Background Briefing | Cosmetics & Personal Hygiene Products

Background

The European Union undoubtedly has some of the best chemicals regulations in the world. Cosmetics and personal care products (from herein referred to as "cosmetics") sold in the UK must comply with these regulations. Despite this, they can still contain chemicals which are known or suspected to cause adverse health effects, with potential links to breast cancer (1).

Chemicals and Cosmetics

People have used personal care products containing chemicals for thousands of years to enhance beauty, as medicine, as scent and in religious ritual (2). 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.

Today the cosmetics and personal care industry is worth around £250 billion per year (3). One US survey (4) found on average, American women use 12 personal care products and/or cosmetics a day. The total products they used contained 168 different chemical ingredients. Cosmetic products are used on the body from birth (e.g. nappy rash creams) onwards, by men and women, teenagers and young children. A survey recently conducted in France (5) found an even greater use of cosmetics products than in the U.S., with on average 18 cosmetics being used daily by adult

One survey found that women on average use 12 personal care/ cosmetic products daily. In total 168 different chemical ingredients were identified in all of the products.

pregnant women, 16 by adult non-pregnant women, 8 by adult men, 7 by girls, 5 by boys and 6 for babies under 3 years.

Cosmetics contain a range of chemicals for specific functions. They include UV filters; colourants; hardeners; preservatives (to prevent the growth of microorganisms); fragrances (parfumes); antioxidants to help prevent skin damage and to improve product stability; emollients/moisturisers to soften skin by reducing evaporation; surfactants used as foaming agents; and emulsifiers (which help water-soluble and oil-soluble ingredients mix). Ingredients can be synthetic or naturally occurring chemicals.

Many ingredients once believed safe are no longer permitted in cosmetics. Lead poisoning from cosmetics is well documented (6). Although still permitted in many countries, the EU Cosmetics Directive bans the use of lead ingredients in any cosmetic sold in the EU (7).

Some fragrance ingredients, including several synthetic nitro musks (used as alternatives to animal-derived musks), have been banned by the EU (8,9), due to their toxicity, their tendency to bioaccumulate and their environmental impact. More recently, several phthalates used as fragrances, including bis-(2-ethylhexyl) phthalate, dibutyl phthalate and benzyl butyl phthalate, were banned for use in cosmetics and children's toys (10), following their classification as reproductive toxicants (11).

The EU Cosmetics Directive covers a wide range of cosmetics and personal care products.

Current cosmetics regulation

One reason the EU established the Cosmetics Directive in 1976 (Directive 76/768/EC) (12) was to help protect consumers from unsafe cosmetics. In 2013, this Directive was replaced with a new regulation (Regulation (EC) No 1223/2009) (13), which unlike the older one, individual countries had to transpose into their own legal system. The new regulation is a stricter piece of legislation which covers products applied externally, such as shampoo, skincare, make-up, perfume and sunscreen, and those used for oral hygiene, including toothpaste.

The regulation bans certain ingredients entirely (14), limits the use of others (15) and specifies ingredients which, if used, must display safety warning labels. Any ingredient used as a colour (16), preservative (17) or UV filter (18) can only be used with pre-approved safety data (19). All cosmetics ingredients must comply with the EU chemicals regulation (REACH) and are assessed for their environmental impact. If ingredients are used specifically for cosmetics, animal experiments can no longer be performed to generate safety data (20). If any "serious undesirable effects" are identified once a product is marketed, the supplier or manufacturer is obliged to notify UK authorities (or those of other EU countries). Under EU law, all cosmetics/body care products must list the chemical ingredients, but many chemicals can come under a single group name such as 'perfume'.

The EU takes a "precautionary" approach to chemicals regulation, which means to stop harm before it *might* occur, as distinct from prevention, where the harm is relatively certain to occur. Therefore, if it is suspected that a chemical may cause harm, steps should be taken to restrict or prohibit its use. There are currently over 1200 ingredients banned from use in cosmetics in the EU and several hundred that are restricted. This contrasts starkly with the U.S.A, who do not adopt a precautionary approach and where only 11 ingredients are prohibited or restricted (21).

Breast Cancer UK
Prevent the preventable

Background Briefing | Cosmetics & Personal Hygiene Products

Despite stringent regulations in the EU and the requirement to produce safety data, certain potentially harmful chemicals, including endocrine disrupting chemicals (EDCs), remain permitted and are used widely in cosmetics, despite evidence to suggest they may be harmful (e.g. 22, 23, 24).

EDCs affect the body's hormones and may cause serious adverse health effects (25). These chemicals may be harmful at very low concentrations, or may combine with other chemicals to cause harm. Most chemicals on the market have not been tested for their endocrine disrupting properties. They may be causing harm without our knowledge (26). Currently, EDCs can be authorised for use under the EU Cosmetics Regulation. A review of their use was due to take place in January 2015 (27), however, as of July 2015, this review has not yet occurred due to delays in other EU regulatory processes on EDCs.

In June 2015, the EU Regulation (EC No 1272/2008) on Classification, Labelling and Packaging (CLP) came into force which included new provisions to ensure the general public were made aware of the health hazards of substances and mixtures. An example is the well known 'skull and crossbones' pictogram. However, cosmetics products are exempt from this regulation, even if they contain substances known to be dangerous. So, manufacturers are not required to include warnings on product labels (28).

Cosmetics ingredients and breast cancer risk

Some ingredients used in cosmetics may increase breast cancer risk. Most are EDCs which mimic oestrogens. Evidence to support this comes from epidemiological and toxicology studies (see below).

Oestrogens stimulate breast cell growth and proliferation. They can also contribute to the proliferation of damaged cells and along with their metabolites (metabolic break-down products), increase the likelihood of mutations which may lead to breast cancer (29). Certain chemicals found in cosmetics interfere with oestrogen levels in the body and may lead to changes in breast tissue, (similar to those caused by oestrogens), which have been associated with an increased risk of breast cancer (30). Some chemical combinations may be particularly harmful (31). Products as a whole, (ie the entire combination of chemicals, not just individual ingredients), have also been shown to act as oestrogen mimics (32). (See our website for more information on oestrogens, EDCs and breast cancer risk).

How do chemicals from cosmetics enter our body?

Most commonly, chemicals are absorbed through the skin. Although many ingredients cannot penetrate the epidermal (outer skin) layer, smaller compounds are capable of dermal absorption (33).

Examples include short chain parabens (34) (used as preservatives) and phthalates (35) (used as fragrances). Exposures can occur through inhalation, e.g from hairsprays and perfumes. People are also exposed to cosmetics ingredients indirectly via the environment. Compounds (or their metabolites) excreted in urine, or those directly disposed of into the sewage system or to landfill, may enter the aquatic environment via discharged wastewater or landfill run-off (36). Biosolids, derived from sewage treatment plants, may also contain non-degraded cosmetics ingredients that contaminate soil and crops, when used as fertilizer (37). Consequently, exposures to cosmetics ingredients can occur through ingestion of contaminated food and water as well as from inhalation and skin absorption.

Human biomonitoring studies have identified cosmetics ingredients in urine (e.g phthalates (38), triclosan and parabens (39)), breast milk (e.g. UV filters, parabens and phthalates (40)) and blood (e.g. phthalates (41)). Ingredients that bio-accumulate (build up in fatty tissues) have also been identified in human tissues, including breast tissue (e.g. aluminium (42) and parabens (43)).

Studies have shown that increased use of cosmetics is directly related to increased concentrations of urinary metabolites of cosmetics ingredients. One study, found that those who used perfume had 2.9 times higher concentration of mono-ethyl phthalate (the primary metabolite of the fragrance ingredient diethyl phthalate) in their urine than other women (44).

Cosmetic ingredients with possible links to breast cancer

Parabens: used widely as preservatives (e.g in shampoos, face creams and body lotions) to help lengthen shelf life but have no specific cosmetic purpose. Often an ingredients list will contain one or more of the following parabens: **butylparaben**, **methylparaben**, **ethylparaben** and **propylparaben**. Parabens are known EDCs and have been linked to breast cancer (45). Recently the EU reduced permissible concentrations of butyl and propyl paraben in most cosmetic products and imposed a ban on their use in nappy creams (46). Products placed on the market since April must comply with the new rules; but existing stocks can remain on the shelves until 16 October 2015.

Phthalates: used as solvents for fragrance, as an alcohol denaturant (in order to render the alcohol in perfumes undrinkable) or (less commonly) to hold colour. According to Cosmetics Europe, **diethyl phthalate (DEP)** is the only phthalate used by the cosmetics industry in the EU (47). It can be found in perfume, nail polish and hair spray. DEP is an EDC (48); exposure may be linked to breast cancer (49, 50) and has been associated with other health problems including adverse male reproductive development (51).

Triclosan: used in antibacterial soaps, deodorants and toothpastes as a preservative and to reduce bacterial growth orally (in toothpaste) and on skin (in soaps). It's an oestrogen mimic which may be linked to breast cancer (52, 53). There is no evidence that inclusion of triclosan in soaps and hand washes has any medical benefit (e.g. 54).

Synthetic musks: used as fragrances in perfumes, cosmetics and aftershave. In the EU, polycyclic musks, **galaxolide (HHBC)** and **tonalide (AHTN**) and nitro musk**, musk ketone**, are the most widely used (55). Musk ketone is concentration restricted (56); it is oestrogenic (57) and may be linked to breast cancer (58). Galaxolide and tonalide are also EDCs (59). All synthetic musks bioaccumulate, break down slowly in the environment, and have been found in human blood, fat tissue and breast milk (60).

Aluminium: used in antiperspirants and deodorants, lipstick and some toothpastes. **Aluminium chloride** and **aluminium chlorohydrate** are oestrogen mimics (61) and limited scientific evidence suggests they may be associated with increased breast cancer risk (62). Aluminium is toxic at high concentrations (63).

Formaldehyde is used at restricted concentrations as a nail hardener and in soaps, make-up and creams in the form of **formaldehyde -releasing preservatives** (e.g. **DMDM hydantoin, diazolidinyl urea, imidazolidinyl urea** and **Quaternium-15**) (64). Product labelling is required if content exceeds 0.05%. Formaldehyde may be released from products as an off-gas. It is a known carcinogen, and has been linked to increased breast cancer risk (65).

Some chemicals used in cosmetics and personal care products may be linked to an increased risk of breast cancer

Cosmetic ingredients with links to other health problems

UV filters such as **benzophenones, ethylhexyl methoxycinnamate** and **homosalate** are added to sunscreen products to protect skin against the damaging effects of UV light. They are also added to other products to protect from UV damage during storage. They are oestrogenic (66,67), bioaccumulate and have been detected in breast milk (68). They may also increase the skin penetration of other chemicals (69).

Siloxanes are inactive ingredients used in sun lotions and creams. One of the most commonly used, **octamethylcyclotetrasiloxane**, is a weak oestrogen mimic, linked with reproductive disorders in animal studies (70). It also bioaccumulates and is toxic (71).

Ethanolamines including **triethanolamine (TEA)** and **monoethanolamine (MEA)** are used to raise pH (control acidity) and as emulsifiers. TEA is used in makeup, fragrances, hair care, skins care and shaving products and sunscreens . MEA is used in hair dyes. TEA is mildly toxic and carcinogenic in mice (72). The EU prohibits diethanolamine (DEA) in cosmetics, and restricts the use of MEA and TEA due to potential cancer risk (73).

Hydroquinone is used in nail varnish and hair dyes, where it is restricted to 0.02% and 0.3% product content respectively (74). It is toxic and carcinogenic (75) and in 2001 the EC prohibited its use as a skin lightener. **Toluene** is found in nail polish (restricted to 25%) and is a neuro-developmental toxin (76). **Butylated hydroxytoluene (BHT)** is used in lipsticks and moisturisers as an antioxidant (preservative). It is an oestrogen mimic (77) and has been found to promote tumour formation in animal studies (78).

Toxic compounds not added as ingredients may still be present in cosmetics as a result of ingredient contamination or reaction by-products. **Ethoxylated alcohols** (emulsifying or solubilising agents) such as **polyethylene glycol** and **polyoxyethylene** used in creams or **sodium laureth sulphate**, used as a foaming agent in shampoos, may contain **ethylene oxide**, a known carcinogen which has been linked to increased breast cancer risk (79) and **1, 4 dioxane**, a suspected carcinogen (80). **Polyacrylamide**, used as a thickener, may contain as a by-product the neurotoxin and possible carcinogen, **acrylamide** (81). Although the EU prohibits or restricts metals hazardous to health in cosmetic products, some products may be contaminated with a number of different **heavy metals**, many of which are toxic at low concentrations (82).

Are beauty salon workers at increased health risk?

Hair and beauty salon workers are exposed to numerous cosmetics on a daily basis. A comprehensive literature review on the health of hair and beauty salon workers by Women's Voices for the Earth (83) concluded that salon workers are more likely to suffer from a range of health problems including an increased incidence of dermatitis, asthma, Alzheimer's disease, lupus, cancers, including breast cancer, miscarriage and birth defects in their children.

In the UK, hairdressers were found to experience higher levels of musculoskeletal problems and coughs (84), and mothers' occupational exposure to hairspray increased the incidence of hypospadia (penis abnormalities) in sons, by 2.4 fold (85). A review (86) found hair and nail salon workers in Europe (including the UK) are at an increased risk of certain cancers, including a slightly elevated risk of breast cancer, although not all studies show a link between salon work and breast cancer risk.

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.

Breast Cancer UK
Preventing breast cancer

Background Briefing | Cosmetics & Personal Hygiene Products

Breast Cancer UK is calling for:

- The regulation of chemicals to be strengthened and improved, based on the precautionary principle, to protect public health;
- The exposure to hazardous chemicals, including EDCs, to be recognised as preventable risk factors for breast cancer;
- Revision of the EU cosmetics regulation to restrict EDCs from use in products, similar to carcinogens and reproductive toxicants;
- An extension of EU Article 60 (87) of the REACH Regulation, to ensure EDCs are, by default, classed as Substances of Very High Concern (SVHC), for which no safe thresholds can be determined (88);
- Use of UV filters be restricted to sunscreens and not permitted for use as a preservative in everyday cosmetics products, such as skin lotion; and
- Cosmetics and personal care products no longer be exempt from the EU Regulation on Classification, Labelling and Packaging (89) and so will display hazard warnings.

Acknowledgements:

We would like to thank Dr Lisette van Vliet (Health and Environmental Alliance) for her help in the preparation of this information sheet.

References

1.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
2.Cosmetics info (2015). A History of Cosmetics from Ancient Times. http://cosmeticsinfo.org/Ancient-history-cosmetics [Accessed June 17, 2015]
3.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]
4.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]
5.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
6.Borowska, S. and Brzóska, M. M. (2015). Metals in cosmetics: implications for human health. Journal of Applied Toxicology 35: 551-572. http://www.ncbi.nlm.nih.gov/pubmed/25809475
7.European Parliament (1976). Council Directive of 27 July 1976 on the approximation of the laws of the Member States relating to cosmetic products (76/768/EEC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1976L0768:20100301:en:PDF [Accessed June 15, 2015]
8.European Parliament (1976), *ibid.*
9.European Parliament (2011). Commission regulation (EU) No. 143/2011 of 17 February 2011 amending Annex XIV to regulation (EC) No 1907/2006 of the European parliament and of the Council on the registration, evaluation, authorisation and restriction of chemicals ('REACH'). http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011R0143 [Accessed June 15, 2015]
10.ECHA (2015). Committee for Risk Assessment (RAC) Opinion on an Annex XV dossier proposing restrictions on four phthalates. ECHA/RAC/RES-O-0000001412-86-07/F. Adopted 15 June, 2012. http://echa.europa.eu/documents/10162/77cf7d29-ba63-4901-aded-59cf75536e06 [Accessed June, 15]
11.SSCP (2007). EU Scientific Committee on Consumer Products SCCP: Opinion on phthalates in cosmetic products. 21 March 2007. http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_106.pdf [Accessed June 9, 2015]
12.European Parliament (1976), *op. cit.*
13.European Parliament (2009). Regulation (EC) No. 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32009R1223 [Accessed June 15, 2015]
14.Annex II. European Parliament (2009), *op. cit.*
15.Annex III. European Parliament (2009), *op. cit.*
16.Annex IV. European Parliament (2009), *op. cit.*
17.Annex V. European Parliament (2009), *op. cit.*
18.Annex VI. European Parliament (2009), *op. cit.*
19.European Parliament (2009), *op. cit.*
20.Vinardell, M. P. (2015). The use of non-animal alternatives in the safety evaluations of cosmetics ingredients by the Scientific Committee on Consumer Safety (SCCS). Regulatory Toxicology and Pharmacology 71: 198–204. http://www.ncbi.nlm.nih.gov/pubmed/25555996
21.FDA (2015). Cosmetics: Prohibited & Restricted Ingredients. http://www.fda.gov/Cosmetics/GuidanceRegulation/LawsRegulations/ucm127406.htm#prohibited [Accessed June 2, 2015]
22.Witorsch R. J. and Thomas, J. A. (2010). Personal care products and endocrine disruption: A critical review of the literature. Critical Reviews in Toxicology 40 (3): 1-30. http://www.ncbi.nlm.nih.gov/pubmed/20932229
23.Lange, C. et al. (2014). Estrogenic activity of constituents of underarm deodorants determined by E-Screen assay. Chemosphere 108: 101-106. http://www.ncbi.nlm.nih.gov/pubmed/24875918
24.Konduracka, E. et al. (2014), *op. cit.*
25.UNEP/WHO (2013). State of the science of endocrine disrupting chemicals 2012: full report. http://www.who.int/ceh/publications/endocrine/en/ [Accessed May 26, 2015]
26.UNEP/WHO (2013), *ibid*
27.European Commission (2015). Environment: Chemicals: Endocrine Disruptors. http://ec.europa.eu/environment/chemicals/endocrine/index_en.htm [Accessed June 17, 2015]
28.Klaschka, U. (2012). Dangerous cosmetics - criteria for classification, labelling and packaging (EC 1272/2008) applied to personal care products. Environmental Sciences Europe 24: 37. http://www.enveurope.com/content/24/1/37
29.Santen, R. J. et al. (2015). Estrogen metabolites and breast cancer. Steroids 99: 61-66. http://www.ncbi.nlm.nih.gov/pubmed/25168343
30.Darbre, P. D. and Charles, A. K. (2010). Environmental Oestrogens and Breast Cancer: Evidence for Combined Involvement of Dietary, Household and Cosmetic Xenoestrogens. Anticancer Research 30: 815-828. http://www.ncbi.nlm.nih.gov/pubmed/20393002
31.Kortenkamp, A. (2006). Breast cancer, oestrogens and environmental pollutants: a re-evaluation from a mixture perspective. International Journal of Andrology 29(1): 193-198. http://www.ncbi.nlm.nih.gov/pubmed/16466540
32.Myers, S. L. et al. (2015). Estrogenic and anti-estrogenic activity of off-the-shelf hair and skin care products. Journal of Exposure Science and Environmental Epidemiology 25(3): 271-277. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4318791/pdf/nihms647390.pdf
33.Bos, J. D. and Meinardi, M. M. (2000). The 500 Dalton rule for the skin penetration of chemical compounds and drugs. Experimental Dermatology 9: 165-169. http://www.ncbi.nlm.nih.gov/pubmed/10839713
34.Cosmetic Ingredient Review Expert Panel (CIR) (2008). Final amended report on the safety assessment of methylparaben, ethylparaben, propylparaben, isopropylparaben, butylparaben, isobutylparaben, and benzylparaben as used in cosmetic products. International Journal of Toxicology 27 (4): 1–82. http://www.cir-safety.org/sites/default/files/PR427.pdf

References

35.Janjua, N. R. et al. (2007). Systemic uptake of diethyl phthalate, dibutyl phthalate, and butyl paraben following whole-body topical application and reproductive and thyroid hormone levels in humans. Environmental Science and Technology 41(15): 5564-5570. http://www.ncbi.nlm.nih.gov/pubmed/17822133
36.Grassi, M. et al. (2011). Endocrine disruptors compounds, pharmaceuticals and personal care products in urban wastewater: implications for agricultural reuse and their removal by adsorption process. Environmental Science and Pollution Research International 20(6): 3616-3628. http://www.ncbi.nlm.nih.gov/pubmed/23532534
37.Grassi, M. et al. (2011), *ibid*
38.Hartmann, C. et al. (2015). Human biomonitoring of phthalate exposure in Austrian children and adults and cumulative risk assessment. International Journal of Hygiene and Environmental Health 218 (5): 489-99. http://www.ncbi.nlm.nih.gov/pubmed/25959523
39.Larsson, K. et al. (2014) Exposure determinants of phthalates, parabens, bisphenol A and triclosan in Swedish mothers and their children. Environment International 73: 323-33. http://www.ncbi.nlm.nih.gov/pubmed/25216151
40.Schlumpf, M. et al. (2010). Exposure patterns of UV filters, fragrances, parabens, phthalates, organochlor pesticides, PBDEs, and PCBs in human milk: Correlation of UV filters with use of cosmetics. Chemosphere 81: 1171-1183. http://www.ncbi.nlm.nih.gov/pubmed/21030064
41.Chen, J. A. et al. (2008) Analysis of di-n-butyl phthalate and other organic pollutants in Chongqing women undergoing parturition. Environmental Pollution 156: 849–853. http://www.ncbi.nlm.nih.gov/pubmed/18565632
42.Exley, C. et al. (2007). Aluminium in human breast tissue. Journal of Inorganic Biochemistry 101: 1344 -1346. http://www.ncbi.nlm.nih.gov/pubmed/17629949
43.Barr, L. et al. (2012). Measurement of paraben concentrations in human breast tissue at serial locations across the breast from axilla to sternum. Journal of Applied Toxicology 32(3): 219-232. http://www.ncbi.nlm.nih.gov/pubmed/22237600
44.Parlett, L. E. et al. (2013). Women's exposure to phthalates in relation to use of personal care products. Journal of Exposure Analysis and Environmental Epidemiology 23(2): 197-206. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4097177/pdf/nihms595291.pdf
45.Darbre, P. D. and Harvey, P. W. (2014). Parabens can enable hallmarks and characteristics of cancer in human breast epithelial cells: a review of the literature with reference to new exposure data and regulatory status. Journal of Applied Toxicology 34(9): 925-938. http://www.ncbi.nlm.nih.gov/pubmed/25047802
46.European Parliament (2014). Commission Regulation (EU) No 1004/2014 of 18 September 2014 amending Annex V to Regulation (EC) No 1223/2009 of the European Parliament and of the Council on cosmetic products. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014R1004 [Accessed June 17, 2015]
47.Cosmetics Europe. Ingredients under discussion. https://www.cosmeticseurope.eu/safety-and-science-cosmetics-europe/products-and-ingredients/-ingredients-under-discussion.html. [Accessed June 9, 2015]
48.Mankidy, R. et al. (2014). Biological impact of phthalates. Toxicology Letters 217 (1): 50-58. http://www.ncbi.nlm.nih.gov/pubmed/23220035
49.López-Carrillo, L. et al. (2010). Exposure to phthalates and breast cancer risk in northern Mexico. Environmental Health Perspective 118(4): 539-544. http://www.ncbi.nlm.nih.gov/pubmed/20368132
50.Manservisi, F. et al. (2015). Effect of maternal exposure to endocrine disrupting chemicals on reproduction and mammary gland development in female Sprague-Dawley rats. Reproductive Toxicology 54: 110-119. http://www.ncbi.nlm.nih.gov/pubmed/25554385
51.Swan, S. H. et al. (2005). Decrease in anogenital distance among male infants with prenatal phthalate exposure. Environmental Health Perspectives 113: 1056-1061. http://www.ncbi.nlm.nih.gov/pubmed/16079079
52.Dinwiddie, M. T. et al. (2015). Recent evidence regarding triclosan and cancer risk. International Journal of Environmental Research and Public Health 11: 2209-2217. http://www.ncbi.nlm.nih.gov/pubmed/24566048
53.Manservisi, F. et al. (2015), *op. cit*.
54.FDA (2012). Triclosan: What Consumers Should Know. http://www.fda.gov/forconsumers/consumerupdates/ucm205999.htm [Accessed June 10, 2015]
55.Homem, V. et al. (2015). Long lasting perfume - A review of synthetic musks in WWTPs. Journal of Environmental Management 149: 168-192. http://www.ncbi.nlm.nih.gov/pubmed/?term=Long+lasting+perfume+A+review+of+synthetic+musks+in+WWTPs
56.European Parliament (2009), *op. cit.*
57.Bitsch, N. et al. (2002). Estrogenic activity of musk fragrances detected by the E-screen assay using human mcf-7 cells. Archives of Environmental Contamination and Toxicology 43: 257-264. http://www.ncbi.nlm.nih.gov/ pubmed/12202919
58.Taylor, K. M. et al. (2014). Human exposure to nitro musks and the evaluation of their potential toxicity: an overview. Environmental Health 13: 14. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4007519/pdf/1476-069X-13-14.pdf
59.Li, Z. et al. (2013). Effects of polycyclic musks HHCB and AHTN on steroidogenesis in H295R cells. Chemosphere 90: 1227-1235. http://www.ncbi.nlm.nih.gov/pubmed/23084589
60.Homem, V. et al. (2015), *op. cit.*
61.Darbre, P. D. (2006). Metalloestrogens: an emerging class of inorganic xenoestrogens with potential to add to the oestrogenic burden of the human breast. Journal of Applied Toxicology 26(3): 191-197. http:// www.ncbi.nlm.nih. gov/pubmed/16489580
62.Darbre, P. D. et al. (2013). Aluminium and breast cancer: Sources of exposure, tissue measurements and mechanisms of toxicological actions on breast biology. Journal of Inorganic Biochemistry 128: 257-261. http://www.ncbi.nlm. nih.gov/pubmed/23899626
63.EC (2014). Opinion on the safety of aluminium in cosmetic products. SCCS/1525/14 Revision of 18 June 2014. http://ec.europa.eu/health/scientific_committees/consumer_safety/docs/sccs_o_153.pdf [Accessed June 11, 2015]
64.SCCS (Scientific Committee on Consumer Safety) Opinion on the safety of the use of formaldehyde in nail hardeners, SCCS/1538/14, written procedure 7 November 2014, revision of 16 December 2014. http://ec.europa.eu/health/scientific_committees/consumer_safety/docs/sccs_o_164.pdf [Accessed June 16, 2015]
65.Coyle, Y. M. et al. (2005). An ecological study of the association of environmental chemicals on breast cancer incidence in Texas. Breast Cancer Research and Treatment 92(2): 107-114. http://www.ncbi.nlm.nih.gov/pubmed/15986119
66.Kerdivel, G. et al. (2013). Estrogenic Potency of Benzophenone UV Filters in Breast Cancer Cells: Proliferative and Transcriptional Activity Substantiated by Docking Analysis. PLoS ONE 8(4): e60567. http://www.ncbi.nlm.nih.gov/pubmed/23593250
67.Schlumpf, M. et al. (2001). In vitro and in vivo estrogenicity of UV screens. Environmental Health Perspectives 109(3): 239-244. http://www.ncbi.nlm.nih.gov/pubmed/11333184
68.Schlumpf, M. et al. (2010), *op. cit.*
69.Pont, A. R. et al. (2004). Active ingredients in sunscreens act as topical penetration enhancers for the herbicide 2,4-dichlorophenoxyacetic acid. Toxicology Applied Pharmacology 195: 348-354. http://www.ncbi.nlm.nih.gov/pubmed/15020197
70.McKim, J. M. et al. (2001). Potential estrogenic and antiestrogenic activity of the cyclic siloxane octamethylcyclotetrasiloxane (D4) and the linear siloxane hexamethyldisiloxane (HMDS) in immature rats using the uterotrophic assay. Toxicological Science 63: 37-46. http://www.ncbi.nlm.nih.gov/pubmed/11509742
71.Wang, D.-G. et al. (2013). Review of Recent Advances in Research on the Toxicity, Detection, Occurrence and Fate of Cyclic Volatile Methyl Siloxanes in the Environment. Chemosphere 93: 711-725. http://www.sciencedirect.com/science/article/pii/S0045653512012805
72.Stout, M. D. et al. (2008). Influence of *Helicobacter hepaticus* Infection on the Chronic Toxicity and Carcinogenicity of Triethanolamine in B6C3F1 Mice. Toxicologic Pathology, 36: 783-794. http://tpx.sagepub.com/content/36/6/783.full.pdf
73.EC (2014). Opinion concerning dialkyl- and dialkanolamines and their salts in cosmetic products adopted by the SCCNFP during the 17th plenary meeting of 12 June 2001 http://ec.europa.eu/health/scientific_committees/consumer_safety/opinions/sccnfp_opinions_97_04/sccp_out144_en.htm [Accessed June 11, 2015]
74.European parliament (2009), *op. cit.*
75.Enguita, F. J. and Leitão, A. A. (2013). Hydroquinone: Environmental Pollution, Toxicity, and Microbial Answers. BioMed Research International 2013: Article ID 542168. http://www.hindawi.com/journals/bmri/2013/542168/
76.Grandjean, P. and Landrigan, P. J. (2006) Developmental neurotoxicity of industrial chemicals. Lancet 368: 2167-2178. http://www.ncbi.nlm.nih.gov/pubmed/17174709
77.Pop, A. et al. (2013). Evaluation of the possible endocrine disruptive effect of butylated hydroxyanisole, butylated hydroxytoluene and propyl gallate in immature female rats. Farmacia 61 (1): 202-211. http://www.revistafarmacia.ro/201301/art-18-2013-1-pop 202-211.pdf
78.Shearn, C. T. et al. (2011). Protein damage from electrophiles and oxidants in lungs of mice chronically exposed to the tumor promoter butylated hydroxytoluene. Chemico-Biological Interactions 192(3): 278-286. http://www.ncbi.nlm.nih.gov/pubmed/21536018
79.Weiderpass, E. et al. (2011). Risk Factors for Breast Cancer, Including Occupational Exposures. Safety and Health at Work 2: 1-8. http://www.e-shaw.net/article/S2093-7911(11)21001-1/pdf
80.HERA (2014). Human & Environmental Risk Assessment on ingredients of European household cleaning products: Alcohol Ethoxylates. http://www.heraproject.com/files/34-f-09 hera ae report version 2 - 3 sept 09.pdf [Accessed June 25, 2015]
81.EC (1999). Opinion of the scientific committee on cosmetic products and non-food products intended for consumers concerning acrylamide residues in cosmetics adopted by the plenary session of the SCNNFP of 30 September 1999. http://ec.europa.eu/health/scientific_committees/consumer_safety/opinions/sccnfp_opinions_97_04/sccp_out95_en.htm [Accessed June 25, 2015]
82.Borowska, S. and Brzóska, M. M. (2015). Metals in cosmetics: implications for human health. Journal of Applied Toxicology 35(6): 551-572. http://www.ncbi.nlm.nih.gov/pubmed/25809475
83.Scranton, A. (2014). Beauty and its Beast. Unmasking the Impacts of toxic chemicals on salon workers. Women's voices for Earth, November, 2014. http://www.womensvoices.org/issues/reports/beauty-and-its-beast/ [Accessed June 17, 2015]
84.Bradshaw, L. et al. (2011) Self-reported work-related symptoms in hairdressers. Occupational Medicine 61: 328-334. http://occmed.oxfordjournals.org/content/61/5/328.full.pdf
85.Ormond, G. et al. (2009). Endocrine Disruptors in the Workplace, Hair Spray, Folate Supplementation, and Risk of Hypospadias: Case-control Study. Environmental Health Perspectives 117(2): 303-307. http://www.ncbi.nlm.nih.gov/pubmed/19270804
86.Takkouche, B. et al. (2009). Risk of Cancer Among Hairdressers and Related Workers: A Meta-Analysis. International Journal of Epidemiology 38: 1512-1531. http://ije.oxfordjournals.org/content/38/6/1512.long#T6
87.REACH Online, Authorisations: Chapter 2 Article 60 Granting of authorizations. http://www.reachonline.eu/REACH/EN/REACH_EN/article60.html [Accessed June 16, 2015]
88.ECHA (2015). Addressing Chemicals of Concern. Substances of very high concern identification http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/substances-of-very-high-concern-identification [Accessed June 16, 2015]
89.European Commission (2015). Classification and labelling (CLP/GHS). http://ec.europa.eu/growth/sectors/chemicals/classification-labelling/index_en.htm [Accessed June 17, 2015]