

# SUMMARY OF PRIORITY CHEMICALS OF CONCERN

## BISPHENOL A<sup>1</sup>

Bisphenol A (BPA) is best known as the monomer building block of polycarbonate plastics. It is frequently used as an additive to other plastics such as polyvinyl chloride (PVC). Because the polymerization of BPA leaves some monomers unbound, BPA molecules can be released from beverage and food containers into drink and food over time. BPA is used in reusable water bottles, baby bottles, and the inner linings of food cans, where leaching is accelerated at elevated temperatures. It is also used to coat thermal paper receipts. Monomeric BPA is an endocrine disrupter.

In its determination of an exposure limit for humans, the U.S. EPA arrived at a value of 50 µg per kg per day. Scientists have argued that neither the EPA limit for BPA nor the typical risk assessment approach are suitable for evaluating BPA's health risks, as many peer-reviewed studies have reported adverse effects of BPA at very low doses (at or below the current EPA limit). Such effects include for males: decreased testosterone, increased prostate size, decreased sperm production and fertility. Low doses in females cause early puberty, increased mortality of embryos, disruption of adult estrous cycles, recurrent miscarriages, sterility, uterine fibroids, ovarian cysts, and polycystic ovarian syndrome. BPA causes behavioral effects such as hyperactivity, increased aggressiveness, alterations in response to pain and threat stressors, and impaired learning. BPA also contributes to various metabolic diseases, such as obesity, diabetes, and cardiovascular disease. Recent studies indicate that substitute bisphenols (BPS and BPH) may cause similar harm.

## PHTHALATES

Phthalates are widely used in commercial and industrial production of plastics, household items, paints, medical devices, children's toys, and personal care products. More than 25 different phthalate esters exist. Phthalates impart flexibility, pliability, and elasticity to otherwise rigid polymers, such as PVC. They comprise 70% of the U.S. plasticizer market. Unlike BPA monomers in polycarbonate plastics, phthalates are not covalently bound to the polymer matrix, which means they migrate easily from packaging into food and beverages. Phthalates are contained in plastics at surprisingly high percentages. Di(2-ethylhexyl) phthalate (DEHP) is one of the principal phthalates causing human health concerns. Important other phthalate additives include di-isononyl phthalate (DINP), dibutyl phthalate (DBP), butylbenzyl phthalate (BBP), di-isododecyl phthalate (DIDP), di-n-octyl phthalate (DnOP), and di-n-hexyl phthalate (DnHP). Phthalates are endocrine disruptors. They are associated with adverse reproductive outcomes, including: malformations of the male reproductive system, including cryptorchidism (failure of testes to descend), male feminization evidenced by reduced anogenital distance (AGD), which is linked to reduced semen volume and sperm count.<sup>2</sup> Such abnormalities can develop into testicular cancer. In young girls, phthalates — DMP, DEP, DBP, and DEHP — can lead to early onset puberty. DEHP is linked to increased waist circumference as well as an inverse association of phthalate levels with insulin resistance.

## PERCHLORATE<sup>3</sup>

Perchlorate is a naturally occurring and man-made chemical that quickly dissolves in water and organic solvents and persists in the environment. It has been found in the urine of all Americans tested. While it leaves the body quickly, perchlorate persists in the environment for many years and there is evidence that it is widespread in the environment, including drinking water. The FDA has approved perchlorate's use as a food contact substance twice. The first time was in 1963 for its use in sealing gaskets for

food containers; and then, in 2005, it was approved for use as a conductivity enhancer or antistatic agent in dry food packaging. Drinking water in the U.S. is widely contaminated with perchlorate. Perchlorate contaminates food through two primary uses: as an antistatic agent in any plastic material that contacts dry food, and as a contaminant associated with bleach. Bleach is widely used to sanitize food surfaces in food-manufacturing and processing facilities. Perchlorate primarily affects the normal functioning of the thyroid gland by inhibiting the transport of iodine from the blood into the organ.

Iodine is an essential element needed to produce thyroid hormone — which plays an important role in controlling metabolism and is critical in regulating fetal and infant brain development. Because perchlorate is such a strong inhibitor of iodine transport, pregnant women, infants, and children with inadequate iodine consumption are the most vulnerable, and exposure to the chemical greatly increases the risk of impaired neurodevelopment.

## PER- and POLYFLUOROALKYL SUBSTANCES (PFAS)

PFAS are highly persistent, mobile, and toxic chemicals used in food packaging, fire fighting foam, stain-resistant coatings for carpets, clothing, and many other industrial applications. In food packaging, PFAS is used to create moisture and grease-proof barriers for paper and fiberboard products. Some sandwich wrappers, french-fry boxes, compostable fiberware boxes, and bakery bags have been found to contain PFAS. Since the chemicals can migrate into food, and contaminate landfills and compost after disposal, the use of PFAS to treat food packaging can lead to unnecessary long-term exposure to harmful chemicals. Some PFAS are so persistent that they don't degrade at all in the environment — so levels will only get higher over time if their use continues. Exposure has been associated with liver damage, harm to the immune system, developmental toxicity, and cancer. People are exposed to PFAS from multiple sources, including the uses named above, and through multiple routes, including food, dust, air, and water.

## FLAME RETARDANTS

Brominated flame retardants (BFRs) used in electronics and electrical equipment are being recycled into black food packaging. Containers, stirrers, straws, and other plastic foodware have demonstrated high levels of BFRs. Meanwhile, increasing numbers of national, state and local laws are calling for the increased use of recycled material. BFRs including PBDEs, HBCDs and TBBP-A have induced endocrine-, reproductive- and behavior effects in laboratory animals. Furthermore, recent human epidemiological data demonstrated association between exposure to BFRs and similar adverse effects as observed in animal studies.

## ANTIMICROBIALS

With the advent of “active packaging,” antimicrobial agents are integrated either directly into food in the packaging material where it is released over a period of time to maintain the products quality, as well as its extended shelf life. Some antimicrobials, such as polychlorinated hydrocarbons, Triclosan (TCS) and Triclocarban (TCC) are an emerging toxic hazard to public health, in the form of endocrine disruption, and to the environment. TCS and TCC interfere with essential signaling systems in animals and humans, thereby adversely affecting development, sexual maturation, metabolism, and behavior. Of particular for human health are the adverse effects of TCS on thyroid homeostasis and of TCC on reproductive health. In the environment, TCS and TCC rank in the list of top contaminants of concern worldwide. It is suspected that they make bacteria resistant to antibiotics.

- 1 Rolph U. Halden, (2010) Plastics and Health Risks, *Annual Review of Public Health*, 31:179-194; Frederick S vom Saal, Laura N Vandenberg (2021). Update on the Health Effects of Bisphenol A: Overwhelming Evidence of Harm, *Endocrinology*, Volume 162, Issue 3, March 2021, bqaa171, <https://doi.org/10.1210/endo/bqaa171>
- 2 Swan SH, Sathyanarayana S, Barrett ES, Janssen S, Liu F, Nguyen RH, Redmon JB, TIDES Study Team (April 2015). “First trimester phthalate exposure and anogenital distance in newborns”. *Human Reproduction*. 30 (4): 963–972
- 3 M. Maffini, T.G. Neltner, S. Vogel (2017). We are what we eat: Regulatory gaps in the United States that put our health at risk, *PLoS Biol* 15(12): e2003578

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