

THE CANCER REVOLUTION

Additional Material for Chapter 11

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Table 2

Sources, categories, examples and potential adverse effects of environmental toxin to which an individual might be exposed

Source	Category	Examples of xenobiotics	Potential adverse effects
Food	Food colourings	Tartrazine (E102), Quinoline (E104) Yellow, Sunset Yellow FCF/ Orange Yellow S (E110), Erythrosine (E127), Allura Red AC (E129), Patent Blue V (E131), Indigotine, Indigo carmine (E132) and Brilliant Blue FCF (E133) present in a wide range of processed foods and confectionary products	Increases hyperactivity in children (Schab and Tringh, 2004).
	Food preservatives	Benzoic acid and benzoate in pickled vegetables, low sugar jams and jellies, candied fruits, semi-preserved fish products, sauces, soft drinks; nitrite and nitrate compounds (E249-250) used in sausage, bacon, ham, foie gras, cheese, pickled herring; sodium metabisulphite and other sulphites (E220-228) in wines and beer	Benzoate preservatives in soft drinks, preserved vegetables etc. can react with vitamin C (benzene) to produce small amounts of benzene (IARC Group 1 carcinogen) (Bonaccorsi et al, 2012). Nitrites and nitrates form carcinogenic N-nitroso in animal models (IARC Group 2A carcinogen) products in the body and 31% increased in epithelial ovarian cancer was found in a US study (Aschebrook-Kilfoy et al, 2012).
	Artificial sweeteners	Sodium cyclamate, aspartame, acesulfame potassium, sucralose in soft drinks	Some artificial sweeteners have been associated with carcinogenic risk (Andreatta et al, 2008).
	Pesticide residues	Wide range of fungicides, insecticides and growth regulators present in fruits, vegetables, meats and dairy products ²	Pesticide residuees in conventionally-produced fruit and vegetables create a cancer risk that well exceeds the US Food and Drug Administration's acceptable threshold for xenobiotics (Keikotlhaile et al, 2011).

Source	Category	Examples of xenobiotics	Potential adverse effects
	Heavy metals	Mercury, cadmium, arsenic and lead in seafood	There is a significant problems with heavy metal contamination of European-sourced seafood, and especially shellfish (Guéguen et al, 2011).
	Food contact materials	Plasticisers such as bisphenol A (BPA) and phthalates in polycarbonate bottles, resins in metal cans, plastic food containers, food films, etc.	Exposure to BPA is almost ubiquitous and has been shown to cause endocrine disrupting effects and mammary cancers in laboratory animals at very low concentrations (Welshons et al, 2006; Meeker et al, 2009)
	Persistent Organic Pollutants (POPs)	Polychlorinated biphenyls (PCBs)	In a survey of foods in Holland, fat from cow's milk, butter and cheese, and beef was responsible for 50% of PCB (IARC Group 1 carcinogen) of the exposure from food. Second most important were food items with a mixture of vegetable and animal fats and oil, as added by the food industry. PCBs were also found in fish oils, but varied greatly in concentration between samples (Theelen et al, 1993).
Dentistry	Amalgam	Mercury, nickel	Patients with certain autoimmune and allergic diseases, such as systemic lupus, multiple sclerosis, autoimmune thyroiditis or atopic eczema benefit from removal of amalgams containing owing to the reduction of inorganic mercury and nickel exposure (Prochazkova et al, 2004).
	Dental sealants	BPA	Dental sealants release endocrine-disrupting BPA into the mouth and body (Welshons et al, 2006).
Drinking water	Chlorine and chlorination by-products	Chloroform ¹ and other trihalomethanes (THMs) formed by reaction of chlorine and organic matter during disinfection of water by chlorination	THMs, halo acetic acids, bromate, chlorite associated with increased risk of cancer, as well as liver, kidney and central nervous system diseases (EPA, 2012).
	Fluoride	Hydrofluorosilicic acid and other synthetic fluorides added to municipal water supplies in fluoridated areas	Delayed neurodevelopment behaviour and reduced IQ in children (Choi et al, 2012). Increased risk of fluorosis (Verkerk, 2010)
	Heavy metals	Arsenic ¹ , cadmium ¹	Arsenic, cadmium and other heavy metals in water (especially in bore water in some developing countries) has been found to cause skin and some internal cancers (Donner et al, 2010)

Source	Category	Examples of xenobiotics	Potential adverse effects
	Xenoestrogens	Residues from contraceptives and Hormone Replacement Therapy (HRT), plasticisers	Proven to cause endocrine-disruption in human and likely to increase the risk of cancers of the reproductive system, breast, lung, kidney, pancreas and brain (Fucic et al, 2012). Plasticisers and softeners on urban surfaces from car tyre wear and abrasion run-off into groundwater contributing endocrine disrupting effects ¹ (Donner et al, 2010)
	Nitrates	From agricultural (fertiliser) run-off into groundwater	Nitrates from fertilizers run-off into groundwater and may contribute to the increased risk of carcinogenic nitrosamines (Ritter et al, 2002).
Air	Tobacco smoking	Nicotine, tar, cadmium	Production of some carcinogenic or harmful pyrolytic compounds such as benzo[a]pyrene, hydrogen cyanide, carbonyl compounds, aromatic amines and various volatile organic compounds (Torikai et al, 2005).
	Vehicle emissions	Petrol and diesel exhaust fumes, ¹ including lead	Traffic fumes contribute to increased risk of respiratory and allergic diseases, including asthma, chronic obstructive pulmonary disease, pneumonia, and possibly tuberculosis (Laumbach and Kipen, 2012).
	Flame retardants	Brominated flame retardants in consumer products e.g., electronic equipment, upholstered furniture	Applied to interior furnishings (carpets, curtains, mattresses), accumulate in breast milk, body fat and the environment and shown in laboratory animals to cause adverse neurobehavioural effects, endocrine disruption, changes in liver and kidney morphology, and, at high doses, cancer (Darnerud, 2003).
	Dust	Wood dust, house dust, particulate air pollution ¹	Wood dust (IARC Group 1 carcinogen) causes ethmoid adenocarcinoma (EADC) which may be latent for over 30 years prior to developing (De Gabory et al, 2009). High carcinogenic polychlorinated biphenyls (PCBs) may be inhaled when sanding or removing old paint (Kuusisto et al, 2007). Indoor particulates from burning solid fuels increases risk of COPD and other respiratory diseases (Perez-Padilla et al, 2010).
	Pesticides	Pesticide drift ¹	A wide range of neurological, skin and other illnesses have been identified among those living in rural areas close to agricultural areas where both ground and aerial spraying occurs (Lee et al, 2011).
	Household products	Cleaning product fumes and air fresheners	Fumes from cleaning products and fragrances may react with ozone in the air to form recognised carcinogens or reproductive toxins (Nazaroffa et al, 2004).

Source	Category	Examples of xenobiotics	Potential adverse effects
	Household decorating	Paints and paint stripping	Release of dichloromethane (DCM) due to the use of DCM-based paint strippers, release of solvents and metal based pigments during paint application (Donner et al, 2010)
Skin	Personal care products ¹	Fragrances ¹ , perfumes ¹ , excipients (non-active ingredients added for technological reasons)	Exposure to phthalates has been shown to cause endocrine disrupting effects and mammary cancers in laboratory animals at very low concentrations (Welshons, 2006). Phthalates have also been associate with infertility, testicular dysgenesis, obesity, asthma, and allergies, as well as leiomyomas and breast cancer. Parabens are also widely present in personal care products and their oestrogenic effect and presence in tissues are causes for concern (Crinnion, 2010).
	Laundry products ¹		Detergents, proteolytic enzymes or surfactants in products may cause skin irritation, erythema, scaling, and edema (Austoria et al, 2010).
	Cleaning products ¹		Household cleaners may contain chorine, ammonia, or other chemicals that may damage or sensitise skin (Austoria et al, 2010).
	Bath, shower and swimming pool water	Chlorine and chlorination by-products	Hot shows and baths contribute to greater dermal absorption of chlronation by-products than exposure to cold water (Chowdhury and Champagne, 2009). Highly carcinogenic N-nitrosodialkylamine (nitrosamine) disinfection by-products were quantified in chlorinated swimming pools and hot tubs at levels up to 500-fold greater than the drinking water concentration of 0.7 ng/L associated with a one in one million lifetime cancer risk (Walse et al, 2008).
Occupational	Chemicals (including agrochemicals) industry	Exposure to industrial chemicals, ¹ agrochemicals and pharmaceuticals in the workplace	Large cohort study links increased prostate cancer risk in pesticide factory workers (Boers et al, 2005). A review confirms that a positive association between occupational exposure to complex pesticide mixtures and the presence of chromosomal aberrations (CA), sister-chromatid exchanges (SCE) and micronuclei (MN) has been detected in the majority of the studies (Bolognesi, 2003). Farmers or pesticide applicators are more likely to develop Chronic Fatigue Syndrome (CFS) (Tahmaz et al, 2003).

Source	Category	Examples of xenobiotics	Potential adverse effects
	Other	Various	The EU's REACH Regulation categorises industrial sectors including: Leather processing ¹ ; Metal extraction, refining and processing; ¹ Mineral oil and fuel industry; ¹ Polymers industry; ¹ Pulp, paper and board industry; ¹ Textile processing industry; ¹ Paints, lacquers and varnishing industry; ¹ Engineering industry. ¹ in addition, occupational exposures to environmental toxins occur in a wide range of other industries including waste treatment and disposal industries (e.g., formation and release of dioxins during industrial waste incineration) ¹ , the energy industry (e.g., emissions from coal-fired power stations, fracking, contaminated cooling water from nuclear power plants) ¹ , and; the transport industry (e.g. solvents and de-icers due to use on cars and planes or accidental spill of chemicals due to a traffic accident involving a transport lorry). ¹ (Donner et al, 2010).

¹ Categories or examples that are marked with an asterisk are listed as xenobiotics in Donner et al (2010).

² Find out more about the 30 most commonly found pesticides in UK foods at Pesticide Action Network website: <http://www.pan-uk.org/food/30-most-commonly-found-pesticides> [last accessed 15 December 2012].