

Cosmetics: the magic of micro-molecules

Abhay S. Bondge¹, Kalimoddin I. Momin², Sushil R. Mathapati³, J. K. Dawle^{4*}

¹Department of Chemistry, Shivneri Mahavidyalaya, Shirur Anantpal, Maharashtra, INDIA.

²Department of Chemistry, Rajshri Shahu Mahavidyalaya, Maharashtra, INDIA.

³Department of Chemistry, Shri Madhavrao Patil Mahavidyalaya, Murum, Maharashtra, INDIA.

⁴Department of Chemistry, Maharashtra Mahavidyalaya, Nilanga, Maharashtra, INDIA.

Email: amritkund_jk@rediffmail.com

Abstract

The concept of beauty and cosmetics is as old as mankind and civilization. Assorted beauty products such as skincare products, hair products, fragrances, oral hygiene, and nail products, which may contain toxic chemicals that can be harmful to health are used especially by women. Most cosmetic products contain hazardous chemicals like Sodium Laureth Sulphate, Talcum, Parabens, Coal tar dye, Phthalates, Fragrance, Mineral oil, Triethanolamine and some heavy metals eg, Lead, Arsenic, Nickel, Cadmium, and Mercury. The bioaccumulation of these harmful chemicals and metals in the body over time has been associated with cancer, reproductive and developmental disorders, contact dermatitis, hair loss, lung damage, ageing, skin disease and reaction, allergies, and damage of nails. The deleterious chemicals and metals can enter into the body by inhalation of perfumes, deodorant, nail polish, scented powder, etc; by absorption through penetration of harmful chemicals from body creams, moisturizers, cleanser, eye shadow, etc. It can also be by ingestion of chemicals and metals in lip sticks, lip balm, lip gloss, etc. through the mouth.

Key Words: Health, Implications, Hazards, Cosmetics, Chemicals.

*Address for Correspondence:

Dr. J. K. Dawle, Department of Chemistry, Maharashtra Mahavidyalaya, Nilanga, Maharashtra, INDIA.

Email: amritkund_jk@rediffmail.com

Access this article online	
Quick Response Code:	Website: www.statperson.com
	Accessed Date: 10 March 2018

INTRODUCTION

People have used personal care products containing chemicals for thousands of years to enhance beauty, as medicine, as scent and in religious ritual¹. Ancient Egyptian women painted their faces with grey galena mesdemet (lead sulphide) and malachite green (copper carbonate hydroxide) and used medicinal scented ointments from myrrh, lavender, peppermint and cedar. Ancient Romans used skin creams made of beeswax, olive oil, and rosewater, and lead-based formulae to whiten their skin. Cosmetic products contain varieties of different harmful or toxic chemicals capable of attacking the skin. Manufacturers of skincare products do not only use synthetic ingredients but also natural products, such

as Shea butter, Rose extract, and cane sugar which are sustainable, cheap and less harmful to the consumer⁴. Cosmetics, such as lipstick, hand lotion, eyeliner, toothpaste, blush, and antiperspirant, are products that millions of us use daily. Recently, numerous claims, largely from activist groups, contend that cosmetic products, in general, are not regulated stringently enough and contain ingredients that pose risks to human health. Cosmetics are the chemicals which help us to alter our appearance, make us look better, feel better and smell better. Cosmetics include the chemicals used to beautify the body by cleaning, coloring, softening or protecting the skin, hair, nails, legs or eyes. A large variety of these chemicals are available under various famous trade names, we shall be discussing the following cosmetics.

CREAMS

Creams are employed to cleanse and soften the skin which becomes dry on exposure to environmental conditions such as sun, wind, rain, pollution, dirt and smog. These are basically emulsion of various oils and waxes with water. They prevent the loss of water by evaporation and keep the skin moist. Most creams and lotions contain petroleum jelly and mineral oil, which form a protective film over the skin and a blend of perfume. The examples of some of these are given below:

1. Emollients are skin softeners. They contain petroleum jelly as a major ingredient.
2. Moisturizers keep the skin moist and soft by preventing the loss of water. They contain petroleum jelly and mineral oils.
3. Cleansing creams are used to remove dirt from the skin without making it dry. They contain paraffin, mineral oils and water as the main ingredients.
4. Vanishing creams are the creams which disappear when rubbed on the skin. They contain emulsion of stearic acid in water and glycerin as the main component and are in general used as a facial and hand cream
5. Sunburn lotions and creams are used to protect the skin from sunburn in summer. These contain linseed oil, olive oil, p-N, N-dimethylaminobenzoic acid and glyceryl mono-p-amino benzoate.
6. Bleach creams are used to alter the normal appearance of the skin. They contain a bleaching agent and oxidizing agent.

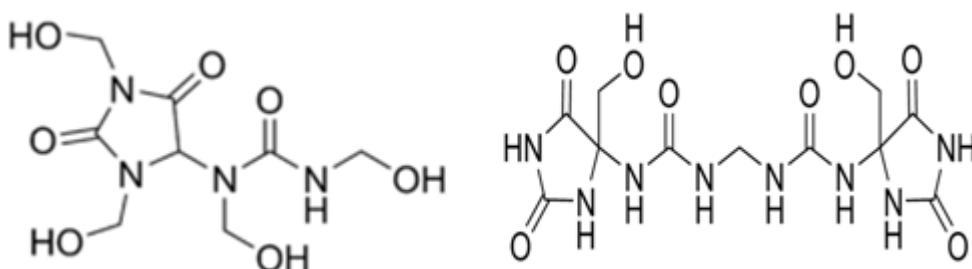


Figure 1: Daizolidinyl Urea Imidazolidinyl Urea

Talcum Powders: Face powder is generally used to complement skin colour and gives a satiny (like satin- a fabric with glossy surface) texture to the skin. Basically they contain the substances which help in giving a good covering to skin, impart a smooth feeling and are capable of absorbing secretions. A face powder and talcum powder has the following composition:

1. Talcum, powdered magnesium silicate $[(H_2Mg_3(SiO_3)_4)]$ which makes powder to go on smoothly.
2. Chalk, Calcium carbonate ($CaCO_3$), Magnesium carbonate and purified kaolin which are used to absorb water.
3. Zinc oxide, (ZnO) to give a good covering and
4. Zinc stearate, $(C_{17}H_{35}COO)_2 Zn$, magnesium stearate and colloidal clay which are used to make it adhere to the skin.
5. In addition to these components, powder may contain a perfume for fragrance and boric acid for antiseptic purposes

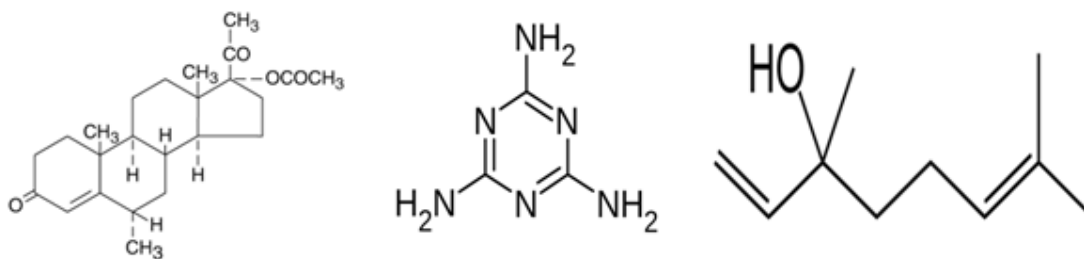


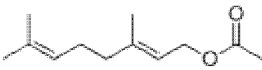
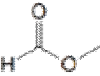

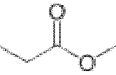
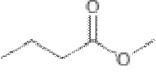
Figure 2: Provera Melamine Lavender

Perfumes: These are chemicals which make us to smell better by masking the body odours and providing a pleasant smell. They contain

1. Odourous compound
2. Solvent, and
3. A fixative

Odourous compounds provide a particular odour. They may be used as a single component or mixture two or more for having a desired effect. They are either derived from natural sources or are prepared synthetically. Some compounds and the odour they produce are given below:

Table 3:

Compound's name	Fragrance	Chemical structure
Geranyl acetate	Fruity, Rose	
Methyl formate	Ethereal	
Methyl acetate	Sweet, nail polish Solvent	
Methyl propionate Methyl propanoate	Sweet, fruity, rum-like	
Methyl butyrate Methyl	Fruity, Apple Pineapple	

butanoate

Fixative is added to perfume solutions in order to obviate the difficulty of a series impressions of odor in the perfume because of different volatilities in the notes of the perfume, fixatives are substances of high boiling points and it will retard the rate of evaporation of the fragrances materials in the perfume, the fixatives give the perfume long time of lasting. There are different types of fixatives used in the formulation of perfumes such as; essential oils, animal secretions, synthetic chemicals and resinous materials. Some commonly used fixatives are given in the following table:

Table 4:

Nature of fixative	Example
Essential oil fixatives	Sandal Wood
Animal Fixatives	Castor, musk, ambergris
Resinous Fixatives	Benzoin, terpenoids sextracts from resin
Synthetic Fixatives	Coumarin, indole, amyl benzoate, cinnamic acid ester, acetophenone, vanillin, glyceryl diacetate

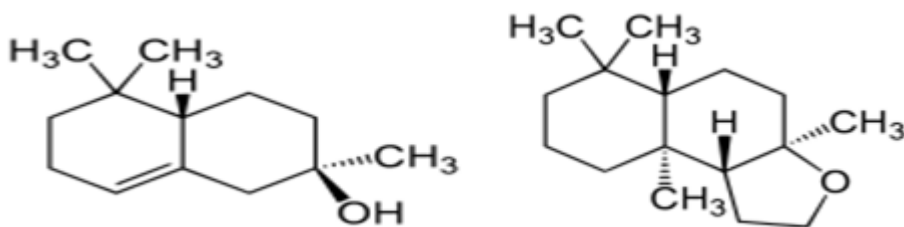


Figure 5: Ambroxan Ambrinol

Deodorants: A person's individual odour is genetically determined and can also be affected by food or medication. Although sweating plays an important role, the classic association of sweat and body odour is only part of the explanation. It is true that unwanted body odour occurs mainly in the axilla (underarm) area and the feet but odour is only indirectly caused by secreted sweat. It is actually caused by bacteria living on the skin which find ideal conditions for growth in the warm areas of the body that tend to stay moist. They metabolise certain compounds found in sweat, leading to the occurrence of unwanted body odour. Quantities of sweat can be reduced by using what are known as antiperspirants. In most cases these are metallic salts based on aluminium, zinc or

manganese. The most frequently used antiperspirants are aluminium salts such as aluminium hydroxychloride, aluminium bromhydrate or aluminium sulphate. Inhibition of body odour-causing bacteria is another important strategy for deodorisation. By inhibiting or deactivating odour producing bacteria, there is no or only slight metabolism of sweat components thus preventing/reducing the occurrence of body odour. The microorganisms present in the underarm area include Gram-positive bacteria of the *Corynebacterium*, *Streptococcus*, *Propionibacterium* and *Micrococcus* genera as well as yeast of the *Malassezia* genus. Bacteria responsible for production of body odour are corynebacteria, streptococci and propionibacteria. A

complete sterilisation of skin however should be avoided, as normal skin flora provides protection against bacterial

infection caused by foreign pathogenic bacteria.



Figure 6: Sodium Stearate Stearyl alcohol

Hazardous Chemicals in Cosmetics

1. **BHA and BHT:** Used mainly in moisturizers and makeup as preservatives. Suspected endocrine disruptors and may cause cancer (BHA). Harmful to fish and other wildlife.
2. **Coal tar dyes: p-phenylenediamine and colours listed as "CI" followed by a five digit number:** In addition to coal tar dyes, natural and inorganic pigments used in cosmetics are also assigned Colour Index numbers (in the 75000 and 77000 series, respectively). Look for p-phenylenediamine hair dyes and in other products colours listed as "CI" followed by five digits. The U.S. colour name may also be listed (e.g. "FDandC Blue No. 1" or "Blue 1"). Potential to cause cancer and may be contaminated with heavy metals toxic to the brain.
3. **DEA (diethanolamine) MEA (monoethanolamine) TEA (triethanolamine):** Used in creamy and foaming products, such as moisturizers and shampoos. Can react to form nitrosamines, which may cause cancer. Harmful to fish and other wildlife. Look also for related chemicals MEA and TEA. These chemicals can also cause mild to moderate skin and eye irritation. Cocamide DEA is known as hazardous to the environment because of its acute toxicity to aquatic organisms and can bioaccumulate²⁵.
4. **Formaldehyde-releasing preservatives:** Look for DMDM hydantoin, diazolidinyl urea, imidazolidinyl urea, methenamine and quarternium-15. Used in a variety of cosmetics. Slowly release small amounts of formaldehyde, which causes cancer.
5. **Parabens:** Used in a variety of cosmetics as preservatives. Suspected endocrine disruptors and may interfere with male reproductive functions. Parabens are the most commonly used preservative in cosmetics. An estimated 75 to 90 per cent of cosmetics contain parabens (typically at very low levels). Parabens easily penetrate the skin and are suspected of interfering with hormone function (endocrine disruption). They can mimic oestrogens, the primary female sex hormone. They can as well interfere with male reproductive functions.
6. **PEG compounds:** Polyethyleneglycols (PEGs) are petroleum-based compounds that are widely used in creams as thickeners, solvents, softeners and moisture-carriers. Depending on the production processes, PEGs can be contaminated with measurable amounts of 1, 4-dioxane. According to the, 1, 4- dioxane has been suspected to be carcinogenic. It does not easily degrade and can remain in the environment long after it is rinsed down the shower drain. PEGs show some evidence of genotoxicity and if used on broken skin can cause irritation and systemic toxicity. (e.g., polyethylene glycol).
7. **Siloxanes:** Look for ingredients ending in "-siloxane" or "-methicone." Used in a variety of cosmetics to soften, smooth and moisten. Suspected endocrine disrupter and reproductive toxicant (cyclotetrasiloxane). Harmful to fish and other wildlife.
8. **Isopropyl Alcohol:** This is a solvent and denaturant (poisonous substance that changes another substance's natural qualities). Isopropyl alcohol is found in hair color rinses, body rubs, hand lotions, after-shave lotions, fragrances and many other cosmetics. This petroleum-derived substance is also used in antifreeze and as a solvent in shellac. According to A Consumer's Dictionary of Cosmetic Ingredients, inhalation or ingestion of the vapor may cause headaches, flushed skin, dizziness, mental depression, nausea, vomiting, narcosis and coma.
9. **Antibacterials:** Overuse of antibacterials can prevent them from effectively fighting disease-causing germs like E. coli and Salmonella enterica. Triclosan, widely used in soaps, toothpastes and deodorants, has been detected in breast milk, and one recent study found that it interferes with testosterone activity in cells. Numerous studies have found that washing with

regular soap and warm water is just as effective at killing germs.

10. **Mineral Oil:** Baby oil is 100% mineral oil. This derived substance, a commonly used petroleum ingredient, coats the skin just like plastic wrap covers any given vessel. The skin's natural immune barrier is disrupted as this plastic coating inhibits its ability to breathe and absorb (moisture and nutrition). Your skin's ability to release toxins is impeded by this "plastic wrap," which can promote acne and other disorders by slowing down normal cell development causing the skin to prematurely age. Petroleum distillates are possible human carcinogens. Look out for the terms "petroleum" or "liquid paraffin."
11. **Nanoparticles:** Tiny nanoparticles, which may penetrate the skin and damage brain cells, are appearing in an increasing number of cosmetics and sunscreens. Most problematic are zinc oxide and titanium dioxide nanoparticles, used in sunscreens to make them transparent. When possible, look for sunscreens containing particles of these ingredients larger than 100 nanometers. You'll most likely need to call companies to confirm sizes, but a few manufacturers have started advertising their lack of nanoparticle-sized ingredients on labels.
12. **Lead and Mercury:** Neurotoxic lead may appear in products as a naturally occurring contaminant of hydrated silica, one of the ingredients in toothpaste. Lead acetate is found in some brands of men's hair dye. Brain-damaging mercury, found in the preservative thimerosal, is used in some mascara and until recently, in many vaccinations.
13. **P-Phenylenediamine:** Commonly found in hair dyes, this chemical can damage the nervous system, cause lung irritation and cause severe allergic reactions. It is also listed as 1,4-Benzenediamine; p-Phenyldiamine and 4-Phenylenediamine.
14. **Talcum Powder:** TALC, is a carcinogenic. Inhaling talc and using it in the genital area, where its use is associated with increased risk of ovarian and lung cancer, are the primary ways this substance poses a carcinogenic hazard.
15. **Lanolin:** Itself is perfectly safe. But cosmetic-grade lanolin can be contaminated with carcinogenic pesticides such as DDT, dieldrin, and lindane, in addition to other neurotoxic pesticides.
16. **Chlorine:** Exposure to chlorine in tap water, showers, pool, laundry products, cleaning agents,

food processing, sewage systems and many others, can effect health by contributing to asthma, hay fever, anemia, bronchitis, circulatory collapse, confusion, delirium diabetes, dizziness, irritation of the eye, mouth, nose, throat, lung, skin and stomach, heart disease, high blood pressure and nausea. It is also a possible cause of cancer.

Green Cosmetics: India has an ancient heritage of traditional medicinal system. Herbal medicines have been used since the beginning of civilization to maintain health and treat disease. Various literatures provide lots of information on the folklore practices in different parts of country and traditional aspect of therapeutically important natural products. Nowadays people increasingly prefer alternative to conventional medicine. The reasons are it is safe and it works. While the allopathic medicine works well in the case of trauma and emergency, it is much less effective when it comes to prevention, chronic disease, and in addressing the mental, emotional and spiritual needs of an individual. These are precisely the areas where alternative medicine excels. To most of the world's population, over 80%, alternative medicine is not "alternative" at all, but rather the basis of the health care system. Both conventional and alternative medicine ascribes to the principle "do no harm". However, while alternative medicine is essentially achieving this goal, conventional medicine seems to have almost totally lost sight of it.

Reduce your risk

- Use fewer cosmetics and personal care products, and less often;
- Avoid fragranced products, which may include numerous ingredients.
- Avoid skin creams and other products which contain UV filters, unless for use as sunscreens.
- Avoid using aerosols (e.g. deodorants, hair sprays) that can be inhaled or leave deposits on domestic surfaces.
- Use toiletries low in additives and avoid chlorinated items
- Check the list of ingredients and try to avoid products which contain any of the chemicals listed above.

REFERENCES

1. Cosmetics info (2015). A History of Cosmetics from Ancient Times. <http://cosmeticsinfo.org/Ancient-history-cosmetics>, Accessed June 17, 2015.
2. A. Rinaldi, "Healing beauty? More biotechnology cosmetic products that claim drug-like properties reach the market," EMBO Rep, 2008, vol.9: 1073-1077.
3. Konduracka, E. et al. (2014). Relationship between everyday use cosmetics and female breast cancer. Polish

- Archives of Internal Medicine 124 (5): 264-269. <http://pamw.pl/en/issue/article/24694726>
4. Cosmetics info (2015). A History of Cosmetics from Ancient Times. <http://cosmeticsinfo.org/Ancient-history-cosmetics> [Accessed June 17, 2015]
 5. Business Wire (2014). Research and Markets: Global Beauty Care Market 2014-2018. <http://www.businesswire.com/news/home/20141029006053/en/Research-Markets-Global-Beauty-Care-Market-2014-2018#.VW13547bxSo> [Accessed June 2, 2015]
 6. EWG (2015). Why This Matters - Cosmetics and Your Health. Washington, DC: Environmental Working Group (2015). <http://www.ewg.org/skindeep/2011/04/12/why-this-matters/> [Accessed June 2, 2015]
 7. Ficheux, A. S. et al. (2015). Consumption of cosmetic products by the French population. First part: Frequency data. Food and Chemical Toxicology 78: 159-169. <http://www.ncbi.nlm.nih.gov/pubmed/25680505>
 8. S.K. Singh, Handbook on Cosmetics (Processes, Formulae with Testing Methods). Asia Pacific Business Press Inc., 2010, pp.688.
 9. Claeysens, "The History of Cosmetics and Make up," <http://ezinearticles.com/?The-History-of-Cosmetics-and-akeupandid=1857725>, 2009. Retrieved, February 28, 2015.
 10. G. Schneider, S. Gohla, J. Schreiber, W. Kaden, U. Schomock, et al., "Skin cosmetics," Ullmann's Encycl. Ind. Chem, 2001, vol. 10: 24-219.
 11. M. Price, "Cosmetics, Styles and Beauty Concepts in Iran," http://www.iranchamber.com/culture/articles/cosmetics_beauty.php, 2001. Retrieved, February 20, 2015.
 12. K. B. Patkar, "Herbal cosmetics in ancient India," Indian Journal of Plastic Surgery, 2008, Vol. 41: S134-S137.
 13. A.D. Hardy, R. Vaishnav, S.S. Al-Kharusi, H.H. Sutherland and M.A. Worthing, "Composition of eye cosmetics (kohls) used in Oman," Journal of Ethnopharmacology, 1998, vol. 60(3):223-234.

Source of Support: None Declared
Conflict of Interest: None Declared