

COMMENT**Are we oversensitive to risks from toxins?**

Campaigns to frighten the public about 'toxic' chemicals may put us all in danger, says Anthony Trewavas of the Institute of Cell and Molecular Biology at the University of Edinburgh, UK.

by **Anthony Trewavas**

This past year has seen two campaigns designed to create anxiety in the public mind by telling us that traces of 'hazardous, man-made industrial chemicals' can be found in the human body. The most recent, *Britain's toxic teens*, published by the Cooperative Bank and the World Wildlife Fund (WWF), focuses on brominated fire-retardant chemicals and phthalates used in plastics. An earlier report concentrated on agrochemicals and used an ex-minister of agriculture as one of its volunteers.

Both reports seem to neglect the fact that modern instrumentation is so sensitive that anything with which humans come into contact, no matter how small, is detectable, and that natural chemicals can be as hazardous as man-made ones. In addition, both reports show no awareness of the cardinal rule of toxicology; virtually all chemicals are hazardous, but how hazardous simply depends on the dose.

Drinking six pints of water quickly can kill you due to the resulting disturbance of your ion balance. Three teaspoonfuls of salt will kill a baby. A tablet of aspirin is good for your circulation, 30 will stop it for good. Insulin is essential for controlling blood glucose levels, but an excess of it easily kills.¹

Brominated fire retardants can cause disturbance to the thyroid, but only at concentrations about one million fold higher than human consumption.² Phthalates in plastics are described as endocrine disrupters, but effects would require human uptake about 100 000 fold higher than current ingestion levels before anything emerged.³ Biological sites bind over a concentration range of about 50-fold. High dose effects, such as those used to characterise supposed hazards, induce unique biological changes that have no relevance to the very low human exposures. High dose effects are only relevant to high doses. J-shaped hormetic responses which characterise the dose response of most chemicals examined in this low-dose range have shown that 'hazardous' chemicals such as dioxin, cadmium, saccharin, anthracenes can lower cancer rates well below the levels seen in control animals.^{1,4}

We are surrounded by 'hazardous' chemicals and always have been. Natural pesticides that have developed in fruit and vegetables to protect them from insects are 'hazardous'. They attack insects in a similar way to synthetic insecticides, and represent about 1–2% dry weight of any fruit or vegetable. We consume these natural pesticides every day in gram quantities; average synthetic pesticide consumption is in micrograms,⁵ and fire retardant consumption in nanograms.² Natural pesticides that are consumed daily contain numerous carcinogens, teratogens, nerve toxins, psycho-active compounds, abortifacients, sterility inducing agents, mutagens, chromosome breakers and oestrogen mimics.^{6,7} Theobromine, about 1–2% dry weight of chocolate, induces sterility in rodents.

Daily consumption of the oestrogen-mimics, flavanoids and isoflavones in fruits and genestein in soya milk would increase circulating oestrogen-type activity by some 3–4%; that of phthalates in plastics by 0.0006% and polychlorinated biphenyls by 10–6%.³ Allyl isothiocyanate is a chromosome breaker at 1/50 000 the

dose of a single cabbage leaf.^{5,7}

We do not go mad or bubble up in tumours after a vegetable or fruit meal. But thousands of natural chemicals enter our bloodstream after every meal, both from traditional foods and exotic ones such as kiwi, coffee, celeriac, mango and yam. There are enormous possibilities for synergy with every new food. Water-soluble natural pesticides are excreted, but fat-soluble natural pesticides will partition into membranes and accumulate if consumption continues. Numerous defence mechanisms, including hormesis, help deal with low doses of any 'hazardous' chemicals. Such mechanisms were essential for hunter gatherers, who could only eat what was available at the time not whatever they chose.⁵

Detailed investigation of the human toxicology of natural pesticides is almost completely absent, thus we do not know where current consumption lies on any dose–response curve. Of greatest concern is the evidence that sensitivity to natural pesticides varies among the human population.

But continued consumption of natural pesticides does not lead to adaptation. A three to four fold elevation of the potato glycoalkoids, solanine and chaconine (a teratogen), caused by a multiplicity of different environmental and physical conditions, has killed more than 30 people and poisoned several thousand.⁸

Because the symptoms of poisoning are very similar to bacterial food poisoning, many other thousands of poisonings are thought to go unremarked. Excess cucurbitacin in courgettes has also caused sickness; excess psoralen in celery induces serious dermatitis;⁵ cattle have died from eating green vine tomatoes containing tomatine. Consumption of 500g of potato at one meal will institute mild poisoning in sensitive people.⁹ The (long-term) chronic effects of solanine are unknown.

Potato solanidine (the only natural pesticide properly investigated) accumulates in the human liver, kidneys and other tissues,¹⁰ it is thought to be released during pregnancy, and it is detectable in human cadavers. Solanine and chaconine are detectable in the blood from a single meal containing potato,¹¹ and solanidine will still be detectable in the body a year later.¹⁰ Solanine and strychnine are both fatal at 4–6mg/kg;⁹ brominated fire retardants have their thyroid effects at 0.8–8mg/kg.

Life expectancy continues to rise and cancer rates to fall. We are an increasingly healthy population and industrial chemicals of many kinds have contributed substantially to that end. The UK government estimates that 360 lives are saved, and 3300 mutilations and disfiguring burn injuries are avoided every year by use of flame-resistant furniture in the home.¹²

The campaign against brominated fire retardants is being promoted by people with little understanding either of toxicology or of actual rather than imagined risk. If it succeeds then all of us and our families are placed in much greater danger.

References

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