they cause. And because of their abilities to absorb, scatter, and reflect visible light, topical products containing pigments and/or metal oxides can provide additional photoprotection. Sunscreens containing iron oxides are more effective than those which do not contain them thanks to these properties! Iron oxides are an excellent choice for cosmetic pigments, and foundation and concealer [27].

Among preservatives, parabens are considered a class of endocrine disruptors, including propylparaben and butylparaben. Many studies have observed that parabens are capable of chemically mimicking estrogenic activity, leading to adverse health effects [28]. Additionally, parabens may play a role in the development of human breast, ovarian, and testicular cancer [29]. For these reasons, many countries have banned the use of certain parabens in personal care products intended for newborns and children [30].

Mica, both natural and synthetic, is used in the cosmetic industry to give cosmetics a metallic, shiny appearance, and it gives shine to colored cosmetics. It is used as a pigment in varnishes. Mica is also used in products such as eyeliners, mascaras, lipsticks, lip glosses and eye shadows [31]. Pigment concentrations differ depending on the product, ranging from 1% (e.g., in liquid soap) up to 60% (in pressed powders) [32]. Daily use of mica in skin care products is not expected to cause harmful side effects, except in sensitive individuals, mica may cause irritation to the skin and eyes, causing itching and redness. Mica can, by inhalation, also cause irritation of the mucous membranes lining the lungs; thus leading to coughing, shortness of breath and wheezing [33, 34]. Natural mica, like other minerals, may contain heavy metals. In order to avoid dangerous trace minerals, many cosmetic companies have started using synthetic mica,

which is made of sheets of magnesium aluminum silicate bonded with potassium. It appears that synthetic mica has no negative impact on the skin; however, some dyes used to color the product may pose a health risk [35].

Table 2 Distribution of additives in cosmetic makeup products

S.N	Allergens	Powder	Nail polish	Liquid Foundation	Eyelid Pencil	Lipstick	eye shadow and blush	Bottom Complexion	Total
1	Limonene	2							2
2	Citronellol	6							6
3	Eugenol	4							4
4	Citral	6							6
5	Coumarin	7							7
6	butylphenyl-methylpropional	2							2
Total Allergens		27							27

This table shows that only the powders contained the additives, the most present of which were coumarin followed by citral and citronellol, then eugenols and finally limonene and butylphenyl-methylpropional.

Limonene and Citral are classified as skin sensitizer (H317), in accordance with the classification, labeling and packaging regulations. substances and mixtures (CLP) [36]. β -Citronellol is a monoterpene alcohol present in the essential oils of various species of aromatic plants. Inhalation of β -citronellol acts on the central nervous system of mice and increases anxiety-like behaviors. However, inhalation of β -citronellol did not affect activity, sensory function, or cognitive function. [37]. Eugenol is a natural compound widely found in many species of aromatic plants, spices and foods and is used in cosmetics and pharmaceuticals. Eugenol has a dual effect on oxidative stress, which can act as an antioxidant or pro-oxidant agent[38].

It is important to remember that mixtures of allergens have an increased power to sensitize and trigger contact allergies compared to an isolated allergen.[39]

Table 3 Distribution of Colorants in cosmetic makeup products

S.N	Dyes	Powder	Nail polish	Liquid Foundation	Eyelid Pencil	Lipstick	eye shadow and blush	Bottom Complexion	Total
1	Purple		1				5		6
2	Tartrazine		3			5	2		10
3	Red 7		1			3	1	2	7
4	Red		3		3	8	2	1	17
5	Carmine Red						3		3
6	Brilliant blue		1			2	7	1	11
7	Prussian Blue		1				5	1	7
8	Carbon Black				13		2		15
9	Green						4		4
10	Orange					3			3
11	Red 40						6		6
12	ULTRA MARINE						7	5	12
Total coloring			10		16	21	44	10	91

As for the dyes, red and carbon black were the most present followed by ultra marine, brilliant blue and tartrazine, then red 7, Prussian blue, red 40, violet and finally green, carmine red and Orange were less present.

These dyes were more present in eye shadow and blush, lipstick and quite present in eyelid pencils, foundations and nail polish. Colors are used to indicate many things. The most common reason for giving so many colors is to spoil the consumer with a choice of numerous shades to accompany their clothing. This idea is mainly promoted for the sale of nail polishes and lipsticks. Colors can also be used to complement the colors of the product packaging [40,41].

The most numerous coloring additives used in cosmetics are synthetic azo-type dyes. The metabolites of these dyes are suspected of causing toxic effects.[2] They are often absorbed into the oral cavity from cosmetic products used around the mouth, such as lipsticks. For many people, dyes can cause some type of negative reaction on the skin or body. This may manifest as sensitive skin, redness, itching, or irritation of the eyes.

4. Conclusion

Through the use of cosmetic products, most people around the world are exposed to various potentially harmful substances. Although present in low quantities, their effects after long and continuous exposure could lead to consequences on the health and well-being of the people and society. Added to this is a potential “cocktail effect” due to the use of combined products during the day. Because it has been shown that the average woman uses 12 different cosmetic products every day. Furthermore, the same substance may be present in several products and come from different sources (“additive effect”), in this way the established safety threshold could be exceeded.

It is necessary to improve the surveillance of cosmetic products, because there are chemicals whose use is not completely safe, but which is nevertheless authorized, so it would be appropriate to resort to the precautionary principle. Furthermore, it would be appropriate to strengthen cytotoxicity studies in order to evaluate the real safety of formulations in vitro and to favor alternative substances including natural or ecological cosmetics, without unnecessary preservatives or dyes compared to those potentially dangerous used for stability and attractiveness of products.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

We had the consent of store managers for authorization to take photos of cosmetic product instructions.

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