Bisphenol A in plastics: does it make us sick?

A consumer guide[1]

September 2008

[1] For a more detailed insight into the issue of BPA, please see Friends of the Earth Australia's report: Blissfully unaware of BPA: reasons why regulators should live up to their responsibilities available at http://www.foe.org.au/BPAreport.pdf

Friends of the Earth
Australia & Europe

Bisphenol A and health

The use of plastics has become one of the defining characteristics of modern life. An increasing number of scientific studies have made a direct link between one of the major components of most clear, shatterproof plastic articles - Bisphenol A or BPA - and a surprising increase in many diseases. BPA is a known endocrine or hormone disruptor and is implicated in diseases ranging from infertility, obesity, breast and prostate cancer, to diabetes, thyroid malfunction and attention deficit syndrome.

Most of the clear, shatterproof plastics used in baby bottles, food storage containers, small kitchen appliances and hard plastic water bottles are made of plastic which contains Bisphenol A. Bisphenol A is also used in the lining of food, beer and soft drink aluminum and tin cans. Evidence of leaching of BPA has been observed for all of the above general public uses.

The endocrine system: an essential and hypersensitive regulatory system of the human body

The endocrine system of the human body is a complex network of glands, hormones and receptors that carefully regulates many body functions, including our metabolism, immunity, behaviour, growth and development during childhood.

This very finely balanced network is involved in developmental processes of cells and organs, including the development of sexual organs. The hormones also regulate our response to disease and even influence our behaviour and relationships with each other, e.g. mother-child bonding.

The endocrine system is a messaging system: the glands secrete hormones, which act as chemical messages and are transported by the bloodstream. Hormones are received by receptors, which detect and react to specific hormones in particular cell/tissue types. This mechanism functions very much like a lock and key.

Under certain conditions, extremely small amounts of endocrine-mimicking chemicals may disturb this endocrine network. This can be the case during pregnancy, early childhood, and in particular during the vulnerable periods of the development of the reproductive system

Thus, while at a certain concentration Endocrine Disrupting Chemicals (EDCs) may not alter the hormone system of adults, the same concentration may have serious effects on a baby during pregnancy or during other sensitive periods, possibly leading to permanent changes to the organ functions.

How BPA can harm you

Scientific research has shown again and again that BPA is a known and proven[2] endocrine disrupting chemical (a chemical that disturbs the hormone system). A 2007 scientific review linked exposure to BPA with an increased risk of cancer of the hematopoietic system (e.g. marrow, spleen, tonsils, and lymph nodes), a significant increase in cell tumours of the testes and an alteration of the number of chromosomes in some cells and tissues (potentially leading to mutations and ultimately cancer). Additionally, early life exposure may induce or predispose humans to an increased risk of breast cancer. When exposure occurs during foetal or early childhood development, BPA may increase a person's susceptibility to cancer by affecting their genetic developmental 'programming'.

The ability of BPA to affect and/or mimic oestrogen, a key female hormone, is well documented, but BPA's effects are not just limited to the inhibition of oestrogen. BPA also has a number of direct impacts apart from the oestrogen inhibition. These include: effects on the androgen regulation system (which regulates the growth, development, and function of the male reproductive system), disruption of thyroid hormone function, diverse influences on the development and function of the central nervous system, and potentially adverse influences on the immune system.

Furthermore, recent studies have shown that BPA can alter how genes are expressed (i.e. turned on or off) and that "low-dose BPA exposure during pregnancy has multi-generational consequences; it increases the likelihood of chromosomally abnormal grandchildren" (Susiarjo et al. 2007). In humans, abnormal chromosomes may lead to miscarriages, death soon after birth or conditions such as Down's syndrome and Turner syndrome.

It is now obvious and indisputable that BPA can have adverse effects on human health even at low doses. But how exactly does BPA get from consumer goods into our blood streams?

The scientific understanding about toxic chemicals is undergoing a revolution

One of the key arguments of the chemical and plastics industry and some governments is that the amount of BPA we ingest is so incredibly small that we do not have to worry about it. It is the traditional idea that the greater the amount of a poison, the more harmful it is.

However, research into endocrine disrupting chemicals is seriously challenging traditional thinking about toxicology. New understanding about how hormones act at extremely low concentrations is putting "the dose makes the poison" credo into a whole new and much more sophisticated context. Endocrine disrupting chemicals, such as Bisphenol A, can interfere with the body's hormonal system by acting like natural human hormones at concentrations much lower than those at which other toxic chemicals have an impact.[3]

Sometimes a low dose may be as or more harmful than a higher dose (this is known as the "low dose" effect). Industry and many governments still dispute the "low dose" effect, but scientific evidence of its existence continues to mount, both for Bisphenol A and for other chemicals.

In addition, the amount and kind of harm the chemical may cause depends on the timing and length of exposure. When several different kinds of chemicals mix together in human body, they can act additively or synergistically and cause adverse effects at concentrations that are insufficient to cause harm when a chemical is by itself. This is commonly known as the "cocktail effect".

Where BPA can be found and how it gets into you

Bisphenol A is one of the most commonly used industrial chemicals in the world today. BPA is a key ingredient in the production of plastic materials and makes them strong and shatterproof, resistant to temperatures between 40 and 145 degrees Celsius, and resistant to many acids and oils. It is also an ingredient in epoxy resins, a type of product that is tough and resistant to many chemicals, and adheres well to numerous surfaces. In addition, BPA is also used in a variety of minor applications, such as brake fluids, dental sealants and pesticides (see Table 1 for a sample list of consumer products containing BPA).

Table 1: Examples of consumer products containing Bisphenol A

Polycarbonate Plastics (65% of use)	Epoxy Resins (30% of use)	Other Uses (5% of use)
Impact-resistant glazing	Coatings	Pesticide formulations
Street-light globes	Food & beverage can linings	Antioxidant
Household appliance parts	Electrical laminates for printed circuit boards	Flame retardant
Components of electrical/ electronic devices	Composites	Brake fluid
Compact discs	Adhesives	Rubber & PVC stabiliser
Automotive applications	Paints	Water supply pipes
Reusable bottles	Nail polish	Dental sealant.
Food and drink containers		Thermal paper additive
Sunglasses		Water main filters
Refrigerator shelving		Reinforced pipes
Microwave ovenware		Electric insulators
Eating utensils		Floorings

Sources: Bro-Rasmussen 2006, Weise and Szabo 2008, Endocrine/Estrogen Letter 2003

The scientific literature shows that BPA is leached from countless consumer products, food contact materials and is released during its production into the environment is extensive (see Table 2).Whether BPA leaches out from plastics or epoxy resin coatings is related to the type of food or liquid, the temperature and heating time. Leaching rates under normal conditions of use have been measured in food containers, epoxy resins, plastics, baby bottles, take-away food containers and plastic wraps.

The BPA that has leached from food containers into food products has been detected in vegetables, fish, fruit (including fresh), canned instant coffee, powdered milk and infant formula, canned milk as well as honey. BPA has also been found to migrate from polyvinyl chloride or PVC hoses and water storage tanks, contributing to the possible contamination of drinking

water. An unexpected source of BPA may be fresh fruit and vegetables grown in greenhouses, as the chemical migrates from the PVC panels used for the walls of greenhouses into the indoor atmosphere.[4]

The potential overall environmental contamination due to BPA production is considerable and largely unacknowledged. BPA has been found in freshwater, seawater, landfill leachates (the liquid that drains from landfill), air, and dust particles. Human exposure to BPA is worldwide and pervasive. Numerous studies have found BPA in human serum, urine, amniotic fluid, follicular fluid, placental tissue, and umbilical cord blood5 despite the chemical being metabolized (i.e. broken down) in the human body within 6 hours.[5]

Table 2: Major sources of Bisphenol A exposure

Product	How
Baby bottles	Leaching from bottle into milk increases with the temperature of the content, length of contact with the bottle and significantly after repeated use.
Polycarbonate plastic bottles	55 fold increase in leaching when filled with boiling water.
Microwave plastic containers	Leaching increases with heating of containers
Polyvinyl chloride plastic wraps	Leaching observed when in contact with water, olive oil or acetic acid.
Paper towels from recycled paper	Bisphenol A is used in the production of thermal paper. Different types of recycled paper contain very different levels of BPA.
Polycarbonate plastic tubing	Leaching levels greatest in river water
Canned food lining	Leaching into foods, including vegetables, fish, fruit, instant coffee, powdered milk and infant formula.
Fresh food	Leaching from PVC in glass house panels via air onto fruit and vegetables.

Sources: as cited by Vandenberg et al. 2007, Lopez-Espinoza et al. 2007, Le et al. 2008.

What you can do to reduce BPA exposure: choose safe options

Whenever possible: choose safe options

- Store food in glass, ceramic or stainless steel containers.
- Buy fresh local products; try to avoid fruit and vegetables grown in greenhouses.

If you need to use plastic that comes into contact with food, choose safer options where possible

- Suitable plastics are those with a recycling code No.1 (Polyethylene terephthalate or PETE), No. 2 (high density poly ethylene or HDPE), recycling code No.4 (low-density polyethylene or LDPE) and No.5 (polypropylene or PP).
- In any case, take care to avoid polycarbonate plastics (PC) as much as possible.

Avoid plastics with recycling codes No. 3, 6 or 7

- No.7 (other plastics) may contain Bisphenol A and are best avoided. Additionally take care and avoid PVC (no.3) and polystyrene (no.6), as the possible residues (vinyl chloride and styrene) may also be harmful.[6]
- PVC has negative environmental and health impacts during production, use and after disposal, for instance when waste is incinerated.

Avoid heating foods or drinks in plastic containers

- Avoid heating all plastics, irrespective of their recycling numbers.
- If you need to store heated food or liquid in plastic containers, wait until the food has cooled down before transferring it.

Avoid canned food and foods grown in plastic greenhouses.

- Although it is not always possible to identify fruits and vegetables grown in greenhouses, eating seasonal products can be first step and a good way to avoid food grown in greenhouses.

Caution: food wrapping:

- Meats, cheeses, and other commercially-wrapped foods in delis/specialty food shops and standard food shops/supermarkets may be wrapped in PVC, which we recommend you avoid.
- Some of the commercial wraps sold for home use are made from polyethylene (no.4), which are probably ok.

Caution: unlabelled could mean unsafe

- Many plastic items are unlabelled and the only way to find out what they are made of is by contacting the manufacturer.
- We encourage you to do so and to express your concerns.
- In the absence of information: avoid using plastics where possible. The safer alternatives are glass and stainless steel.

Take care with all plastic products

- Take plastic products to recycling stations where possible.
- Ask your dentist to use dental sealants that do not contain BPA.

What you can do: minimize baby and infant exposure

Some suggestions to reduce exposure
Babies and infants are especially at risk from low dose BPA exposure. Here are some suggestions:

Feeding
- Breastfeed whenever possible for as long as possible. Breast milk is the optimal food for your baby, the World Health Organisation (WHO) recommends six months of exclusive breastfeeding and continued breastfeeding thereafter until two years or longer, so no need for infant formula and bottles.
- If you need to use infant formula, choose a powdered one, as liquid formulas have higher levels of BPA, and use glass bottles or cups for feeding.
- Use as few cans as possible, as the metal will probably be coated with epoxy resin which contains BPA.
- Do not use ready-to-eat liquid formulas in metal cans.
- Avoid liquid formulas that are in rigid and transparent plastic containers marked with “PC”.
- When expressing breast milk, use breast pumps, shields and jars and bags that are BPA free.

Baby bottles/sippy cups:
- Use glass or plastic baby bottles that are labelled “Bisphenol A-free” or made of polyethylene, polypropylene or polyamide.

Teats, ‘dummies’ or pacifiers
- Choose teats/‘dummies’ or pacifiers made from silicon. They are the most durable and inert options.

Ask your local childcare centre to get rid of all polycarbonate food contact and food storage materials

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Plastic Code Quick Guide

Avoid: 3,6,7
No.3-PVC (Polyvinyl chloride)
No.6-PS (Poly Styrene)
No.7- PC (Poly Carbonate)9

Probably Safe: 1,2,4,5
No.1-PET (Polyethylene terephthalate)
No.2-HDPE (High-density Polyethylene)
No.4-LDPE (Low-density Polyethylene)
No.5-PP (Polypropylene)

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Note: Number 7 is the general code for “other plastics” and may therefore include many sorts of plastics. When followed by the letter PC, it clearly indicates Polycarbonate plastics, which contains BPA and should therefore be avoided.

Demand change: engage with retailers, producers & government

- **Always read the labels.** Sometimes a company declares that their product is free of BPA. Avoid buying products that do not declare the content of their products.
- **Ask your retailer to stop using and selling polycarbonate food contact materials.** Write to them with this request.
- **Contact the manufacturer** and ask them whether the food contact material contains BPA. Tell them that you will stop buying their products, if it does.
- **Write to Food Standards Australia & New Zealand** (FSANZ) to request that they review their opinion on BPA**. Ask them to ban BPA for use in all food contact material immediately.**
- **Write to your member of parliament and ask them to take action on BPA.** Ask them to support a bill that bans the use of BPA for use in all food contact material.

---------- **Sample letter to a manufacturer**----------

Dear Sir/Madam
I am writing to ask you to inform me if your product XXX or its packaging contains Bisphenol A.

Should the product or its packaging contain Bisphenol A, I regret to inform you, that I will switch to a product that I consider more adapted to my health and that of my family.

I would also be grateful if you would inform me about steps you are taking to provide products intended for the same use, but which do not contain such potentially hazardous chemicals.
Yours faithfully

---------- **Sample letter to FSANZ**----------

Steve McCutcheon,CEO
PO Box 7186
Canberra, ACT 2610

Dear Sir,
I am writing to ask you to ask you to ban the use of Bisphenol A in all food contact materials.

There is now worldwide broad scientific consensus that human exposure to, and contamination with, BPA is widespread and at much higher levels than expected. Numerous studies have found BPA in human serum, urine, amniotic fluid, follicular fluid, placental tissue, and umbilical cord blood. The levels of BPA found in human serum, urine, placental tissues and umbilical cord blood are consistent with the levels that have been proven harmful in all studies conducted on animals.

FZANS must act. I look forward to your positive reply on this matter.

Yours faithfully

Please also consider sending a similar letter to:

- Members of the FSANZ board, see http://www.foodstandards.gov.au/aboutfsanz/theboard.cfm
- The Head of FSANZ , the Parliamentary Secretary to the Minister for Health and Ageing Senator Jan McLucas email: senator.mclucas@aph.gov.au

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Endnotes

[2] See the Chapel Hill Bisphenol A Expert Panel Consensus Statement 2007 where thirty-eight of the world's leading scientific experts on Bisphenol A have warned policymakers of potential adverse health effects of the widespread exposure to this chemical in Reproductive Toxicology 24: 131–138.

[3] Since the 1980s, scientists have been able to measure concentrations of a chemical in 'parts per trillion', or 1 part in 1 trillion (1012) – or the equivalent of one grain of sand in a sand-filled Olympic-size swimming pool of 50 x 25 meters.

[4] See Vivacqua et al. 2003 and Sajiki et al. 2007

[5] See Chapel Hill Bisphenol A Expert Panel Consensus Statement 2007, as cited.

[6] Mutti A, Mazzucchi A and P Rustichelli (1984). Exposure-effect and exposure-response relationships between occupational exposure to styrene and neuropsychological functions. American Journal of Industrial Medcine 5: 275-286.
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