

Bisphenol-A and Your Health

An Alaska Community Action on Toxics Fact Sheet

September 2007

WHAT IS BISPHENOL-A?

Bisphenol-A (BPA) is a high-volume production chemical used to make epoxy resin and polycarbonate plastic products, including some kinds of water bottles, baby bottles, and food storage and heating containers.¹ It is also used in the lining of metal food cans and in dental sealants, and is an additive to certain plastics used in children's toys.^{1,2} The chemical was first developed as a synthetic estrogen and was later polymerized to produce polycarbonate.^{3,4} Bisphenol-A mimics estrogen activity and is known as an "endocrine disruptor," a chemical that interferes with the hormonal system in animals and humans and contributes to adverse health effects.¹ Bisphenol-A also causes a variety of impacts through mechanisms of action that are probably unrelated to estrogenic properties.

HOW ARE WE EXPOSED TO BISPHENOL-A?

Humans are exposed to bisphenol-A on a daily basis through consumption of food and beverages contaminated with bisphenol-A, as well as through environmental contamination. Polycarbonate plastic can become unstable over time and with use, allowing bisphenol-A to leach into material in contact with the plastic.⁴ Additionally, bisphenol-A is now pervasive in the environment and commonly found in dust particles, surface water and drinking water, as over 6 billion pounds are produced worldwide each year⁵ and production of bisphenol-A chemical releases approximately 2 hundred thousand pounds of the chemical into the atmosphere annually.⁶

BISPHENOL-A IN OUR BODIES

A recent study by scientists from the U.S. Centers for Disease Control and Prevention found that 95% of Americans now carry bisphenol-A in their urine at an average level of 1.36 µg/g.⁷

Although the United States Environmental Protection Agency (EPA) considers exposure to 50 µg/kg/day of bisphenol-A safe, this standard was set in 1993 and is based on studies from the 1980s.⁸ Currently, there is controversy over effects of bisphenol-A on human health. In August 2007, over 30 scientific experts on bisphenol-A, known as the Chapel Hill panel, published a consensus statement in the peer-reviewed journal *Reproductive Toxicology*, stating significant evidence indicates adverse health effects occur in animals at levels within the range of exposure that is typical for humans living in developed countries.⁹ Later that month, a separate panel of scientists in the U.S. National Toxicology Program's Center for Environmental Risks to Human Reproduction (CERHR) concluded they have "minimal concern" about the role of bisphenol-A in human reproductive effects, and "some concern that exposure to Bisphenol A in utero causes neural and behavioral effects."¹⁰ While this statement by the CERHR panel makes it the first government panel in the world to declare that bisphenol-A is not safe, its conclusions nevertheless differ drastically from the Chapel Hill panel in degree of concern. Adding to the controversy are considerations that the CERHR panel excluded from review many peer-reviewed scientific studies and relied heavily upon an industry-funded study that had not been peer reviewed.¹¹

In one of the reviews of scientific literature excluded by the CERHR panel, researchers found numerous studies indicate a wide range of health effects from exposure to bisphenol-A at significantly lower doses (as low as 2 parts per billion in some studies) than considered “safe” by the EPA.¹²

WHAT DOES EXPOSURE TO BISPHENOL-A MEAN FOR OUR HEALTH?

While the majority of research on bisphenol-A has been conducted on animals and cell cultures, there is strong evidence that similar effects occur in humans. The Chapel Hill panel reached the conclusion in August 2007, “Based on existing data we are confident ... the similar effects observed in wildlife and laboratory animals exposed to bisphenol-A predict that similar effects are also occurring in humans.”⁹ Moreover, research on estrogenic compounds all over the world has consistently demonstrated that “animal studies of the effects of estrogenic substances are highly predictive of human impacts.”¹³

Since summer 2005, over 130 studies have examined the low dose effects of bisphenol-A.¹⁴ As a result, bisphenol-A has been linked to the following effects:

Endocrine disruption: As early as 1936, bisphenol-A was shown to be an environmental estrogen. Compared with natural estrogen, bisphenol-A is a less potent activator of the classic estrogen receptor, but in recent years it has been recognized that “BPA is equipotent with estradiol in its ability to activate responses via recently discovered estrogen receptors associated with the cell membrane,” as found in several studies on cell culture and laboratory animals.⁹ In addition to being shown to bind to estrogen receptors, evidence suggests that bisphenol-A also can cause alterations in endogenous hormone synthesis, hormone metabolism and hormone concentrations in blood.⁹ Exposure to bisphenol-A has been shown to cause changes in tissue enzymes and hormone receptors as well as interacting with other hormone-response systems.

Recurrent miscarriage: Researchers found that women with a history of recurrent miscarriage had average blood serum levels of bisphenol-A at 2.59 ng/ml, more than three times higher than women with successful pregnancies,¹⁵ a finding predicted by previous animal studies.¹⁶

Altered mammary gland development: In a laboratory study, mammary gland development was significantly altered in mice exposed to 250 ng BPA/kg bw_d of bisphenol-A,¹⁷ the lowest dose thus far shown to disrupt animal development. Scientists suggest that this study’s implications for human health include increased susceptibility to breast cancer after perinatal exposure to bisphenol-A.¹⁶

Prostate cancer: Research using cell cultures showed that a concentration of bisphenol-A of 1 nM made prostate cancer cells less responsive to the hormone treatment used to control prostatic adenocarcinomas into remission.¹⁸ Whether this cell culture impact also occurs in people is uncertain, but the concentration is lower than the average level of bisphenol-A found in Americans, as reported by Calafat et al. in 2005.⁷

Altered brain development and behavior: Scientists found that bisphenol-A exposure in the womb modifies sexual differentiation of the brain and behavior in rats at only 30 µg/kg/day,¹⁹ lower than the dose considered safe by the EPA.⁸ For some behaviors tested, results suggest that bisphenol-A exposure was linked to both demasculinization of males and defeminization of females.

Insulin resistance: A recent study in adult mice provided evidence of an association between bisphenol-A exposure and increased risk of type II diabetes, hypertension and dyslipidemia.²⁰ In this study, scientists found that chronic exposure to low doses of bisphenol-A yields insulin resistance in adult mice. Doses used in their experiments were 5 times lower than the dose considered safe by the EPA.⁸

Developmental origins of adult health and disease: The 2007 “Chapel Hill Bisphenol A Expert Panel Consensus Statement: Integration of Mechanisms, Effects in Animals and Potential to Impact Human Health at Current Levels of Exposure” states that enough evidence exists to suggest that adverse health outcomes may not become apparent until after exposure during critical developmental periods has happened.⁹ Especially of concern is that “these developmental effects are irreversible and can occur due to low-dose exposure during brief sensitive periods in development, even though no BPA may be detected when the damage or disease is expressed.”⁹

REDUCING OUR EXPOSURE

You can prevent or minimize exposure to bisphenol-A in the following ways:

- Use glass, stainless steel, or polyethylene bottles (PETE, PET, or #1; HDPE or #2; LDPE or #4) instead of polycarbonate (PC or #7) bottles.²¹
- Avoid heating foods in polycarbonate containers, as bisphenol-A tends to leach faster with higher temperatures.²² Use glass or ceramic containers instead.
- Cut back on consumption of canned foods to reduce exposure to bisphenol-A contamination from the interior coating of the container. Also, avoid canned foods with higher fat content, which may have higher levels of bisphenol-A.²²
- Before getting dental sealants, check with your dentist about the ingredients in the products they use, as some formulations may leach bisphenol-A.²²

REGULATIONS FOR BISPHENOL-A

Federal regulation of toxic chemicals is a critical part of protecting public health. However, according to the Environmental Working Group, “The nation's system of regulations for industrial chemicals like [bisphenol-A] are embodied in the Toxic Substances Control Act, a law passed in 1976, and the only major environmental or public health statute that has never been updated.”²³ Furthermore, “under this law, companies are not required to test chemicals for safety before they are sold, and are not required to track whether their products end up in people or the environment at unsafe levels.”²³ To date, the U.S. Food and Drug Administration has not performed a standard toxicology study or determined an Acceptable Daily Intake (ADI) for bisphenol-A.^{23,24} Globally, bisphenol-A has not been banned, restricted, cancelled, or designated illegal for import in any country.²⁵

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¹ National Institute of Environmental Health Sciences (NIEHS). 2006. Endocrine Disruptors. Available: <http://www.niehs.nih.gov/oc/factsheets/pdf/endocrine.pdf> [Accessed 25 June 2007].

² Maffini MV, Rubin BS, Sonnenschein C, Soto AM. 2006. Endocrine disruptors and reproductive health: The case of bisphenol-A. *Molecular and Cellular Endocrinology* 254-255:179-186.

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- ³ Colborn T, Dumanoski D, Myers JP. 1996. *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival?—A Scientific Detective Story*. New York: Dutton.
- ⁴ Myers JP (Ed). *Our Stolen Future: Background on BPA: What is it, how is it used and what does science say about exposure risks*. Available: <http://www.ourstolenfuture.org/NewScience/oncompounds/bisphenola/bpauses.htm> [Accessed 9 July 2007].
- ⁵ Susiarjo M, Hassold TJ, Freeman E, Hunt PA. 2007. Bisphenol A exposure in utero disrupts early oogenesis in the mouse. *PLoS Genetics* 3(1):63-70.
- ⁶ Markey CM, Michaelson CL, Sonnenschein C, Soto AM. 2001. Alkylphenols and bisphenol A as environmental estrogens. In: Metzler M (Ed.), *The Handbook of Environmental Chemistry*. Part L, Endocrine Disruptors—Part I, vol. 3. Springer-Verlag, Berlin Heidelberg, pp. 129–153.
- ⁷ Calafat AM, Kuklenyik Z, Reidy JA, Caudill SP, Ekong J, Needham LL. 2005. Urinary concentrations of bisphenol A and 4-nonylphenol in a human reference population. *Environmental Health Perspectives* 113:391-395.
- ⁸ United States Environmental Protection Agency (EPA), Integrated Risk Information System. 1993. Bisphenol A. CASRN 80-05-7. Available: <http://www.epa.gov/iris/subst/0356.htm> [Accessed 2 July 2007].
- ⁹ vom Saal F, Akingbemi BT, Belcher SM, Birnbaum LS, Crain DA, Eriksen M, et al. 2007. Chapel Hill bisphenol A expert panel consensus statement: Integration of mechanisms, effects in animals and potential to impact human health at current levels of exposure. *Reproductive Toxicology*, in press.
- ¹⁰ Center for the Evaluation of Risks to Human Reproduction (CERHR). 2007. Draft meeting summary. Expert panel evaluation of bisphenol A. Available: http://cerhr.niehs.nih.gov/chemicals/bisphenol/draftBPA_MtgSumm080807.pdf [Accessed 7 September, 2007].
- ¹¹ Myers JP (Ed). 2007. *Our Stolen Future: 38 experts on bisphenol A warn policy makers about potential adverse health effects*. Available: <http://www.ourstolenfuture.org/Consensus/2007/2007-0803chapelhillconsensus.html> [Accessed 7 September 2007].
- ¹² vom Saal F, Hughes C. 2005. An extensive new literature concerning low-dose effects of bisphenol A shows the need for a new risk assessment. *Environmental Health Perspectives*, 113(8): 926-933.
- ¹³ Myers JP (Ed). *Our Stolen Future: Scientists call for new risk assessment of bisphenol A and reveal industry biases in research*. Available: <http://www.ourstolenfuture.org/NewScience/oncompounds/bisphenola/2005/2005-0413vomsaalandhughes.htm> [Accessed 10 September 2007].
- ¹⁴ vom Saal F, Welshons W. 2006. Large effects from small exposures. II. The importance of positive controls in low-dose research on bisphenol A. *Environmental Research* 100:50-76.
- ¹⁵ Sugiura-Ogasawara M, Ozaki Y, Sonta S, Makino T, Suzumori K. 2005. Exposure to bisphenol A is associated with recurrent miscarriage. *Human Reproduction* 20:2325-2329.
- ¹⁶ Hunt PA, Koehler KE, Susiarjo M, Hodges CA, Ilagan A, Voigt RC, et al. 2003. Bisphenol A exposure causes meiotic aneuploidy in the female mouse. *Current Biology* 13:546-553.
- ¹⁷ Muñoz-de-Toro M, Markey C, Wadia PR, Luque EH, Rubin BS, Sonnenschein C, Soto AM. 2005. Perinatal exposure to bisphenol A alters peripubertal mammary gland development in mice. *Endocrinology* 146:4138-4147.
- ¹⁸ Wetherill YB. 2002. The xenoestrogen bisphenol A induces inappropriate androgen receptor activation and mitogenesis in prostatic adenocarcinoma cells. *Molecular Cancer Therapeutics* 1(7):515-24.
- ¹⁹ Kubo K, Arai O, Omura M, Wantanabe R, Ogata R, Aou S. 2003. Low dose effects of bisphenol A on sexual differentiation of the brain and behavior in rats. *Neuroscience Research* 45:345-356.
- ²⁰ Alonso-Magdalena P, Morimoto S, Ripoll S, Fuentes E, Nadal A. 2006. The estrogenic effect of bisphenol-A disrupts the pancreatic β -cell function in vivo and induces insulin resistance. *Environmental Health Perspectives* 114:106-112.
- ²¹ Physicians for Social Responsibility. 2001. Environmental Endocrine Disruptors. Available: http://www.psr.org/site/DocServer/Environmental_Endocrine_Disruptors.pdf [Accessed 10 July 2007].
- ²² Myers JP (Ed). *Our Stolen Future: Bisphenol A may interfere with treatment for prostate cancer*. Available: <http://www.ourstolenfuture.org/NewScience/oncompounds/bisphenola/2002-0515wetherill.htm#commonsense> [Accessed 10 July 2007].
- ²³ Sutton R, Jackson J, Walker B, Tupper G, Horenstein B (eds.). 2007, July 12. *Down the Drain: Sources of Hormone-Disrupting Chemicals in San Francisco Bay*. Oakland, CA: Environmental Working Group. Available: <http://www.ewg.org/reports/downthedrain> [Accessed 10 September 2007].
- ²⁴ U.S. Food and Drug Administration. 2007. Cumulative Estimated Daily Intake/Acceptable Daily Intake Database. Available: <http://www.cfsan.fda.gov/~dms/opa-edi.html> [Accessed 10 September 2007].
- ²⁵ Kegley S, Hill B, Orme S. 2007. PAN Pesticide Database: Bisphenol A – toxicity, ecological toxicity and regulatory information. San Francisco, CA: Pesticide Action Network, North America. Available: http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC33756 [Accessed 10 September 2007].