

INTRODUCTION TO DRINKING WATER CONTAMINANTS

RACHEL NICOLL



‘The next war in the Middle East will be over water, not politics’ (1977, Boutros Boutros-Ghali, UN Secretary-General)

- Approximately 40% of the world’s population face some level of water shortage.
- >2.3 billion people live in river basins in which surface water supplies are under stress, largely due to increased need for water for irrigation.
- It is estimated that by 2023, global demand will outstrip supply.

BUT MERELY SUPPLYING WATER IS NOT ENOUGH

- It needs to be free of bacteria, chemicals, metals and other toxins.
- Instead it is inadvertently contaminated with fertilisers, pesticides, industrial waste, toxic metals and pharmaceutical drugs. See handout.
- It is also deliberately contaminated with disinfectants and, in some areas, fluoride.
- It had long been thought that discharging chemicals into water would simply dilute them harmlessly.
- Now it is clear that is not the case, for 2 reasons:
 - Most chemicals are lipophilic and hence cannot be diluted by water.
 - Aquatic microorganisms transform them, making them either more toxic or more bioavailable than the original. Examples include trichloroethylene, which can be transformed into vinyl chloride, a more toxic carcinogen, and inorganic mercury which can be transformed into the highly toxic methyl mercury.

REGULATION

- The WHO has issued Guidelines for Drinking Water Quality but implementation is down to national standards. The WHO has no regulatory authority.
- In the UK, standards are set by DEFRA but the means by which they are upheld is down to the local water companies.
- In practice, the focus is almost entirely on killing dangerous microorganisms rather than the overall extent of chemical contamination.

HOW WIDESPREAD IS THE INADVERTENT CONTAMINATION?

- A 1971 US report showed that drinking water contained more than 2,100 carcinogenic chemicals.
- Things had not improved in 1998: another US report assessed groundwater under a golf course and found 39 herbicides, 30 insecticides, 32 fungicides, 4 nematicides, 3 pesticide adjuvants and 7 growth hormones, most of which are considered POPs.
- Studies of sewage water effluent have found pharmaceutical drugs (including antibiotics, hormones, strong pain killers, tranquilisers and chemotherapy drugs), which will be recycled back into drinking water (Hignite C, Azarnoff DL, 1977; Daughton CG, Ternes TA, 1999).

DELIBERATE WATER CONTAMINATION

- In Europe there is a legal requirement for public water to contain disinfectant chemicals to destroy micro-organisms.
- Water may also contain coagulants and flocculants (to bring colloids out of suspension) to make disinfection more effective.
- This has largely resulted in the eradication of numerous waterborne diseases including cholera and typhoid.

DISINFECTANT CHEMICALS

- Chlorine is generally considered to be an effective barrier to pathogens, providing an easily measurable residue to indicate that disinfection was carried out and preserving its effect in the water distribution system.
- However, a number of microorganisms are now thought to have become resistant to chlorine, particularly the parasite *Cryptosporidium parvum*.
- Other disinfectants may also be used: chloramines, chlorine dioxide or ozone. These can slow the disinfectant resistance but tend not to remain in the water system, allowing microorganisms to reappear later in the distribution chain.
- Chlorine and other disinfectants also produce disinfectant byproducts (DBPs), resulting from the interaction of the disinfectant with organic matter in the water (sewage, animal waste, soil, plant material).
- Brominated by-products (BBPs) are also produced from the reaction of ozone with bromine.

POOR DISINFECTION OR CHLORINE RESISTANCE?



Residents in a County Donegal village were told to boil their drinking water after a reservoir became contaminated with bacteria (BBC, 2008).

Some residents in the affected areas say they have not been provided with information quickly enough



WHAT ARE DISINFECTION BYPRODUCTS (DBPs)?

- Many DBPs are halomethanes: chloroform, bromoform, dichloromethane, dibromomethane, trichloroacetic acid and mutagen X, but predominantly chloroform (Nieuwenhuijsen MJ 2000).
- Showering is an important route of exposure to chloroform and trihalomethanes. The quantity inhaled during a 15-minute shower is equivalent to drinking 8 glasses of contaminated water (Andelman JB, Environ Health Perspect 1985).
- These chemicals can also be absorbed through the skin and into the circulation; skin absorption can contribute up to 91% of the total exposure to VOCs (Brown HS, Am J Public Health, 1984).
- Hence inhalation, skin contact and ingestion must all be taken into account when assessing the exposure to DBPs (Jo WK, Risk Anal 1990).
- DBPs are carcinogenic in animals.
- Only trihalomethane levels are regularly monitored in the UK.

IN CASE YOU THINK YOU CAN ESCAPE THE CONTAMINANTS BY DRINKING BOTTLED WATER....

- Plastic bottles may leach bisphenol-A (BPA) into the water (Biles JE, J Agric Food Chem, 1997; Lambert C, Larroque M, J Chromatogr Sci 1997). Milk and juice cartons may do the same.
- >90% of the world's population have BPA in their bodies; BPA has been classified as an endocrine disruptor (Venisse N, Talanta, 2014).
- The European Chemicals Agency has recently classified BPA as a reproductive toxin. If agreed by the European Parliament, this means it will be placed under control measures from November 2017.
- Only glass water bottles avoid BPA contamination.



FLUORIDE

- Fluoride was originally developed during WW2 for weapons research and was subsequently used for the manufacture of weapons-grade uranium and plutonium during the Cold War.
- Fluoride is also used as a rat poison.
- To prevent tooth decay, around 10% of the UK drinking water supply is deliberately contaminated with hydrofluorosilicic acid (an industrial waste product from phosphate fertiliser manufacture, containing arsenic, beryllium, lead, cadmium, mercury, silicon, radioactive polonium).
- Most of the remainder of western Europe has rejected fluoridation on the grounds that:
 - it does not work and
 - it is a violation of human rights to forcibly medicate whole populations of people.

‘FLUORIDE PREVENTS TOOTH DECAY’

- Some of the research shows that fluoride benefits teeth but these studies are based on naturally occurring calcium fluoride, whereas what is added to the water supply is hydrofluorosilicic acid.
- Some studies are now showing that among children there is little difference in incidence of dental caries between children living in fluoridated and non-fluoridated areas.
- And dental decay does not increase when communities stop fluoridation (Burt BA, J Dent Res 2000; Kunzel W, Commun Dent Oral Epidemiol, 2000; Seppa L, Caries Res 2000).
- The maximum allowable level of fluoride in water is 4 parts per million. But the fluoride concentration in toothpaste is considerably higher.
- The fluoride in toothpaste is generally sodium fluoride, some of which may be ingested, particularly by children. Only 5g may be a lethal dose (Bentley EM, Br Dent J, 1999).
- Several hundred children each year are treated at healthcare facilities for suspected over-ingestion of fluoride toothpaste (Shulman JD, Wells LM, J Public Health Dent, 1997).
- In the US, fluoride-containing toothpastes now come with a health warning and information on how to contact your local poisons control office in the event of accidental ingestion.

HEALTH EFFECTS OF CONTAMINATED WATER

In most instances, it is impossible to isolate water-borne contaminants as a source of disease since we all have multiple exposures from multiple sources. But nevertheless, some studies have investigated more serious solvent and nitrate exposures and found an association with birth defects.

- Industrial solvents, mainly trichloroethylene, from a waste disposal site leaked into municipal drinking water, generating an increase in childhood leukaemia and birth defects, mainly Down's syndrome, where the water was drunk by pregnant women (Lagakos SW, Wessen BJ. J Am Stat Assoc. 1986).
- Pregnant women drinking water contaminated with solvents had a higher risk of giving birth to a baby who developed childhood leukaemia (Costas, Knorr, Condon, 2002).
- Pregnant women consuming high nitrates in drinking water more frequently gave birth to babies with the CNS defect anencephaly (Croen LA, Todoroff K. Am J Epidemiol. 2001).

MORE HEALTH EFFECTS OF CONTAMINATED WATER

Water-borne solvents, nitrites, radon and radium also have an association with cancer:

- Women exposed to the highest quantities of perchloroethylene in water had an increased risk of breast cancer (Aschengrau, Rogers, Ozonoff 2003), while women exposed to trichloroethylene had a higher risk of non-Hodgkin's lymphoma (Cohn P, Klotz J, 1994).
- Solvents in drinking water were associated with bladder cancer (Mallin K, Am J Epidemiol, 1990).
- In areas with high levels of nitrites in drinking water, there may be an increased risk of gastric cancer, colon cancer and lymphoma (Gilli G, Corrao G, Favilli S 1984; McElroy JA, Trentham-Dietz A, 2008; Ward MH, Mark SD, Cantor KP, 1996).
- Increased risk of adult myeloid leukaemia in areas with elevated levels of radium in groundwater (Lyman GH, Lyman CG, Johnson W 1985).
- Association of radon in drinking water with childhood leukaemia and childhood cancer mortality (Collman GW, Loomis DP, Sandler DP 1991).

HEALTH EFFECTS OF ARSENIC IN DRINKING WATER

The level of arsenic in ground water in the UK is low, but contamination may be a problem for immigrants from Asia:

- The WHO have recognised that high arsenic contamination can contribute to cancers of the skin, lung, bladder and liver, as well as hyperkeratosis and peripheral vascular disease (WHO 2001; IARC 2003; Kurttio P, Pukkala E, Kahelin H, 1999).
- Even with lower concentrations, bladder cancer risk can be exacerbated by smoking (Bates MN, Smith AH, Cantor KP 1995).
- There may also be an association with diabetes development (Brauner EV, Environmental Health Perspectives, 2014).

HEALTH EFFECTS OF DISINFECTION BYPRODUCTS

Cancers:

- **Bladder cancer** (Nieuwenhuijsen MJ 2011; Cantor KP, Epidemiology, 1998; Kantor KP, Cancer Causes Control, 1997; King WD, Marrett ID, Cancer Causes Control, 1996).
- **Rectal cancer** (Morris RD, Environ Health Perspect 1995; Morris RD, Audet AM, Am J Public Health 1992)
- **Cancer mortality** (Yang, Chiu, Cheng, Tsai 1998)

Adverse birth outcomes: spontaneous abortion, low birth weight, stillbirth and congenital malformations (Nieuwenhuijsen MJ 2000; Waller K, 1998; Bove F, Shim Y. Environ Health Perspect 2002; Shaw GM, Ranatunga D, Quach T. Epidemiology. 2003).

Congenital cardiac defects (Cedergren MI, Selbing AJ. Environ Res. 2002)

However..... these rates are substantially lower than the risks associated with contaminated water; in Africa infant mortality rates from inadequate and unsafe water are 2-5% annually.

HOW MANY OF YOU TELL YOUR CLIENTS TO DRINK 8 GLASSES OF WATER PER DAY?

- People who drank 8 glasses of chlorinated tap water daily for 40-59 years had a 40% greater risk of bladder cancer.
- Those who had drunk this amount for ≥ 60 years had an 80% greater risk of bladder cancer

(Cantor KP, J Natl Cancer Inst, 1987)



HEALTH EFFECTS OF FLUORIDATION OF WATER

- As a general rule, approximately half of each day's fluoride intake is retained and is taken up in bones and teeth and some organs.
- The best-known effect of fluoridation is dental fluorosis (teeth become white-spotted, yellow, brown-stained or pitted) (Griffin SO, Commun Dent Oral Epidemiol, 2002; Beltran-Aguillar ED, J Am Dent Assoc, 2002).
- Fluoride has a particular affinity for bones; overexposure is widely linked to increased risk of skeletal fluorosis, hip fracture and osteoporosis (Danielson C, JAMA 1992; Jacobsen SJ, JAMA 1990; Cooper C, JAMA 1991).
- Accumulation of fluoride begun in infancy can result in bone damage after just 38 years.
- And in case you have never seen dental fluorosis before....

A BAD CASE OF DENTAL FLUOROSIS



INTRODUCTION TO TOXIC METALS

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SOURCES OF TOXIC METALS

| | |
|------------------------------------|---|
| Non-organic foods and cans/linings | Aluminium, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, palladium, silver, titanium |
| Infant formula/food | Aluminium, arsenic, cadmium, lead, manganese, mercury |
| Cookware | Aluminium |
| Drinking water | Aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, palladium, uranium |
| Pharmaceuticals | Aluminium, copper, mercury, palladium, titanium |
| Cosmetics and toothpaste | Aluminium, arsenic, cadmium, chromium, lead, mercury, nickel, silver, titanium |
| Toiletries | Aluminium, arsenic, nickel |
| Vaccines | Aluminium as adjuvant, mercury (as thimerosal) |
| Dental materials | Cadmium, chromium, copper, mercury, nickel, palladium |
| External or internal air | Aluminium, arsenic, cadmium, iron, lead, mercury, nickel, silver, titanium, uranium |

COOKING AND EATING

- Don't assume that just because a toxin is banned in food in the EU that all imported food is similarly free of it (e.g. arsenic in US pesticides, animal feed, rice and fruit juice).
- Don't forget cooking pots and pans, especially with acidic foods, aluminium foil and anything that is 'non-stick', cutlery and cooking knives of stainless or carbon steel; ceramic cookware.



EATING FISH?

- Fish and seafood: arsenic, cadmium, iron, mercury and nickel.
- A US study shows that all river fish contain mercury; fish is the principal source of US mercury toxicity.
- So does the contamination of fish (metals, PCBs etc) outweigh the benefits of fish eating?



IRON IN FOODS AND SUPPLEMENTS

- Beware foods fortified with iron (unless menstruating): a 2001 US study showed that 3% of elderly were iron-deficient but 13% had iron overload.
- Also these fortified foods contain inorganic iron (aka rust).
- Those on a gluten-free diet may be at risk of iron overload since the fibre and phytate content of grains can usefully inhibit non-haem iron absorption.
- Check iron content of multis; may be ferrous sulphate and/or too high.

BABIES, TODDLERS AND CHILDREN

- Maternal exposure to metals when *in utero*
- Breast milk from toxic mothers, particularly mercury
- Infant formula, particularly if made from soya: aluminium, cadmium, manganese
- Baby food: lead or arsenic if imported from US
- Toys: cadmium, lead (imported or old)
- Children's jewellery: cadmium, silver, thallium, lead (use of lead in plastics has not been banned!)
- Lead and mercury from peeling paint in old homes: attractive to infants

Lead in baby food? Surely not?

**Lead In Baby Food: Trial
Against Large Baby Food
Makers Begins Monday**
(Huffington Post 04/08/2013)

**A lawsuit was filed by an
environmental group against the
nation's largest baby food makers,
aimed at forcing the companies to
alert consumers that some products
contain low amounts of lead.**



VACCINATION: MERCURY

- Thimerosal, a preservative (antimicrobial) is 49.6% mercury.
- In the UK, since 2004 only hepatitis B and influenza jabs are allowed to contain thimerosal, which must be phased out.
- BUT...Green Health Watch found that in the US, manufacturers still made vaccines with thimerosal to reduce costs but filtered it out afterwards. So they are technically thimerosal-free. BUT.....
- This did not necessarily remove all the mercury, which continued to be present in vaccines, albeit in lower quantity.
- Also, US vaccines exported to 'less developed countries' could still contain thimerosal. Mercury's antimicrobial function was deemed more important than its neurotoxicity. The WHO raised no objection.

‘THEY TOOK OUT THE MERCURY AND PUT IN SOMETHING WORSE!’

www.mercola.com

- **Aluminium is added to vaccines as an adjuvant: an agent that stimulates the immune system to increase its response to the vaccine. This reduces costs for the manufacturer.**
- **Aluminium in vaccines has never been tested for safety.**
- **Studies on the HPV vaccine found that the aluminium adjuvant had no beneficial effect on immune response.**
- **There is risk of ‘accidental exposure’: a study found that some vaccines contained 5-6 times more aluminium than shown on the label.**
- **In contrast to ingested aluminium, the body absorbs 100% of injected aluminium.**

DENTISTRY

- Dental amalgams contain mercury.
- The amalgam releases mercury vapour continuously, which is exacerbated by eating, drinking and brushing and grinding teeth.
- Several European countries (not the UK!) have required amalgam fillings to be phased out. In Sweden they were banned in 1994.
- Sweden also requires all amalgam fillings to be removed from corpses before cremation to prevent environmental contamination.
- The UN Minamata Convention requires the phasing out of many mercury sources by 2020. But the treaty takes effect only after its ratification by 50 nations, which has not yet occurred.
- The EU Commission is currently debating ratification of legislation requiring 'phasing down' of mercury use, rather than 'phasing out'.
- Even toothpaste contains metals: mercury, aluminium, titanium (whitening agent)

PHARMACEUTICALS

- **Aluminium:** aspirin and other analgesics, antacids (including Gaviscon), anti-diarrhoea medication, nasal sprays
- **Copper:** birth control pills and IUDs
- **Mercury:** vaccines, thiazide diuretics, laxatives, suppositories, antiseptics, ointments
- **Palladium:** chemotherapy; antimicrobial agent
- **Titanium:** antimicrobial; in the 'safety' coating on low dose aspirin
- **Also note that imported traditional medicines may contain lead and other toxic metals.**

HEALTH EFFECTS: MOST METALS ARE NEUROTOXINS

- Metals, particularly in the form of nanoparticles, can cross the BBB.
- Neurological problems: learning difficulties, reduced cognitive function, lower IQ, poor memory, disorientation, sensory impairment, confusion, disturbed neurotransmitters.
- Behavioural problems: hyperactivity, poor attention and responsiveness
- Mental health problems: depression, anxiety, paranoia, aggression, phobias, schizophrenia
- Possible association with autism: aluminium, mercury, copper
- Neurodegenerative disease: AD (aluminium, mercury, copper, iron); PD (iron, lead, manganese, mercury), ALS (mercury) and MS (mercury).

(Exley C, Vickers T, 2014; Polizzi S, Pira E, 2002; Singh I, Sagare AP, 2013; Lei P, Ayton S, 2012; Tran TT, Chohanadisai W, 2002; Palmer RF, Blanchard S, 2009)

HEALTH EFFECTS: MOST METALS ARE ENDOCRINE DISRUPTORS

- Most metals are metalloestrogens, interacting with and distorting oestrogen receptors.
- This disrupts sex hormones, delays or accelerates puberty, causes prostate and testicular dysfunction, reduces fertility and causes PMS and PCOS.
- Aluminium may affect the pineal gland: reduced melatonin production.
- Thyroid gland: arsenic, mercury and lead are associated with hypothyroidism, probably through enzyme inhibition
- Adrenal insufficiency: copper

(Palazzolo DL, Ely EA, 2015; Rana SV, Biol Trace Elem Res, 2014; Henson MC, Chedrese PJ, 2004)

MATERNAL OR FOETAL EXPOSURE TO METALS

- Studies using hair mineral analysis confirm that all newborns have toxic metals.
- A 2004 study by the US Environmental Working Group found that blood samples from newborns contained an average of 287 toxins, including mercury, fire retardants, pesticides and other chemicals.
- Toxic metals pass into the placenta and into foetal tissues or are contained in breast milk.
- Babies' immature immune and detoxification systems cannot cope.
- Results in increased miscarriages, stillbirths, premature births, low birth weight, birth defects, cerebral palsy and increased infant mortality.
- Offspring show increased neurological problems, deranged autonomic nervous system, learning disabilities, poor memory, reduced IQ.
- Offspring have increased cancer risk

(Bouchard MF, Sauve S, 2011; Ericson JE, Crinella FM, 2007; Steuerwald U, Weihe P, 2000; Parodi DA, Greenfield M, 2014)

HEALTH EFFECTS: MOST METALS ARE CARCINOGENIC

- Increased hormonal cancers through the metalloestrogen properties of metals. Breast cancer particularly associated with aluminium antiperspirants.
- Increased non-hormonal cancers as well, particularly:
 - Kidney/bladder, since urine is main route of excretion
 - Liver, probably due to inadequate detoxification
 - Respiratory system, due to inhaled metals
 - Gastric cancer, due to ingested metals
- Animal studies show single and double DNA strand breaks, poor DNA repair and micronuclei production

(Radulescu S, Brookes MJ, 2012; Mannello F, Tonti GA, 2011; Smith AH, Marshall G, 2006; Julin B, Wolk A, 2012; Welling R, Beaumont JJ, 2015)

INTRODUCTION TO FOOD CONTAMINANTS AND ADDITIVES

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FOOD CONTAMINATION: THE SCOPE OF THE PROBLEM

- A 1999 estimate suggested that consumption of contaminated food in the US led to the illness of about 76 million people each year (Mead PS, 1999), thought to be gross underestimation of the true problem.
- Infection by biological agents (bacteria, viruses, moulds, antibiotics, parasites and their toxins) are thought to account for >95% of acute food poisoning outbreaks but individual chronic poisoning is a more insidious process.
- Food may also be contaminated by toxic metals (particularly cadmium, lead and mercury), pesticides, fertilisers, chlorinated hydrocarbons, polychlorinated biphenyls (PCBs), dioxins, furans and phthalates.
- These contaminants can gain access to the non-organic food chain at any stage during growing, processing, preparation or storage, through:
 - contamination of the soil or animal feed,
 - crop spraying
 - deposits of air pollutants onto the earth and crops
 - water used for irrigation and cooking
 - deposits of lipophilic chemicals in animal fat, including pharmaceutical drugs
 - food containers: phthalates leaching from plastic and cling film; metal cans lined with a plastic containing BPA which can leach into food, particularly fatty foods.
 - cooking pans and implements

FOOD CONTAMINATION THROUGH COOKING OR PROCESSING

- Brownd or burned meat contains heterocyclic aromatic amines, many of which are highly mutagenic.
- Acrylamide may be found in starch-based foods such as biscuits, cereals, French fries and potato crisps, that are cooked or baked at temperatures exceeding 120 degrees C.
- Acrylamide can cause neurological effects and induce cancer and heritable mutations in rats.



HEALTH EFFECTS OF CONTAMINATED FOOD

In most instances, it is impossible to isolate food-borne contaminants as a source of disease since we all have multiple exposures from multiple sources. But nevertheless, some studies have investigated acute contamination, most of which had reproductive effects:

- Hungarian villagers who ate local fish contaminated with trichlorofon (OP) from the local fish farm. 11 out of 15 live births in a 2-year period had congenital abnormalities and 4 had Down's syndrome. No congenital abnormalities were seen in the 2 years after the chemical treatment of fish was banned. (Czeizel A, Elek C, Gundy S. Lancet 1993)



ACUTE EXAMPLES OF CONTAMINATED FOOD

- In the 1950s, industrial wastes containing mercury were discharged into Minamata Bay, Japan. After eating contaminated fish, >100 people were poisoned and 46 died.
- Foetuses exposed *in utero* were born with nervous system anomalies (cerebral palsy, ataxia, disturbed psychomotor development, mental retardation, microcephaly), although there were no symptoms in the mothers (Harada M. Teratology 1978).



ACUTE EXAMPLES OF CONTAMINATED FOOD

In Iraqi Kurdistan in 1971, grain treated with methyl mercury as a fungicide was distributed for planting. However, because there was a famine, many people used them for baking bread. After eating the bread, >6,000 were hospitalised with acute mercury poisoning and nearly 500 died. Hundreds of pregnant women gave birth to babies with congenital defects (Bakir, 1973; al-Mufti, 1976).

A plot to eliminate the Kurds?



ACUTE EXAMPLES OF CONTAMINATED FOOD

- Japan and Taiwan both had outbreaks of disease following use of cooking oil contaminated with PCBs. Among pregnant women there were increased stillbirths and babies born with low birthweight, pigmented skin and neonatal jaundice.
- (Kuratsune M, Yoshimura T. Environ Health Perspect 1972; (Hsu ST, Ma CI. Environ Health Perspect 1985).



ANTIBIOTIC AND HORMONE USE IN FARM ANIMALS

- Animals bred for meat are regularly treated with hormones or medications, both oral and by vaccination, containing antibiotics to prevent infection or to inhibit its spread. Animals may also be exposed to pesticides via sheep dips, fly dressings and tick treatments.
- These chemicals are generally lipophilic and remain in adipose tissue and fatty deposits.
- Some countries also allow growth hormone to be fed to livestock to encourage early growth, although it was banned in the EU in the 1980s. However, all non-EU imports of meat, especially beef, may contain growth hormone.

ANTIBIOTIC AND HORMONE USE IN FARM ANIMALS

- The high use of antibiotics has contributed to antibiotic resistance in various pathogens. After FDA approval of fluoroquinolones for feeding to poultry, >15% of *Campylobacter jejuni* and 30% of *Campylobacter coli* isolated from humans showed resistance to the antibiotic (Falkow, Kennedy, 2001). Antibiotic resistance is thought to cause around 70% of fatal hospital infections.
- The EU banned use of some antibiotics to help prevent the spread of infections such as *Staphylococcus aureus* in humans, with the result that fewer resistant bacteria were found in both animals and humans (Ferber D, 2002). *Staph. aureus*, the cause of MRSA, is one of the most common causes of hospital- and community-acquired infections in humans.

BBC News 23 April 1998



There are fears that feeding antibiotics to farm animals could lead to drug-resistant bacteria being passed on to humans

The continued use of growth promoters - low-dose antibiotics placed in livestock feed - risks the development of antibiotic-resistant bacteria which could threaten human health. The rapid reproduction of bacteria means there is always a chance that a population of microbes will develop which is antibiotic resistant.

FOOD AND BEVERAGE ADDITIVES

- Include colouring agents, antioxidants, emulsifiers, stabilisers, stimulants, flavourings, preservatives, artificial sweeteners.
- Of particular concern are the additives tartrazine (FD&C yellow 5), sulphites, nitrates, BHT (butylated hydroxytoluene), BHA (butylated hydroxyanisole), aspartame.
- Most studies have been of single food additives in animals. But humans consume them in large quantities and in multiple combinations, which have never been tested.
- Many can cause allergies and sensitivities and are banned in some countries.

BREAST MILK: THE ULTIMATE CONTAMINATED FOOD?

- The breast feeding dilemma has a lot of nutritionists and EM doctors stumped!
- Human milk is without question the best source of nutrition for human infants, as it contains the optimal balance of fats, carbohydrates and proteins and contains immune and growth factors which can influence brain development and increase resistance to chronic diseases and allergy.
- But....human breast milk can be contaminated by toxic chemicals, including PCBs, DDT, dioxins, dibenzofurans, PBDEs and heavy metals (Sonawane, 1995; Hooper K, McDonald, 2000; Hooper K, 1999; Dewailly E, 1993).
- Longitudinal studies of babies which consumed breast milk are lacking and there are no standards for a 'safe' level of contaminants in breast milk.
- However, the American Academy of Pediatrics believes that the benefits of breast feeding outweigh the risks.
- What do you think?

INTRODUCTION TO FOODS AND BEVERAGES AS TOXINS

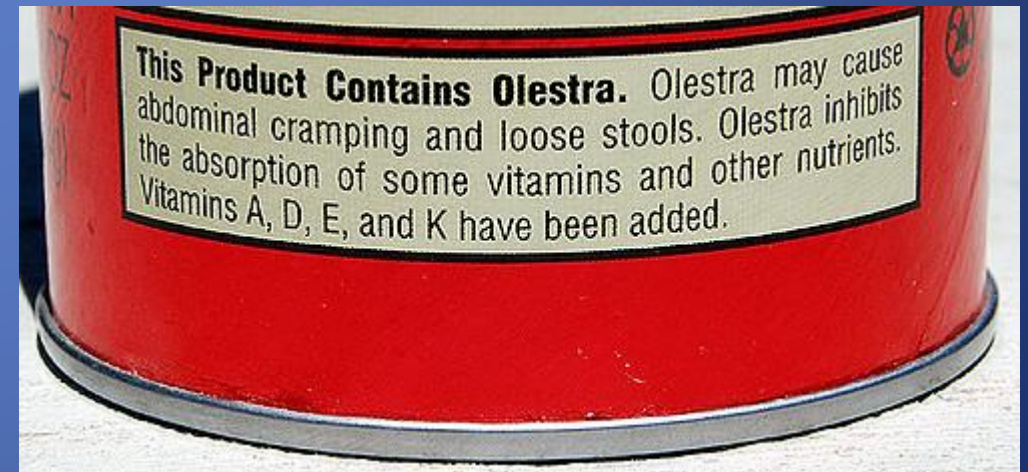
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TRANS-FATTY ACIDS AND HYDROGENATED OILS

- Trans fats and hydrogenated oils (HOs) are found in margarine, commercially baked goods, deep-fried foods, fast foods and many restaurant foods.
- High intake of trans fats and HOs raise LDL-C and lower HDL-C compared with cis-fatty acids, raise the total/HDL cholesterol ratio twice as much as saturated fat and increase plasma lipoprotein(a) and triglycerides.
- One mechanism of action is to inhibit delta-6-desaturase, thereby decreasing the metabolism of essential fatty acids.
- They also increase plasma markers of inflammation (CRP, IL-6, TNF-alpha and E-selectin) in healthy men (Baer DL, Judd JT, Clevidence BA, 2004; Mozaffarian D, Pischon T, 2004)
- High intakes of trans-fats can promote insulin resistance and increase the risk of T2D (Bray GA, Lovejoy JC 2002).
- Trans-fats increase the risk of colon and breast cancer (Kohlmeier L, Simonsen N, 1997; Bakker N, Zock PL 1997), allergic diseases in children (Stendera S, Dyerbergh J 2004) and neurodegenerative diseases (Morris MC, Evans DA, Bienias JL, 2003).

FAKE FATS

- Olestra, Simplesse and others inhibit fat absorption, so reducing the absorption of essential fatty acids and fat-soluble vitamins, including serum retinol, 25(OH)D, alpha-tocopherol, phylloquinone and carotenoids (Rock CL, Thornquist M, 1999).
- Promotes faecal incontinence!



SUGARS

- In 1997, the average American consumed the equivalent of 53 teaspoons of added sugars per day.
- Our genetically similar Paleolithic ancestors consumed the equivalent of 20 teaspoons of sugar per year.
- Sugars have adverse effects on weight, metabolism and triglycerides leading to T2D and CVD (Schulze MB, Manson JE 2004)
- They also affect the mesolimbic dopaminergic system, which links sugar consumption and drug addiction through stimulation of similar neural reward pathways (Levine AS, Kotz CM, 2003).
- Increase catecholamines, cortisol, inflammatory markers and markers of coagulopathy.
- Sugar is the preferred substrate of cancer cells (Warburg O, 1956).

ARTIFICIAL SWEETENERS

- **Examples:** aspartame (NutraSweet), stevia, neotame, acesulfame potassium, saccharin, sucralose, advantame and dihydrochalcones; cyclamates have been banned in the US.
- Questions remain about the long- and short term safety of all artificial sweeteners.
- Because the breakdown products of aspartame include phenylalanine, it must be avoided by people with the genetic condition phenylketonuria.
- Aspartame is also an excitotoxin (Uribe M, 1982; Olney JW, 1984; Garriga MM, Metcalfe DD, 1988) and includes methanol and formaldehyde, both toxic in their own right (Trocho C, 1998).
- It can disrupt brain chemistry and increase seizure risk, depression and headaches (Sharma RP, Coulombe RA, 1987; Camfield PR, 1992; Walton RG, 1993; van den Eeden SK, 1994; Lipton RB, 2001 and 1989).

HIGH FRUCTOSE CORN SYRUP (HFCS)

- The consumption of HFCS increased >1000% between 1970 and 1990, far exceeding the changes in intake of any other food or food group.
- HFCS now represents >40% of caloric sweeteners added to foods and beverages and is the sole caloric sweetener in soft drinks in the United States (Bray GA, Nielsen SJ 2004).

The Corny Truth About HIGH FRUCTOSE CORN SYRUP

Top 10 Foods with the Highest Quantity of HFCS:

- | | |
|---------------------|------------------------|
| 1) Yogurt | 6) Boxed Mac n Cheese |
| 2) Breads | 7) Salad Dressing |
| 3) Frozen Pizza | 8) Tomato-Based Sauces |
| 4) Cereal Bars | 9) Apple Sauce |
| 5) Cocktail Peanuts | 10) Canned Fruit |

***High Fructose Corn Syrup has been linked directly to obesity, diabetes and metabolic dysfunction**



HFCS MECHANISM OF ACTION

- Glucose is transported into the brain, where it stimulates insulin and leptin secretion and reduces ghrelin. These hormones signal satiety and reduce appetite.
- However, fructose does not stimulate insulin or leptin secretion and nor does it reduce ghrelin. Instead, it decreases levels of adiponectin, increasing insulin resistance.
- Fructose consumption is associated with insulin resistance, increased energy intake, impaired metabolism, weight gain, dyslipidaemia and hypertension. HFCS's introduction into the food supply coincided with the obesity epidemic and may play a causal role (Bray GA, Nielsen SJ 2004).
- The same problems do not occur with the fructose in whole fruit, as quantities are much lower and the fructose is taken in with fibre and micronutrients, which modify its effect on gastric and other peptides.

PHYTOESTROGENS AND ISOFLAVONES

- Isoflavones first drew attention as a possible health hazard in the 1940s, when Australian ewes grazing on clover were found to have reduced fertility (Bennetts H, J Dept Agric West Aust 1946). [Clover contains the isoflavone coumestan]
- Isoflavones comprise mainly genistein, daidzein and coumestan. They are the most important class of phytoestrogens and are found predominantly in legumes, particularly soybean.
- When taken as food, they may have beneficial effects and may be protective against breast, uterus and prostate cancer in Asian women who consume large quantities (Boulet MJ, Maturitas 1994). These women do not take them as supplements.
- In larger amounts phytoestrogens become endocrine disruptors (Strauss L, Toxicol Lett, 1998). In sufficient quantities, they evoke all the same hormonal responses as physiological oestrogens (Kuiper GG, Endocrinology 1998).

HEALTH EFFECTS OF SUPPLEMENTAL PHYTOESTROGENS

- Supplemental phytoestrogens have shown mixed results in relieving menopausal symptoms (Albertazzi P, Obstet Gynecol 1999; Washburn S, Menopause 1999; Albertazzi P, Obstet Gynecol 1998; Knight DC, Climacteric 1999; Baber RJ, Climacteric 1999).
- Several recent trials have found that a placebo works as well as red clover and better than soya isoflavones at relieving hot flushes (Knight DC, Climacteric 1999; Baber RJ, Climacteric 1999; Quella SK, J Clin Oncol 2000).
- High levels of soya during pregnancy increased the risk of breast cancer in female offspring (Hilakivi-Clarke L, Oncol Rep 1999) i.e. the effect is not confined to one generation.
- And *in vitro* studies of cancer induction show mixed results, with some showing increased cell proliferation with red clover (Zava DT, Proc Soc Exp Biol Med 1998).
- The US Centers for Disease Control (CDC) have now added phytoestrogens to the list of potential human toxins.
- Concern over the phytoestrogen content of soya led to the UK government to conclude that there is cause for concern regarding widespread use of soya-based infant formulas.
- We don't yet know the long term effect of consuming large amounts on a regular basis. Although.....

Another use for phytoestrogens?

- A high intake of dietary soya for just 14 days significantly stimulated the proliferation rate of healthy breast cells (McMichael-Phillips DF, Am J Clin Nutr 1998).
- Consequently, phytoestrogen supplements are now being marketed as a form of natural breast enhancement.



SOYA-BASED BABY MILK

- Concerns have been raised about soya-based baby milk. In a typical day an infant will receive 11mg of phytoestrogens per kg of body weight, compared to 1mg/kg in an adult (Barrett JR, Environ Health Perspect, 2002).
- Soya baby milk is thought to induce subtle changes in menstrual patterns as a young adult (Strom BL, JAMA 2001).
- Soya baby milk also contains high levels of thyroid-disrupting cadmium (Eklund G, Oskarsson A, Food Addit Contam 1999). In addition, heating infant formula in plastic bottles may release BPA and phthalates into the liquid.
- In the UK, soya baby milk is now only available on prescription.

'Concern over soya baby milk' BBC May 2002



HEALTH EFFECTS OF GOITROGENS

- Goitrogens include the isoflavones found in soyabeans and the isothiocyanates in the Brassica family of vegetables (turnips, cabbage, broccoli, cauliflower, Brussels sprouts, mustard greens, kale, kohlrabi, rutabaga) (Doerge DR, Chang HC 2002; Doerge DR, Sheehan DM 2002; Stoewsand GS 1995).
- Both isoflavones and isothiocyanates are heat-sensitive, so cooking lowers their availability (Conaway CC, Getahun SM, 2000; Rouzaud G, Young SA 2004).
- Goitrogens reduce thyroid hormone output by blocking the activity of thyroid peroxidase, the enzyme responsible for adding iodine to the thyroid hormones.

FOOD ALLERGIES AND SENSITIVITIES: WHEN NOURISHING FOOD BECOMES A POISON

- The body must differentiate friend (nutrients, water, oxygen, beneficial microbes) from foe (pathogenic microbes and environmental toxins).
- Allergies and sensitivities develop when the immune system is unable to distinguish between the two and treats a nutritious food as an allergen.
- Anaphylaxis is the life-threatening IgE-mediated form. But lesser sensitivities can develop to almost anything but predominantly milk, eggs, wheat protein, peanuts, soy, tree nuts, fish and shellfish.
- Sensitisation may result from long term exposure or may be triggered by a sensitising event such as a large toxic dose of some other chemical.
- Once an individual is sensitised, a reaction can be caused by a tiny portion. Avoidance is the only solution, although some remain allergic for life.

ALCOHOL: INTAKE AND METABOLISM

- Alcohol is readily absorbed from the stomach and intestine but is slowed by the presence of food; it can also be absorbed by the lungs.
- Alcohol is metabolised in the liver by alcohol dehydrogenase to acetaldehyde, a toxin. High levels cause headache, nausea and vomiting (i.e. a hangover).
- Humans have varying amounts acetaldehyde dehydrogenase. Approximately 50% of Asians have a single base change in a gene that codes for acetaldehyde dehydrogenase, resulting in an inactive form, making drinking alcohol extremely unpleasant.
- This is how the drug Antabuse (disulfiram) works, prescribed to cause an aversion reaction to alcohol by blocking acetaldehyde dehydrogenase, causing blood levels of acetaldehyde to rise.
- Females will have a higher blood alcohol concentration for any given intake than males, because:
 - They have lower body weight,
 - They metabolise less alcohol in the intestine than men, giving higher blood levels,
 - They have a greater proportion of body fat, resulting in lower volume of fluid by weight.

FIRST WRITTEN ALCOHOL WARNING?



And the angel of the Lord appeared unto the woman and said unto her ‘...thou shalt conceive and bear a son.....drink not wine nor strong drink and eat not any unclean thing’.

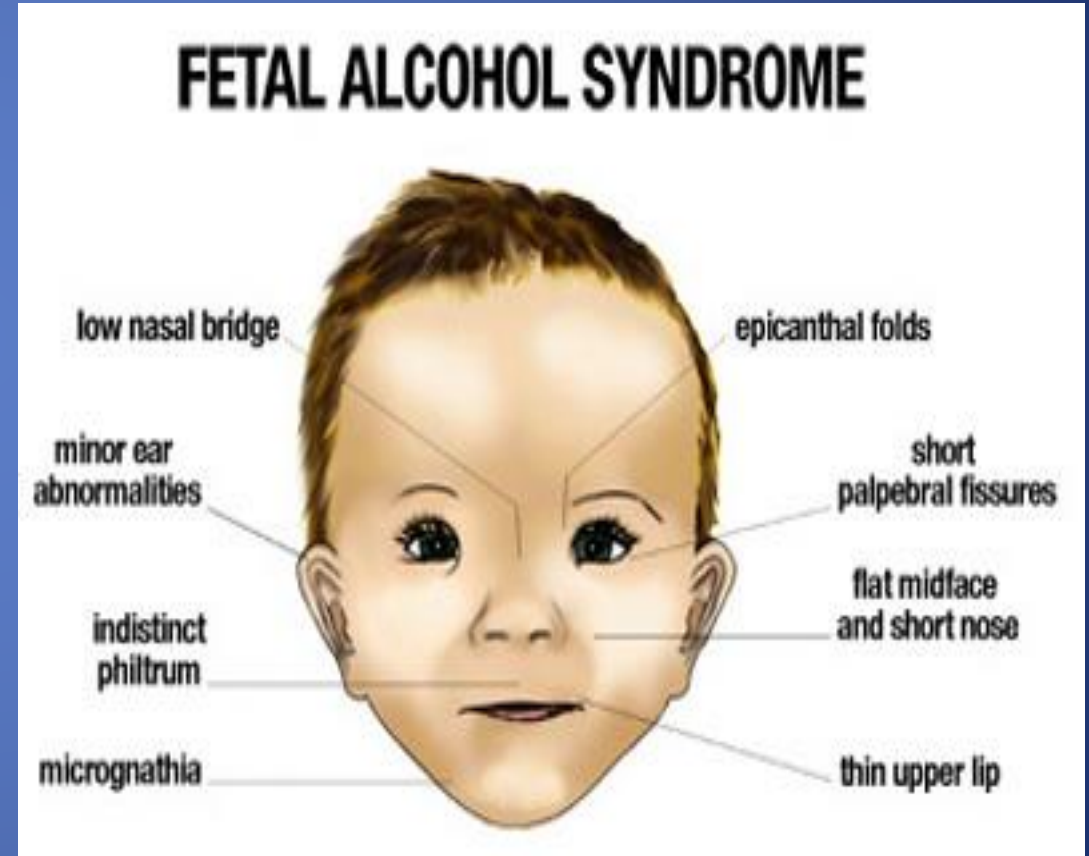
(Judges 13:3-4).

HEALTH EFFECTS OF ALCOHOL IN PREGNANCY

- Alcohol consumption during pregnancy causes an increase in stillbirths and spontaneous abortions.
- It was first noted in 1923 that the placenta cannot protect the foetus against alcohol but this finding was ignored until 1973 when 2 American paediatricians coined the term 'foetal alcohol syndrome' (Jones, Smith Lancet 1973), from 8 cases manifesting as delayed growth, cognitive difficulties and facial anomalies, all with an alcoholic mother.
- As adults, they remained with mental retardation, severe learning difficulties, behavioural disturbances, emotional instability, some had no language, some had an IQ below 50, some had attempted suicide (Lemoine 1992; Streissguth 1997).
- Others displayed irritability, tremors, seizures, visual problems, hearing loss, delayed motor skills, short memory span, impulsivity, many were in trouble with the law (Hill 1989).

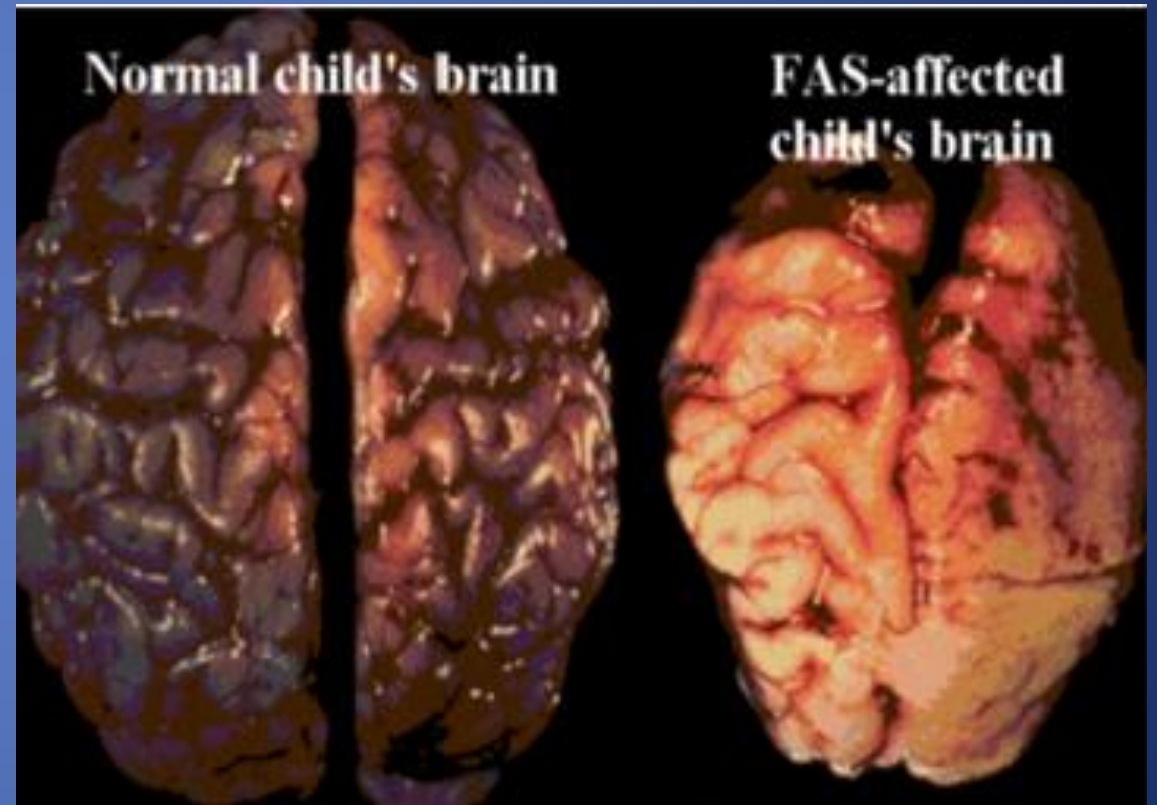
FOETAL ALCOHOL SYNDROME

- Foetal alcohol syndrome (FAS) is characterised by facial malformations, particularly around mouth and eyes, growth retardation and small head.
- FAS is thought to affect up to 12,000 newborns per year in the US, with 3 births per 1000 globally.
- Foetal alcohol effect (FAE) or alcohol-related neurodevelopmental disorder (ARND) is a milder form without facial deformities.
- The effects may persist throughout life.



FOETAL ALCOHOL SYNDROME

- Foetal alcohol syndrome is one of the leading causes of learning disabilities, CNS dysfunction, reduced IQ and stunted physical growth.
- Foetal alcohol effect (the lesser form) is still associated with learning disabilities and CNS dysfunction.



HEALTH EFFECTS OF ALCOHOL IN ADULTS

- Acute effects of alcohol include mild CNS effects such as relaxation, sleepiness, decreased motor and reaction time, uncontrolled mood swings, decreased sexual function, respiratory depression, coma and death. Vasodilatation also occurs, especially in vessels near the skin, giving an impression of warmth.
- Chronic effects of alcohol include alcoholism, addiction, liver disease, various forms of cancer, brain disorders, CV disease, other organ system diseases and malnutrition.
- An IARC 1988 report showed that alcohol is a carcinogen and an independent risk factor for cancer of the liver and upper GIT. It also increases the risk of breast cancer and possibly colon cancer.
- BUT... a low intake may be protective against CVD (Nicoll R, Henein MY, 2011).

HEALTH EFFECTS OF CAFFEINE

- Caffeine is part of the purine family of methylxanthine derivatives. It occurs naturally in a number of plants: cocoa beans, coffee beans, cola nuts and tea leaves. Its metabolites are the methylxanthines: theophylline, theobromine, paraxanthine.
- The half-life of caffeine in the body is 4-5 hours. Smokers metabolise caffeine more quickly, making the half-life around 3 hours.
- The foetus and newborn cannot metabolise caffeine and must rely solely on excretion in the urine, meaning that the half-life can be measured in days, not hours.
- Caffeine is principally a CNS stimulant, through blocking the adenosine receptor. In high dose it causes tachycardia, arrhythmia and elevated respiration.
- Effects on the developing foetus:
 - The amniotic fluid will contain caffeine in the same concentration as the mother's blood.
 - During the last 2 trimesters, maternal caffeine metabolism decreases, so the half-life increases to 8-10 hours.
 - Caffeine will block the adenosine receptor in the foetal brain; the long term effects of this are not clear.

**‘The morning cup of coffee
has an exhilaration about
it which the cheering
influence of the afternoon
or evening cup of tea
cannot be expected to
reproduce’
(Oliver Wendell Holmes
19th century US writer and
physician).**



INTRODUCTION TO PESTICIDES

RACHEL NICOLL

THE EXTENT OF THE PROBLEM

- The US EPA estimated in 1999/2000 that about 1 billion pounds of pesticides were used annually in the US and around 5.6 billion pounds globally.
- Few pesticide chemicals are applied alone; instead they are applied in formulations using different combinations of several active and 'inert' ingredients.
- Pesticides are ubiquitous in our regular environment. Grocery stores, restaurants, hotels, hospitals, nursing homes, schools and apartment buildings are routinely sprayed and fumigated, pesticides are included in bathroom and kitchen cleaners and they are in the water supply from agricultural run-off.
- Since the advent of pesticides, the total number of pests has not significantly lessened, but they have now become highly resistant to pesticides. This prompts the use of more pesticides.
- Pesticides used on foods during growth and storage cannot be washed off.

FOOD SURVEYS

- 2 UK surveys found that 46% of foods contained pesticide residues, many among the most highly toxic. This percentage rises every year and has almost doubled since 2003 when it was 25%.
 - DDT (OC), banned in the EU since the 1970s, was found in burgers, oily fish, smoked fish (particularly salmon) and liver.
 - 2,4-D (OC herbicide), also banned, was in over 50% of the organ meats tested,
 - lindane (OC) was found in 75% of the chocolate samples
 - pesticides were found in over 12% of jars of baby food
- Similar results were found in the US.
- Most pesticides are considered persistent organic pollutants (POPs).
- Of particular concern is the residues of DDT, which can bioaccumulate in ecosystems for decades. *'...there is now not a single living organism on the planet that does not contain DDT'* (Turusov V, Environ Health Perspect, 2002).

SO WHAT ARE THE AUTHORITIES DOING ABOUT IT?

- Although several pesticides are banned from sale in the EU, this does not stop EU firms manufacturing banned pesticides for export to other countries. The produce from these countries is then imported back into the EU, having been sprayed or grown with banned chemicals.
- Even when a pesticide has been banned it may still exist in stockpiles which, if poorly stored, can leach into groundwater.
- EU banning or restriction decisions are usually made based on the impact on the environment and not on human health.
- Despite European policies to reduce pesticide use, it has not in fact decreased, with new toxic chemicals replacing those now banned.
- Governments continue to insist that pesticide levels are falling and are now almost undetectable. But these surveys are normally carried out at the instigation of conventional farmers who complain that the organic food industry is stealing business from them.

‘All crops need protection from disease and pests’.

**The European Crop Protection Association
(the pesticide producers’ union)**

- Although European regulations are fairly strict, there is no guarantee that manufacturers will adhere to the restrictions.
- It is usually cheaper to pay the fine if they are found out!



TYPES OF PESTICIDE

| | |
|-------------------------------------|---|
| Organochlorine insecticides | The oldest, and generally the most toxic, pesticides. Most of them are POPs and have been banned. Includes DDT, lindane, aldrin, dieldrin, chlordane, heptachlor. |
| Organophosphate insecticides | Slightly less toxic than organochlorines. Includes malathion, dursban, diazinon, trichlorofon, parathion, chlorpyrifos, malathion and mevinphos. |
| Carbamate insecticides | Similar to organophosphates. Includes aldicarb, carbaryl, methomyl, propoxur, thiophanate methyl and carbofuran (N-methyl carbamate). |
| Pyrethroid insecticides | The newest class, based on pyrethrin from chrysanthemums, supposedly much less toxic. Includes allethrin, cismethrin, fenvalerate and remethrin. |
| Herbicides | Some (e.g. paraquat) banned in the EU. Most common: Glyphosate, developed by Monsanto as RoundUp, designed for use with GM crops. |
| Fungicides | Widely used in agriculture/supermarkets. Mancozeb, maneb, tributyltin. |

DDT and its metabolites DDE and DDD

- First synthesised in the 1940s and developed as a chemical warfare agent.
- DDT bioaccumulates in ecosystems for decades and damages non-target species (Turusov V, Environ Health Perspect, 2002).
- DDT remains an important class of insecticide for the eradication of malaria in both developed and developing countries (Kapp C, WHO Bulletin, 2004).
- The US still manufactures DDT for export.
- DDT and all organochlorines may also be imported illegally.

ORGANOPHOSPHATES



Organophosphates (OPs) are also derived from chemical warfare nerve agents and were used in the Gulf War, possibly contributing to Gulf War Syndrome.

Sarin gas, used in the Tokyo subway attacks in 1995, and others were stockpiled by the military of various countries and continue to present problems of disposal.

HERBICIDES

- Also developed for warfare, they were the principal components of Agent Orange, used in the Vietnam war.
- Best known is glyphosate, developed by Monsanto as RoundUp.
- Glyphosate can commonly contaminate streams in both agricultural and urban areas.
- Herbicides are now an essential part of the agriculture industry but a serious limitation is their lack of specificity i.e. they also damage the crop they are intended to protect.
- Because of its extreme toxicity, there have been petitions to ban glyphosate.



'INERT' PESTICIDE INGREDIENTS

- Pesticides contain inert ingredients that are toxic in themselves and can enhance the toxic potential of the active ingredients. But they are not listed on the label as they are 'trade secrets'. In many cases these inert ingredients make up >90% of the pesticide product.
- Many inert ingredients are extremely toxic, including known human carcinogens.
- The health effects of pesticides may be as much to do with these 'inert' ingredients as those declared on the label.

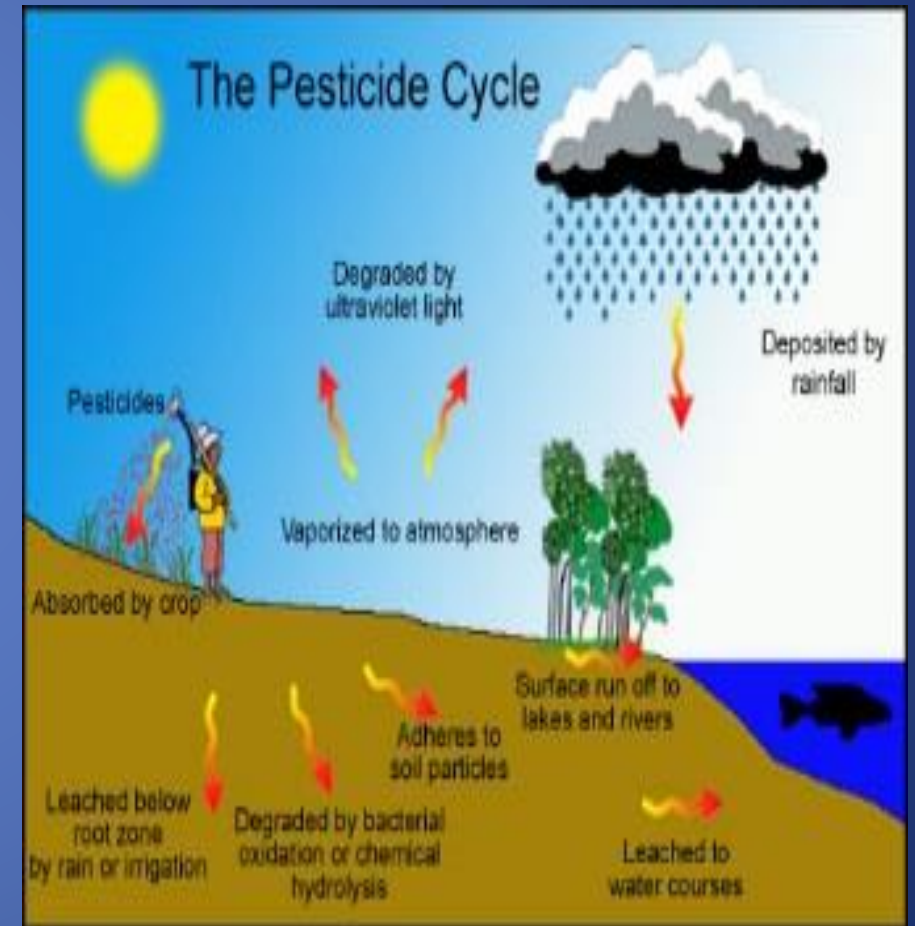
PESTICIDE EXPOSURE

Pesticide exposure can occur through:

- ingestion of contaminated foods;
- drinking water;
- inhalation (including from showering or bathing);
- skin contact.

Indoor exposure is often underestimated: domestic pesticide spraying and present in soft furnishings and flooring (Hore P, Zartarian V, 2005).

Virtually all public buildings and spaces and transportation now have some form of pest control.



PESTICIDE TOXICITY

- Pesticides have been designed to disrupt the nervous system – and they do this in varying degrees in non-target species as well as the target species.
- Acute toxicity is most associated with OCs, OPs and carbamates and affects both the CNS and PNS (Delgado E, Scand J Work Environ Health, 2004; Miranda J, Occup Environ Med, 2004).
- Chronic toxicity is also of growing concern as epidemiological and toxicological evidence accumulates. Multiple organ systems may be involved in pesticide damage in the body, particularly lungs, kidney, digestive tract, immune system, CNS and endocrine system.
- Pesticides bioaccumulate; even a single dose of fipronil resulted in its metabolite fipronil sulphone being retained in tissues (Cravedi, Chemosphere, 2013).
- A US study showed that 19% of blood samples contained more than one pesticide residue. Research is showing that ingesting multiple pesticide residues even below the arbitrary 'safe' limit can have magnified effects.

HEALTH EFFECTS OF PESTICIDES

- In the US there were between 10,000 and 20,000 medically-treated pesticide poisonings each year, including suicides and attempted suicides (Blondell J, 1997).
- Cancer: 2 reviews show that pesticide exposure can be associated with increases in the risk of non-Hodgkin's lymphoma, leukaemia, multiple myeloma, soft-tissue sarcoma, prostate cancer, pancreatic cancer, lung cancer, ovarian cancer, breast cancer, testicular cancer and Hodgkin's disease (Alanvanja, J Agromedicine, 2007; Alavanja MC, Annu Rev Public Health 2004).
- Diabetes: A review found that among Asians, OC were associated with diabetes but the studies tended to be poor in design (Jaacks, Environ Int, 2015).

HEALTH EFFECTS OF PESTICIDES

Neurodegenerative disease: Some evidence linking AD, PD and ALS with long-term/low-dose exposure to all types of pesticides although genetic susceptibility plays a part (Baltazar, Toxicol Lett, 2014; Freire, Neurotoxicology, 2012). Certain pesticides can almost completely reproduce the symptoms of PD in animals via the gut/brain axis (Klingelhoefer, Nat Rev Neurol, 2015) but there is a marked reluctance to infer that pesticides cause PD.

Neurodevelopmental toxicity: 2 reviews showed that neonates exposed to OPs had a higher proportion of abnormal reflexes and more attention problems, while children exposed to OCs had poorer alertness and attention (Jurewicz, Ann Agric Environ Med, 2013; Polanska, Int J Occup Med Environ Health, 2013).

HEALTH EFFECT OF GLYPHOSATE ADJUVANTS

- The toxicity of glyphosate alone to human placental cells is enhanced by the presence of Roundup adjuvants (Richard, Environ Health Perspect, 2005)
- Adjuvants caused total cell death within 24 hours (Benachour, Chem Res Toxicol, 2009)
- The Roundup adjuvant POE-15 is toxic to the mitochondria, the membrane and caspase activities (Mesnage, Toxicology, 2013).
- Several glyphosate adjuvants are deemed inert and not shown on the label.

INTRODUCTION TO GENETICALLY MODIFIED FOOD

RACHEL NICOLL

WHAT IS GENETICALLY MODIFIED (GM) FOOD?

- Genetically Modified food may also be known as Genetically Engineered food.
- It may be directly modified or contain ingredients which are derived from GM technology (i.e. they contain genes from other plant, animal or bacterial species or modified genes constructed in the laboratory).
- Bacterial genes inserted into plants will produce molecules that function as natural herbicides and pesticides and some will also block the action of synthetic herbicides, fungicides and insecticides in the plant. This allows farmers to use high doses to kill the weeds without damaging the plant. In theory, the reduction in pesticide use may offset the increased risks.
- A serious limitation to most herbicides is their lack of specificity i.e. they also damage the crop they are intended to protect. Monsanto developed RoundUp, the glyphosate-based herbicide, and then manufactured a genetically modified soybean (called RoundUp Ready) which was resistant to the herbicide and is now widely planted and so increases the sale of RoundUp.

MONSANTO IS GM FOODS!

Monsanto is largely responsible for the introduction of GM foods to the food supply.

This company also produced Agent Orange and dioxins and were responsible for a massive cover-up after a PCB spill in the US.



EXTENT OF GM CROPS IN THE US

US crops taken over by GMOs:

- Soy 93%
- Cottonseed oil 93%
- Canola oil 93%
- Corn 86%
- Beets and their sugar 95%
- Hawaiian papaya 80%

Monsanto will be moving into wheat next.

According to Michael Taylor, a lawyer formerly employed by Monsanto, then appointed by Obama as the 'food-safety czar':

The only testing required in the US for proving safety is for the GM food producer to provide a self-authored report, stating that GM foods are 'substantially equivalent to food and are therefore deemed safe'.



THE DEVELOPING WORLD: WHO IS GROWING GM FOOD?

- Among the developing world, only China has developed its own biotechnology industry; all others are heavily dependent on the US.
- China is developing GM rice, wheat, potatoes and peanuts. As a result Chinese farmers are enthusiastically embracing GM crops whenever permitted to do so. They have successfully incorporated *Bacillus thuringiensis* into cotton to increase yield.
- China now has the greatest amount of land devoted to GM crops, many well-trained scientists, a low-cost research environment and large collections of germ plasm, suggesting that they may soon be exporting to less developed and industrialised countries. (Huang J, Science, 2002)
- In 2002, the Indian government approved the commercial planting of GM cotton.

APPROVAL OF GM FOODS IN EUROPE

- Since 2010, the EU treats all GM crops, along with irradiated food, as 'new food'. They are subject to extensive, case-by-case, science-based food evaluation by the European Food Safety Authority (EFSA).
- By September 2014, 49 GM crops, consisting of eight cottons, 28 maizes, three oilseed rapes, seven soybeans, one sugar beet, one bacterial biomass and one yeast biomass had been authorised.
- Member states may invoke a safeguard clause to temporarily restrict or prohibit use and/or sale of an approved GM crop within their territory if they have justifiable reasons to consider that it may be a risk to human health or the environment. The EC is obliged to investigate and either overturn the original approval or ask the country to withdraw its temporary restriction.
- By 2012, seven countries had submitted safeguard clauses. The EC investigated and rejected those from six countries and one, the UK, withdrew their objection.
- So no EU country had its objection upheld.

WHO IS GROWING GM FOODS IN EUROPE?

- Spain is the largest producer of GM crops in Europe with 137,000 hectares (340,000 acres) of GM maize planted in 2013 equalling 20% of Spain's maize production.
- Smaller amounts were also produced elsewhere.
- The principal opponents of GM crops have been France and Germany, although Germany has approved a potato modified with higher levels of starch for 'industrial purposes'.
- Co-existence of GM and non-GM crops is regulated by the use of buffer zones and isolation distances. But the guidelines are not binding and each Member State can implement its own regulations. This has resulted in buffer zones ranging from 800 metres (Luxembourg) to only 15 metres (Sweden).
- Member States may also designate GM-free zones, effectively allowing them to ban cultivation of GM crops in their territory without invoking a safeguard clause.

LABELLING OF GM FOODS IN EUROPE

- All food (including processed food) or animal feed which contains greater than 0.9% of approved GM ingredients must be labelled as such.
- By 2010 unapproved GM foods had been found twice and returned to their port of origin. One was a shipment of rice from the U.S., the second occurred when trace amounts of a GM maize were found in a non-GM soy flour cargo.
- In 2012, the EU imported about 30 million tons of GM crops for animal consumption.

ALLEGED BENEFITS OF GM FOODS

- Improvement in fruit and vegetable shelf-life
- Improved nutritional quality and health benefits in foods
- Improved protein and carbohydrate content of foods
- Improved fat quality
- Improved quality and quantity of meat, milk and livestock
- Increased crop yield.
- Improvement in agriculture through breeding insect, pest, disease and weather resistant crops and herbicide tolerant crops
- Use of GM plants as bio-factories to yield raw materials for industrial uses
- Use of GM organisms in drug manufacture, in recycling and/or removal of toxic industrial wastes
- The ability to withstand drought, arid conditions, impoverished soils, disease, insects or fungi
- The ability to grow in salty water
- To reduce the allergenic potential of certain foods (such as peanuts)
- The possibility of using GM livestock to grow organs for transplant into humans

OBJECTIONS TO GM FOODS

- Alteration of nutritional quality of foods
- Potential toxicity
- Possible antibiotic resistance from GM crops
- Potential allergenicity from consuming GM foods, which will often contain proteins that humans have never previously encountered
- Potential carcinogenicity from consuming GM foods
- Environmental pollution
- Unintentional gene transfer to wild plants (gene escape), creating genetic pollution and 'superweeds'. Australian and Canadian studies have demonstrated that pollen from GM plants can spread to neighbouring fields and is carried on the wind some considerable distance.
- Possible creation of new viruses and toxins
- Development of insects resistant to natural toxins
- Limited access to seeds due to patents being taken out on GM food plants
- Threat to crop genetic diversity
- Religious, cultural and ethical concerns.

HEALTH EFFECTS OF GM FOODS

All studies to date are of animals. The majority demonstrate that GM foods present no problem, but...:

- A study of lab rats fed exclusively GM foods for 2 years found that all of them had organ failure or organ damage, half of them were sterile and the other half had growth aberrations (Pusztai A 2002).
- Renal tumours developed in rats fed GM maize (Hardisty JF, Food Chem Toxicol, 2013).
- Chickens fed GM soy developed inflammatory and degenerative liver lesions, muscle hypertrophy, kidney tubular necrosis and necrosis and ulceration of the bowel (Cirnatu D, Jompan A, 2011).

POTENTIAL EFFECTS OF GM FOODS IN HUMANS

- GM foods contain altered DNA. When we ingest them, the altered DNA now becomes a part of us. This has the potential of damaging our genetic code or, far worse, becoming incorporated into our genetic code.
- Anything foreign to the body is an antigen, to which the body will make antibodies. This could potentially give rise to a host of new autoimmune diseases.

GENETICALLY MODIFIED FOOD



‘Control the oil and you control entire continents. Control the food and you control the people’.

Henry Kissinger

AND FINALLY..

- ‘If it has a label, it isn’t food’ – but with the absence of any requirement to label GM food or any ingredients this may now longer be true.
- Genetic modification (aka genetic engineering) is based on the premise that man knows better than nature.

