Why Ban Sex Hormones in the Nursery?

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"He put away the soma bottle, and taking out a packet of sex-hormone chewing-gum, stuffed a plug into his cheek and walked slowly away" (Brave New World, Aldous Huxley, 1932, p. 60).

Canada has just declared bisphenol A to be a toxic substance (Government of Canada, 2008). Which is odd considering that, as I write, all the baby bottles for sale in this town are made from bisphenol A. Well, maybe there is a glass baby bottle for sale, but if there is, I didn't find it. Canada has responded to the accumulating evidence that bisphenol A, (also known as BPA), leaches from polycarbonate baby bottles and behaves like an estrogen. And an extra dose of female sex hormones is not necessarily the best of dietary supplements for babies, either male or female; or for teenagers, or even adults.

Canada is the first country in the world to act to banish bisphenol A from the nursery (Nature, 2008). The regulations to implement the ban are currently being drafted and it is expected they will be in place in 2009 (Health Canada, 2008). Canada leads the world in announcing its new regulations: "to prohibit the importation, sale and advertising of polycarbonate baby bottles that contain bisphenol A (BPA). The Canadian Government will also take action to limit the amount of bisphenol A that is being released into the environment" (Health Canada, 2008).

Those cute baby bottles in the pharmacy printed with nursery cartoon characters are made of polycarbonate. "Polycarbonate plastic has been the material of choice for baby bottles and reusable water bottles for decades because it's lightweight, highly shatter resistant, and transparent" (Clement, 2008). Yes, these bottles are light, strong, clear, rigid, nearly unbreakable; and that's all good. Bisphenol A is the monomer - the chemical building block - that goes to build the polymer, polycarbonate, of which these bottles are made, (mono = one; poly = many). Polycarbonate, $(C_{16}H_{14}O_3)_n$, is a polymer of bisphenol A, $(C_{15}H_{16}O_2)$. When those chemical bonds which stitch the polymer together break (depolymerization),

then there can be a reversion to the monomer, bisphenol A.

Heat has been identified as one factor accelerating the release of BPA from polycarbonate baby bottles. Research earlier this year reported that heating polycarbonate baby bottles can dramatically increase the release of BPA: "Exposure to boiling water (100 °C) increased the rate of BPA migration by up to 55-fold" (Le et al., 2008, p. 149).

The world production of bisphenol A is currently 3.3 billion kilograms per year (vom Saal & Myers, 2008), half a kilogram per person. Estrogens have biological effects at parts per billion. BPA is used in food and beverage containers, including baby bottles, some drink bottles, and food container linings, in particular can linings. A recent study in the USA reported that all the adult subjects tested had bisphenol A in their urine, and half had it in their blood (Curtis & Wilding, 2008). BPA is "detectable in virtually everyone in the United States" according to vom Saal & Myers (2008, p. 1353).

The estrogenic activity of BPA has been known at least since 1936 (Dodds & Lawson). In 1993 Krishnan et al. reported that the polycarbonate flasks that they were using in their laboratory released an "estrogenic substance" which acted as a contaminant and was interfering with their research (p. 2279).

Deborah Cadbury published The Feminization of Nature - Our Future at Risk in 1997, which is recommended reading, and in which she wrote:

> *"Hormones are the most potent chemical messengers in the body because they act directly on the genes, instructing our cells how to behave and controlling critical body functions, There is evidence that some chemicals used in plastics, pesticides and many industrial products can mimic them, and may randomly create havoc with our reproduction and sex development, and may even play a part in some cancers. More frightening still, these are chemicals which we are eating, drinking, breathing and bathing in.They are chemicals which no human escapes, sometimes even from before birth" (p. x).*

According to the latest research "BPA acts as a potent estrogen" (vom Saal & Myers, 2008, p. 1354). In a study of 28 different polycarbonate baby bottles, manufactured in 11 different countries, Wong et al. (2005) found that the amount of "Residual BPA" in polycarbonate baby bottles varies greatly from less than 3.0 mg/kg up to 141 mg/kg (p. 283). They tested the amount and speed of migration of BPA out of the fabric of the bottle and into the contents, and those metrics

seem to not directly relate to the "residual BPA" in the bottle.

In a recent issue of Reproductive Toxicology, an "expert panel" of 38 academics state their concerns about:

> *"the potential for a relationship between BPA and negative trends in human health that have occurred in recent decades. Examples include increases in abnormal penile/urethra development in males, early sexual maturation in females, an increase in neurobehavioral problems such as attention deficit disorder (ADHD) and autism, an increase in childhood and adult obesity and type 2 diabetes, a regional decrease in sperm count, and an increase in hormonally mediated cancers, such as prostate and breast cancers" (vom Saal et al., 2007, p. 131).*

Human exposure to BPA is now described as "Widespread and continuous", and that it is "primarily through food" (Lang et al., 2008, p. 1303). In a representative sample of 1455 adults in USA, higher levels of BPA in urine were associated with cardiovascular disease, coronary heart disease, and diabetes (Lang et al., 2008). Links have also recently been drawn between endocrine disrupting chemicals and obesity (Newbold et al., 2008).

Canada has taken the initiative to protect children. Why children? The "exposure to BPA during development poses the greatest risk for adverse effects; the fetus and infant are believed to be more susceptible to the estrogenic effects of BPA because

of small body size and limited capacity to metabolize BPA" (vom Saal & Myers, 2008, p. 1354). Early exposure may have lifelong adverse consequences. "BPA can alter the programming of genes during critical periods of cell differentiation during fetal and neonatal development. This process, referred to as 'epigenetic programming,' can result in the expression of metabolic disease and cancers during later life" (vom Saal & Myers, 2008, p. 1354).

Concern about BPA stretches far beyond the nursery, although that is a fine place to begin a retreat from endocrine disrupting chemicals (EDCs) in general, and BPA in particular. The anthropogenic introduction of BPA into the environment has knock-on effects throughout the biosphere. Even '"animals in the wild show evidence of harm" (vom Saal et al., 2007, p. 133).

Farmers are not exempt. BPA has recently been shown to inhibit the symbiotic nitrogen fixation (SNF) that many farmers, including organic and biodynamic farmers, rely upon. Fox et al., (2007) report that BPA disrupts the capacity of legume crops and nitrogen fixing bacteria to capture atmospheric nitrogen, and thereby crop yields are reduced.

Many plastics are imprinted with a number, from 1 to 7, within the "chasing-arrows" triangle logo. These designations can be recruited as an aid to avoiding BPA. Number 7 is "the rest", and polycarbonate falls into this category - and will therefore be excluded from many recycling schemes. PBA may also be a component PVC (#3) in which it may serve as an antioxidant. Plastics with numbers other than #7 and #3 can be expected to be free of PBA (see Table 1).

Code Number	Plastic	Bisphenol A?
1	PET - Polyethylene terephthalate	No
2	HDPE- high density polyethylene	No
3	PVC - polyvinyl chloride	Yes, Avoid
4	LDPE- low density polyethylene	No
5	PP -polypropylene	No
6	PS - polystyrene	No, Avoid styrene
7	other, including PC - polycarbonate	Yes, Avoid

Table 1: Labelling codes for plastics. For food and beverages, consider avoiding plastics coded #3, #6 or #7.

Food Standards Australia New Zealand has issued bold, perhaps reassuring, yet unsubstantiated assertions that:

> *"Bisphenol A does not cause cancer";* and
>
> *"Some studies in laboratory animals suggest that low levels of (consumed) BPA may have an effect on the reproductive system. Similar consequences in consumers at these low concentrations are considered unlikely because BPA is rapidly inactivated and then excreted in the urine" (FSANZ, 2008).*

What to do? There is space for individual, corporate and government action. Canada is the trail blazer with its banning of BPA from the nursery. There is already a call for action, with the already substantial body of existing evidence of adverse effects, "further evidence of harm should not be required for regulatory action to begin the process of reducing exposure to BPA" (vom Saal & Myers, 2008, p. 1354).

Corporations including retailers can act in the absence of, and in advance of, government action. In Canada, Toys 'R' Us announced earlier this year that "All baby bottles containing the controversial chemical bisphenol A will be pulled … by the end of the year" (CBC News, 2008).

Senjen & Azoulay (2008, p. 21) offer suggestions for minimizing baby and infant exposure to BPA. Their suggestions include: "breast-feed whenever possible for as long as possible"; if using an infant formula choose a powder rather than liquid; use glass bottles; avoid polycarbonate containers; and "use as few cans as possible".

While the issues are complex, and BPA contamination is multifaceted and multi-source, individual action can be prioritized, based on what is already understood: "of particular concern is the use of BPA in food and beverage plastic storage and heating containers and to line metal cans" (2007, vom Saal et al., p. 131). Pregnant women, and others, may reduce their BPA exposure by reducing their intake of canned food (where the plastic can lining can leach BPA), and by avoiding BPA food containers, including

Left: A recycle mark on the bottom of a bottle, with no recycle code indicating what type of plastic it is made from.

polycarbonate drink bottles. For infants, the use of glass bottles - they can still be ordered from Australian pharmacies - is indicated, as an alternative to using BPA baby bottles. If using processed baby food, consider glass jars rather than cans. Consider making a wake-up-call to FSANZ and/or your local member, to precipitate some government action.

The organic and biodynamic food sectors aim to supply the market with food free from xenochemicals which must include xeno-estrogens. In the light of the current BPA research, avoidance of BPA and polycarbonate is indicated. Organic and biodynamic farmers could be advised to avoid shipping or storing food in polycarbonate, to avoid growing under polycarbonate sheeting, and to avoid the harvesting of water from polycarbonate roof sheeting.

We have gone already some way beyond the Brave New World envisioned by Aldous Huxley. For fake sex hormones we don't need "sex-hormone chewing-gum". We are remaking the world with fake sex hormones - in the air, the water, the dust, and the food. It is surely past time to hit the brakes on bisphenol A.

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