

## 7 COMMON SYNTHETIC COSMETIC INGREDIENTS

Synthetic chemicals are industrial chemicals. Their production is big business. Not so surprisingly, they are ubiquitous today in cosmetic products. It is almost impossible to find a shampoo that is not made with synthetic ingredients. Because these are often labeled “natural” and “organic”, you **MUST** read labels.

Synthetic chemicals carry the risk of a spectrum of hazards—some sap our health, some cause cancer, some deform our children. None are truly beneficial to skin and hair. Given their dangers and the absence of cosmetic benefits, there seems little reason to use them.

The publication of *Silent Spring* by Rachel Carson in 1962 clearly stated for the first time the dangers of pesticides and herbicides and their causal relationship to cancer in humans—and raised our awareness of man-made environmental toxins.

In 1997 *Our Stolen Future* by Theo Colborn, Dianne Dumanoski, and John Peterson Myers presented yet another hazard: synthetic chemicals capable of disrupting the endocrine systems of humans and other animals. These chemicals cause thyroid dysfunction, decreased fertility, birth deformities, metabolic and behavioral abnormalities, and other disorders. The effects are most often manifested in offspring, not the exposed parent. Chemicals known to be endocrine disrupters are the dioxins and alkyl phenols (non-biodegradable detergents and antioxidants present in modified polystyrene and PVCs).\* Some of these chemicals may be present in commercial cosmetics or the plastic containers in which they are packaged.

Synthetic cosmetic ingredients may be harmful themselves and/or they may be contaminated by a harmful substance. Some synthetic ingredients are prone to contamination with carcinogenic substances, especially the “peg-”, “polyethylene”, “polyethylene glycol”, “polyoxyethylene”, “-eth”, “oxynol-”, “DEA” and “TEA”. Nitrosamine contamination became an issue in early 1977. The FDA announced in April 1975 that they considered such contamination to be an adulterant and subject to “enforcement action”. Another contaminant is 1,4-dioxane, which was first reported in 1978.

**Alcohol:** There are many synthetic alcohols. Most commercial ethanol is made from a petroleum byproduct. Isopropyl alcohol, made from the petroleum byproduct propane, is used commercially to make hand lotion, after shave lotion, and rubbing alcohol. There are various specially denatured (SD) alcohols which are formulated to meet the requirements of specific substances by the addition of different chemicals; the unique formulas are numbered, as in SD 40. Denature means to deprive of natural qualities; denatured alcohol is made unfit for drinking (by adding an obnoxious substance) without impairing its usefulness for other purposes. If it’s unfit for drinking and deprived of its natural qualities, what makes it fit for topical application?

**Alkyl sulfates** are anionic surfactants†. Two of the most widely used surfactants are sodium lauryl sulfate (SLS) and sodium laureth sulfate (SLES); they are very harsh synthetic detergents, do not clean the face well, and, worse, are very drying and irritating to the skin. SLS was developed in Germany during World War II as a tank cleaner. The sodium salt of dodecyl sulfate, it is made with sulphuric acid, monododecyl ester, and sodium salt. SLS is currently the primary foaming agent of Western civilization. In the cleaning industry, SLS is used in products such as garage floor cleaners, engine degreasers, and car wash soaps.

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\* There are over 50 chemicals known to be endocrine disrupters, but I am focusing here on those relevant to skin and hair care. Other chemicals which you are likely to know of are DDT, PCBs, and DES.

† Surfactants, also known as wetting agents, lower the surface tension of a liquid, allowing easier spreading, and the interfacial tension between two liquids. The term surfactant is a contraction of “surface active agent”. A surfactant can be classified by the presence or absence of formally charged groups in its head. A *nonionic* surfactant has no charge groups in its head. The head of an ionic surfactant carries a net charge. If the charge is negative, the surfactant is more specifically called *anionic*; if the charge is positive, it is called *cationic*.

Most SLS is made from coconut oil because it is rich in the fatty acid lauric acid. The production of SLS begins with heating coconut oil in water in the presence of sodium hydroxide. This converts the coconut oil into fatty acids (lauric acid and glycerin). The fatty acids are next converted into fatty alcohols by a process called hydrogenation. Lauryl alcohol is then converted into lauryl sulfate by a process called sulfonation. In the final step, lauryl sulfate is reacted with sodium hydroxide to produce sodium lauryl sulfate. When lauryl sulfate is reacted with ammonia instead of sodium hydroxide you have ammonium lauryl sulfate. Likewise, when triethanol amine (TEA) is used, you have TEA lauryl sulfate.

Ethoxylation is the process that makes degreasing agents such as sodium lauryl sulfate less abrasive and gives them enhanced foaming properties. When SLS is ethoxylated, it forms SLES. The problem is, the extremely harmful compound 1,4-dioxane may be created during the ethoxylation process, contaminating the product. 1,4-dioxane was one of the principal components of the chemical defoliant Agent Orange used to great effect by the Americans during the Vietnam War to strip off the jungle canopy and reveal their enemy. 1,4-dioxane is also a hormone disrupter believed to be the chief agent implicated in the host of cancers suffered by Vietnam military personnel after the war. It is also an estrogen mimic thought to increase the chances of breast cancer and endometrial cancer, stress related illnesses, and lower sperm counts.

SLS is considered to be a health hazard when inhaled, absorbed through skin, and ingested. It irritates the skin, can cause dermatitis, corrodes hair follicles, impairs the ability to grow hair, and can combine with other chemicals to produce a carcinogen. Tests on lab animals indicate it may cause mutagenic effects. Tests in Germany have shown that SLES can cause hair loss. SLS denatures proteins, which causes skin and eye damage. SLS and SLES can react with nitrogen-bearing or other compounds to produce either carcinogenic nitrates or dioxins; ALS cannot. SLS is used world-wide as the standard irritant for biological research on the skin and other bodily systems: On a scale of 0 to 10 for surfactant irritation, SLS is rated as a 10. Water would be rated 0. ALS is rated as a 4. SLES is rated as a 5.5.

Interestingly, a 1999 study by Joseph A. Sisnerosa of Florida Institute of Technology, Melbourne, FL and Donald R. Nelson of California State University, Long Beach, CA determined that dodecyl sulfate is the most effective surfactant shark repellent, but it does not meet the Navy's potency requirement. Dodecyl sulfate was found to be practical only as a directional repellent such as in a squirt application.

**Cetaryl alcohol** is a blend of cetyl alcohol and stearyl alcohol.

**Cetyl alcohol** is a 16-carbon fatty alcohol. In form it is white flakes. It may be made from coconut oil or crude oil (petroleum). It is used in many cosmetics as an emollient, thickening agent, moisturizer, emulsifier, stabilizer, opacifier as well as a carrying agent for other ingredients.

**Coco polyglucose** is a nonionic surfactant and foaming agent manufactured from fatty alcohols (from coconut) and glucose (from corn\*). It has the lowest irritation score of all common surfactants tested. It is free from ethylene oxide (which can cause nitrosamine contamination) and free from preservatives. It is highly biodegradable.

**Colors** are usually named a FD&C number or a D&C number. Some are outright carcinogenic. Others are suspected of being allergenic and causing health problems. They are best avoided.

**Decyl glucoside** is a nonionic surfactant in the alkyl glucoside group, a fatty polyglycoside manufactured by reacting cornstarch glucose with a C6–C16 natural fatty alcohol†. It provides excellent foaming characteristics. Its

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\* Glucose results from two enzymatic reactions, first by alpha-amylase and then glucoamylase, on cornstarch which has been separated from the corn kernel by a wet milling process.

† The following is a description of the Davy process to manufacture “natural detergent alcohols”: Fatty acids (typically C12 to C16 acids) derived from palm kernel or coconut oils are first esterified with methanol to give their equivalent methyl esters. Then esterification takes place in a reactive distillation system. The methyl esters are then

irritation rating is 2.5 (on a scale of 10, see the discussion above under SLS). It may cause a reaction in people allergic to corn.

**Diethanolamine (DEA)**, while used itself in very few cosmetics, comprises part of many synthetic chemicals used in cosmetics. It is used as a wetting agent, an alkalizing agent, an antioxidant, a solvent, an emulsifier, and an humectant. It provides a rich lather in shampoos and keeps a favorable consistency in lotions and creams. It is subject to contamination with nitrosamines (known carcinogens). In 1998 the National Toxicology Program found that DEA was associated with cancer in laboratory animals. DEA is known to react with other ingredients in the cosmetic formula to form an extremely potent carcinogen called nitrosodiethanolamine (NDEA). The DEA MSDS says: “Corrosive to eyes. Moderate to severe skin irritant. Skin absorption hazard. Not expected to be a sensitizer. Respiratory tract irritant. CNS depressant. Irritating to gastrointestinal tract.”

**Fractionated coconut oil**, also known as MCT oil (medium-chain triglyceride oil), has virtually no lauric acid. It is 75% caprylic acid and 25% capric acid. It is a cheap by-product of the manufacturing process that makes detergents like sodium lauryl sulfate from whole coconut oil. It is used medically in hospitals and is found in nutrition supplements and baby formulas. But it is not as beneficial as whole coconut oil.

**Glycerine** is a hydrocarbon whose principal component is glycerol. It is clear, odorless, viscous liquid with a sweet taste. It is used as an humectant in creams, lotions, soaps, and more. Mixed with a floral water (orange and rose are commonly used) it makes a traditional hand or body lotion, very effective on chapped or dry skin. Glycerin can be used in amounts that vary from 2–5% for a moisturizing cream, to 5–15% for an oil-water lotion, and as much as 25–40% in a combination with a floral water or herbal water. It may be used to enhance a cosmetic’s consistency. There can be too much of a good thing—too much glycerine in a cosmetic will result in moisture being pulled out of the skin.

However, the production process of glycerine defines it as a completely manufactured commodity: Glycerine is obtained from fats and oils (commonly tallow and palm oil) during soap and fatty acid production and by transesterification, and is subsequently concentrated and purified (by distilling and condensing) prior to commercial sale. “Synthetic” glycerine is produced from propylene. According to Sun Valley Labs ([www.sunvalleylabs.com](http://www.sunvalleylabs.com)), “most glycerine used today is a synthetic product manufactured by the Dow Chemical Corp.” (ChemExpo reports that in 1998 Procter & Gamble had a larger capacity than Dow.)

**Jojoba butter** is an isomerized form of jojoba oil made by treating it with bentonite. It has a shelf life of several years. One formula melts at 95° F. It is not really natural.

**Jojoba wax** is produced by hydrogenating jojoba oil. It is white in color. It melts at 149–154° F. It is an “excellent replacement” for spermaceti wax.<sup>11</sup> It is stable when kept dry and sealed, and can last 25 years. It is available in flakes, which are easy to measure; it can revert to this form when melted with an insufficient amount of liquid vegetable oil.

“**Liposomes** do not occur in nature but were developed by scientists as a way of delivering components such as drugs to the cells in the body. They are composed of a phospholipid layer in which the phosphorus moiety is on the outside and the lipid moiety is on the inside. The layer encapsulates a watery liquid, not fatty acids.”<sup>31</sup>

**Sorbitol** is a polyol (sugar alcohol). It is used as a bulk sweetener in numerous food products and it is an excellent humectant and texturizing agent. A French chemist first discovered sorbitol in the berries of the mountain ash in 1872. It occurs naturally in a wide variety of fruits and berries. Today it is commercially produced by high-pressure catalytic hydrogenation of glucose sugar derived from cornstarch. Sorbitol can be produced as a coproduct with mannitol if invert sugar (50 percent glucose, 50 percent fructose) is used as raw material.

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hydrogenated at low pressure and moderate temperature over a chromium free catalyst to give a high purity crude alcohols product. The crude product is refined to yield market quality products.

**Mannitol** is the alcohol form of mannose, a sugar alcohol. It occurs naturally in pineapples, olives, asparagus, sweet potatoes, and carrots. Mannitol is extracted from seaweed for use in food manufacturing. It can also be obtained from hydrogenation of D-mannose or D-Fructose. It is used as a nutritive sweetener, stabilizer, humectant and bulking agent in foods and supplements. It also has many medical applications.

**Hexachlorophene** has been “used as a bacterial agent in soaps, cosmetics, and deodorants.”<sup>11</sup> It is currently prohibited by the FDA as a cosmetic ingredient because it is neuro-toxic.

**Mineral oil** is a petroleum derivative. It is absorbed very poorly, inhibits the skin’s own moisture-producing capacity (thereby producing dry skin), tends to clog pores\*, and is phototoxic and allergenic. As mineral oil is absorbed it removes the oil-soluble vitamins (A, D, E, K) from the skin; the vitamins are eventually excreted in the feces. Mineral oil in a collagen cream product greatly inhibits the absorption of the collagen.

**Petrolatum**, or petroleum jelly, is a semisolid petroleum derivative. It has the same faults as mineral oil.

**Preservatives** are itemized in pp. 225–234 of *Natural Organic Hair and Skin Care*. The parabens (e.g., methylparaben) and urea are perhaps the most common. Preservatives slow the inevitable natural process of decay, but cannot stop it. Synthetic preservatives are often more toxic than the bacteria they’re supposed to kill. Furthermore, many are incompatible and/or inactive with common cosmetic ingredients.

**Propylene glycol** is a petroleum derivative. It is used as an humectant, surfactant, and solvent. It yields a firmer cream with a more stable consistency than a natural humectant.

**Quaternary ammonium salts** are synthesized by the complete alkylation of ammonia or other amines, including TEA. They are used as disinfectants, surfactants, emulsifiers, softeners, and anti-electrostatics. They are principally used in shampoos and hair conditioners. In the long run they damage the hair: it becomes dry and brittle. They are also allergenic. A natural and organic alternative is lecithin. The quats include: benzalkonium chloride (lethal and irritating to the eye), cetalkonium chloride (toxic), cetrimonium chloride (irritating and toxic), cetylpyridinium chloride (irritating and toxic), cocotrimonium chloride, myristalkonium chloride, stearalkonium chloride, and quaternium 15.

**Sodium PCA** (abbreviated NaPCA) is a naturally occurring component of human skin that is thought to be, at least in part, responsible for its ability to find water. Consequently, sodium PCA is thought to be a kind of natural moisturizing factor (NMF). When found in cosmetics, is likely to be a synthetic chemical that can cause strong allergic reactions and severely dry the skin. Like other amines, the chemical may produce carcinogenic N-nitrosamines when combined with “nitrosating” agents. PCA stands for pyrrolidone carboxylic acid.

**Triethanolamine** (known as TEA, N,N-diethylethanamine, or N,N,N-Triethylamine) is, from the chemical point of view, a tertiary amine. It is “used ubiquitously throughout the cosmetic industry...as a pH adjuster, as an emulsifier, and a preservative.”<sup>11</sup> Like DEA, it may be contaminated with a carcinogen.

**Waxes** include *paraffin wax*, which is a by-product of kerosene, produced from petroleum. Paraffin contains eleven documented toxins. Paraffin is not biodegradable. *Microcrystalline wax* is made by refining petroleum. Typical grades show a much finer crystalline structure than paraffin.

**Emulsifying wax** is an effective emulsifier that is commonly used in cosmetics and classified as “natural” by their manufacturers. But it is not natural by my definition. Emulsifying wax, which can be either plant- or petroleum-based, is created when the wax material (either a vegetable wax of some kind or a petroleum-based wax) is treated

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\* Mineral oil in hand cream gave me endless trouble with pimples and blackheads on my jawline where I tended to rest my head in my hand. Discontinuing the use of such hand creams immediately stopped the acne.

with a detergent (typically sodium laurel sulfate or polysorbates). One such product is made of cetearyl alcohol (mixture of cetyl and stearyl alcohols), Polysorbate 60 (a fatty acid ester), PEG-150 stearate, and steareth-20. Another is made of cetostearyl alcohol and ethoxylated sorbitan ester (a polyoxyethylene derivative of a fatty acid ester of sorbitan). Some products are named NF (or National Formulary\*) referring to a national standard.

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\* The National Formulary was established in 1888 by the American Pharmaceutical Association; it includes standards for excipients, botanicals, and other similar products. USP (United States Pharmacopeia) purchased the NF in 1975, combining the two publications under one cover, creating the USP-NF.