

Dr. Sedjelmaci Nesrine
Lecturer in Toxicology

TOXICOLOGY OF COSMETIC PRODUCTS

I. Definitions

- **Cosmetic:** from the Greek *kosmêtikos*, from *kosmos*, meaning beauty, order, ornament, adornment, and good appearance. Historically, it was used to describe the sky, beauty, and an army.
- **Cosmetic product:** “Any substance or preparation other than medicines intended to be in contact with various superficial parts of the human body such as the epidermis, hair system, nails, lips, eyelids, teeth, and mucous membranes for the purpose of cleaning, protecting, maintaining in good condition, altering appearance, perfuming, or correcting odor.”
- **Cosmetology:** multidisciplinary science combining the art of blending with skin biology. Historically, Egyptians (3000 BC) formulated pigments and beauty products. Currently, it is a constantly evolving industry with significant economic impact.

II. Classification

1. **By origin:**
 - Natural (plant, animal, environmental)
 - Synthetic (fine chemistry, biotechnology)
2. **By use:**
 - Hygiene: oral care, soaps, shampoos, deodorants, baby products
 - Care: creams, sunscreens, shaving creams
 - Beauty: makeup, hair gels, dyes, perfumes, nail polish
 - Well-being: essential oils
3. **By formulation:** emulsions, solutions, aerosols, powders
4. **By composition:**
 - Excipients >90% (water, oils, surfactants)
 - Adjuvants and active ingredients (effect sometimes hard to prove, e.g., anti-aging)
5. **By adjuvant type:**

Adjuvant	Examples
Surfactants	Palmitates, sulfates, quaternary ammonium, sorbitol
Preservatives	Parabens, quaternary ammonium
Thickeners / Gelling agents	NaCl, cellulose derivatives, diethanolamines, xanthan gum, carbopol
Colorants / Opacifiers	TiO ₂ , white pigments, CI colorants
Abrasives	Carbonates
pH adjusters	Lactic, phosphoric, tartaric, citric, malic, sorbic acids
Foam stabilizers	Diethanolamine, lecithins
Chelating agents	EDTA
Humectants	Glycerol, EG, PEG
Film-formers	Dimethicone, cellulose, polyquaternium
Bactericides	Quaternary ammonium
Tanning agents	Tannins
Fragrances	Linalool, citronellol

6. By toxic mechanism:

- Carcinogenic
- Allergic
- Endocrine disruptors
- Non-biodegradable

Examples:

- Parabens, aluminum salts, synthetic musks, BHT, BHA, colorants, EDG, formaldehyde
- Allergens: parabens, fragrances, essential oils
- Endocrine disruptors: parabens, UV filters, phthalates
- Non-biodegradable: silicones, EDTA, quats/polyquats, acrylates, VOCs

III. Issues with Cosmetic Products

- Deep action of certain compounds
- Gender-targeted marketing
- Misleading advertising
- Unregulated market
- Non-biodegradable waste production

IV. Toxicology of Components

1. Parabens:

- Synthesized from benzoic acid, widely used as preservatives since 1920 in food, pharma, and cosmetics.
- Replace formaldehyde.
- Moderate allergens, potential carcinogens, endocrine disruptors.
- Six types: methyl-, ethyl-, propyl-, isopropyl-, butyl-, isobutyl-paraben

2. Glycol ethers (EDG):

- Solvents and preservatives, amphiphilic, penetrate skin (human < rat), distribute in liver, kidneys, fat, excreted quickly.
- Toxic metabolites: acids, aldehydes → slow elimination.
- Risks: reprotoxic, hematotoxic, immunotoxic.
- Examples: phenoxyethanol ($\leq 1\%$), ethoxydiglycol ($\leq 1.5\%$), banned in oral hygiene.

3. Polyethylene glycols (PEG):

- PEG, PPG, (-eth) compounds.
- Emulsifiers/surfactants, increase skin permeability, may contain carcinogenic impurities.

4. Aluminum salts (chlorohydrates):

- Antiperspirants, astringent, block sweat pores
- Breast cancer and Alzheimer's risk

5. **UV filters (cinnamates, benzophenones):**

- Mineral: reflect UV light, nanoparticle variants penetrate skin
- Organic: absorb UV and convert to IR
- Some allergens or endocrine disruptors
- Max concentration: 10%

6. **Synthetic musks:** allergenic, bioaccumulative

7. **Colorants:** PPDA (bladder cancer risk)

8. **Formaldehyde releasers:** e.g., diazolidinyl urea

9. **BHT/BHA:** antioxidants, suspected carcinogens, high-dose liver/kidney/lung toxicity

10. **Phthalates:** DEP allowed, DEHP/DBP banned, reprotoxic

11. **EDTA:** chelator, preservative, antioxidant, poorly biodegradable

12. **Silicones/siloxanes:** non-toxic but environmentally persistent

13. **Triclosan:** antibacterial, may favor resistant bacteria

14. **Fragrances:** allergens

15. **Cocamide:** can form carcinogenic nitrosamines

16. **Petrolatum:** may contain carcinogens

17. **Laureth sulfate:** derived from 1,4-dioxane, carcinogenic

18. **Mercury, ethanol, methanol:** toxic

V.Regulation

- **Algeria:** Ministry of Commerce, decree 10-114, 2010
- **Europe:** 2009 regulation active since 2013, allergenic substances listed since 2005
- **Monitoring authorities:** FDA, GERDA, VIGIPIL, IRIS (AFSSAPS)
- **Gaps:** Asia, China, some products

VI.Evaluation

- Acute & chronic toxicity: in vivo (Draize tests) & in vitro (HETCAM, cell culture)
- Mutagenesis, carcinogenesis, reprotoxicity testing