

## January Article of the Month

Migration of Parabens, Bisphenols, Benzophenone-Type UV Filters, Triclosan, and Triclocarbon from Teethers and Its Implications for Infant Exposures

**Authors:** Alexandros G. Asimakopoulos, Madhavan Elangovan, and Kurunthachalam Kannan

**Keywords:** [endocrine-disrupting chemical \(EDC\)](#), [bisphenol A \(BPA\)](#), [parabens](#), [benzophenone](#), [triclosan](#)

[Article](#) found in [Environmental Science & Technology](#).

### Background:

Chemicals that have the ability to interfere with the endocrine system--a collection of glands that produce hormones--are known as endocrine-disrupting chemicals (EDCs). EDCs can be found in many consumer products such as cosmetics, metal food cans, plastic bottles, detergents, flame retardants, food, toys, and pesticides. Those which humans are most frequently exposed to include parabens, some bisphenols (such as BPA), benzophenone-type ultraviolet (UV) filters, and triclosan. Parabens are widely used in cosmetics, in pharmaceutical products, and in food as preservatives.<sup>1</sup> BPA is commonly added to polycarbonate plastics used to make polycarbonate tableware, food storage containers, toys, and water bottles, and can be found in older baby bottles.<sup>2</sup> Benzophenone is used to block or absorb UV light and can be found in sunscreens, cosmetics, and other personal care products.<sup>3</sup> Triclosan is found in antibacterial soaps and wash products.<sup>4</sup>

Over the past 30 years, there has been an increase in the use of these chemicals in everyday consumer products, thereby increasing human exposure to these chemicals. In the 2003-2004, the National Health and Nutrition Examination Survey (NHANES) found detectable levels of BPA in 93% of Americans who were six years and older.<sup>5</sup> Due to the prevalence of chemicals and widespread human exposure, there is growing concern about the little information known about the health effects of these chemicals.

Research findings indicate that exposure to EDCs are linked with adverse developmental, neurological, reproductive, and immune effects, including lowered fertility, effects on brain,

---

<sup>1</sup> Biomarker Epidemiology of In Utero Environmental Exposures and Child Development. Retrieved December 15, 2016 from

<https://cfpub.epa.gov/ncer/abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/10647>.

<sup>2</sup> Bisphenol A. Retrieved December 15, 2016 from

[https://www.niehs.nih.gov/health/assets/docs\\_a\\_e/bisphenol\\_a\\_bpa\\_508.pdf](https://www.niehs.nih.gov/health/assets/docs_a_e/bisphenol_a_bpa_508.pdf)

<sup>3</sup> Benzophenone. Retrieved December 15, 2016 from <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf#sthash.EmnpugmJ.dpuf>

<sup>4</sup> FDA issues final rule on safety and effectiveness of antibacterial soaps. Retrieved December 15, 2016 from

<http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm517478.htm>

<sup>5</sup> Bisphenol A. Retrieved December 15, 2016 from

[https://www.niehs.nih.gov/health/assets/docs\\_a\\_e/bisphenol\\_a\\_bpa\\_508.pdf](https://www.niehs.nih.gov/health/assets/docs_a_e/bisphenol_a_bpa_508.pdf)

behavior, and metabolism, and some cancers.<sup>6</sup> Exposures of infants or children in the womb are of particular concern due to the risk of EDCs interfering with hormones that are vital to healthy development.<sup>7</sup> Thus, it is important to understand the exposure risks posed via all possible pathways to these youngest of children. The exposure of infants to these chemicals through the use of teethingers is still unknown.

### **Objective:**

This study describes the occurrence and leaching of parabens, BPA, benzophenone, and triclosan from teethingers in conditions that mimic typical infant behavior with teethingers. This was done in order to characterize an infant's risk of exposure to EDCs from these products.

### **Methods:**

Researchers collected 59 teethingers of 3 different types (solid plastic, gel-filled, and water-filled), most of which were labelled "bisphenol A-free", from the U.S. market. Leaching/migration tests were performed to analyze for the presence of 26 EDCs on intact surfaces of the teethingers.

### **Results:**

The total amount of the sum of six parent parabens ( $\Sigma 6$  Parabens) leached from teethingers ranged from 2.0 to 1990 nanograms (ng). Four compounds formed from these parabens' chemical reactions (also possible EDCs) were also assessed. The total amount of the sum of these four "transformation products" ( $\Sigma 4$  Parabens) ranged from 0.47 to 839 ng. The total amount of the sum of nine bisphenols ( $\Sigma 9$  bisphenols) and 5 benzophenones ( $\Sigma 5$  benzophenones) leached from teethingers ranged from 1.93 to 213 ng and 0.59 to 297 ng, respectively. Triclosan and triclocarban were found in the extracts of teethingers at approximately 10-fold less amounts than were bisphenols and benzophenones. Even though 48 of the 59 teethingers were labeled "BPA-free," the study results suggest that the labels were misleading; BPA was found to migrate from all teethingers analyzed.

Daily intake of all EDCs was estimated from the use of teethingers (direct from packaging without prewashing step) by infants at 12 months of age. The exposure doses of EDCs (adjusted for differences in infant weights) from the use of teethingers for 60 min (based on median values) by an infant were 3.30–3.56 ng per kilogram of body weight per day. The estimated exposures to EDCs (for a 12 month old) from the teethingers were lower than regulatory standards set for other products.

### **Policy Implications:**

In response to the public's growing concerns about the health effects of BPA, especially for young children, manufacturers phased out the use of BPA in baby bottle and sippy cup production and from infant formula packaging. In 2012 and 2013, the U.S. Food & Drug Administration (FDA) banned BPA from baby bottles, sippy cups, and infant formula packaging

---

<sup>6</sup> Endocrine Disruptors. Retrieved December 15, 2016 from

<https://www.niehs.nih.gov/health/topics/agents/endocrine/>.

<sup>7</sup> <http://ehp.niehs.nih.gov/wp-content/uploads/124/7/EHP358.alt.pdf>

to eliminate confusion for parents – although the FDA still states that BPA is safe.<sup>8</sup> As indicated in the study, there are products that infants regularly interact with, like teethingers, that contain BPA despite being labelled as “BPA-free”. In addition, preliminary research findings on replacement bisphenols such as BPS and BPF used in place of BPA indicate that these replacement compounds may be as harmful, or possibly worse, than BPA. Chemicals need to be tested for safety (especially to our youngest and most vulnerable populations) prior to being placed on the market. Products on all store shelves, including at discount/dollar-stores, need to be safe.

The FDA has also amended its regulations regarding triclosan. In September of 2016, the FDA banned the production of triclosan in antibacterial soaps. Triclosan was not shown to be more effective than soap and water in preventing illness and the spreading of certain diseases, and some studies associated triclosan with harmful long-term effects.<sup>9</sup> The rule becomes effective in September of 2017. Increased public awareness of the potential harmful effects of triclosan is needed to encourage consumers to discard older products containing triclosan and replace them with triclosan-free products.

There are no current regulations or restrictions regarding parabens and benzophenone. Parabens and benzophenone are believed to have endocrine-disrupting properties; however, research has not indicated to what extent these chemicals are harmful.<sup>10</sup> Continued research is needed to determine the health effects of parabens and benzophenone.

This study provides evidence of exposure to potentially harmful chemicals from infant products during a crucial stage of child development. Despite the fact that the study found that estimated exposure to EDCs from the teethingers were lower than existing regulatory standards for some of the chemicals in other products, current government regulations need to consider the cumulative impacts of exposure to multiple endocrine-disrupting chemicals from numerous other products and through diet.

More studies of this nature are warranted to further explore leeching of chemicals from infant products, and these studies need to inform child protective policy.

---

<sup>8</sup> Questions & Answers on Bisphenol A Use in Food and Contact Applications. Retrieved December 15, 2016 from <http://www.fda.gov/Food/IngredientsPackagingLabeling/FoodAdditivesIngredients/ucm355155.htm>

<sup>9</sup> FDA issues final rule on safety and effectiveness of antibacterial soaps. Retrieved December 15, 2016 from <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm517478.htm>

<sup>10</sup> Biomarker Epidemiology of In Utero Environmental Exposures and Child Development. Retrieved December 15, 2016 from

[https://cfpub.epa.gov/ncer\\_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/10647](https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/10647).

Benzophenone & Related Compounds. Retrieved December 15, 2016 from <http://www.safecosmetics.org/get-the-facts/chemicals-of-concern/benzophenone/>.