Bisphenol A (BPA) in Food Packaging
A Review of the Literature

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Introduction

Bisphenol A (BPA) is the chemical building block for polycarbonate plastic and can be found in baby bottles, water bottles and food storage containers. It is also used in epoxy resins that coat the lining of metal food cans, including infant formula cans. BPA is regulated by the 1958 FDA petition and review process, which means that after BPA was initially approved for food contact, companies were not required to register new food contact uses of BPA or to report BPA use to the FDA. Based upon our review of the literature, including product testing of over 600 items for the presence of BPA, we estimate the average level of BPA concentration in cans is 24.6 ppb, and the average in polycarbonate water and baby bottles is 26.6 ppb. Levels in polycarbonate vary dramatically depending on the application of heat.

BPA is an endocrine disruptor that can affect health at very low doses, particularly when exposures occur during gestation or in early life. Low doses in the parts per billion and even parts per trillion have been shown to have effects on laboratory animals and human breast cells.[i] According to the U.S. Centers for Disease Control and Prevention, 93 percent of Americans have detectable levels of BPA in their bodies.[ii]

What is a part per billion, anyway?

A part per billion is equal to about 3 seconds in a century. In other words, a part per billion is a very small concentration. Nevertheless, a considerable body of research shows that health effects in animals occur at in the range of 10 to 25 ppb, and several studies have shown effects in animals at the 25 parts per trillion (ppt) to 2.5 ppb range.[iii] Comparably, oral contraceptives contain doses of hormones between 20 and 35 ppb.

Principal Route of Exposure to BPA: Food Packaging

BPA is found in the lining of metal food cans and in some plastic food containers, including some baby bottles, water bottles, microwave ovenware and eating utensils. Because BPA is an unstable polymer and is lipophilic (fat-seeking), it can leach into infant formula and other food products, especially when heated.[iv] Once in food, BPA can move quickly into people—a real concern for women of childbearing age and for young children. Since the half life of BPA is estimated to be around 6 hours, meaning that BPA leaves the body completely within a couple of days, removal of BPA from food containers would rapidly reduce exposures.

We reviewed the literature regarding BPA in food cans, polycarbonate baby and water bottles, and in packaging alternatives. Table 4 highlights the average values of BPA by packaging and food category, as reported in 17 studies[v] and nearly 700 individual products, in the US, Canada, and the UK, and from government, academic and NGO studies. Based upon these values, we estimate that exposures to BPA from canned foods and polycarbonate plastics yield exposures over 200 times that of other packaging. We calculated this value based upon the highlighted values below.

Table 4: Average BPA concentration in food packaging

Food Contact Type	Average BPA in ppb
Epoxy cans and polycarbonate	25.6
Epoxy cans	24.6
Polycarbonate food & beverage	26.6
BPA-free cans	10.7
Polypropylene with epoxy lids	4.7
Other packaging	0.1

A. Canned food

Food (Container Type)	Number of items	Average BPA in ppb
Beer (Epoxy beverage can)	11	2.2
Energy Drink (Epoxy beverage can)	12	1.1
Soda (Epoxy beverage can)	76	0.6
Meal replacement (Epoxy beverage can)	7	12.8
Other beverages (Epoxy beverage can)	3	0
Juice (Epoxy can)	4	31.2
Beans (Epoxy can)	9	34.1 (food)
	10	11.7 (simulant)
Coconut Milk (Epoxy can)	3	78.1
Dessert (Epoxy can)	4	4.3
Evaporated Milk (Epoxy can)	8	4.1
Fish (Epoxy can)	20	24.6
Fruit (Epoxy can)	21	6.8
Infant Formula (Epoxy can)	54	6.1
Meals (Epoxy can)	24	36.3
Meat (Epoxy can)	9	65.0
Soup (Epoxy can)	52	70
Vegetables (Epoxy can)	65	63.8
Meals (polypropylene with Epoxy lid)*	2	9.4 (food)
	3	.04 (simulant)
Beans (Oleoresin can)	Average of 3 or 4 items	1.1
Tuna (Unknown can)	Average of 3 or 4 items	20.2

B. Polycarbonate

Container type	Number of items	Average BPA in ppb
Food dishes	3	1.1
polycarbonate baby bottle	48	45.9
polycarbonate water bottle**	43	32.9

** The levels of BPA migrating from polycarbonate were generally low at room temperature, but very high with the application of heat**.**

Condition	Number of items	Average BPA in ppb
polycarbonate – room temp 24 hours	7	0.2
polycarbonate - heated 24 hours	5	19.8
polycarbonate - room temp 120 hours	8	0.4
polycarbonate - heated 120 hours	2	403.5

C. Alternatives

Food (Container type)	Number of items	Average BPA in ppb

Baby food (Plastic tubs)	2	0.02
Baby food (Glass jars with metal lids)	101	.9
Fish (Retort package, e.g,, pouch)	2	0
Infant formula (powdered)	39	0
Juice (Pouch)	1	0
Juice (Tetra Pak)	2	0.001
Juice or Milk (Waxed cardboard cartons)	4	0
Meals (Coated cardboard trays – for microwave)	6	.02
Meals (polypropylene trays)	4	0
Pasta sauce (Glass jars with metal lids)	2	0
Soups (Tetra Pak)	1	.002
Vegetables (Frozen steam bags)	5	0.4
HDPE water bottle	12	0.08

Analytical methods for measuring BPA migration from food packaging

Several methods are used to analyze BPA migration from food packaging. The FDA recommends placing food simulants, which are typically water or water mixed with ethanol or oils to approximate the acidity or fat content of foods, into food contact items to assess the amount of migration from the container into food.[vi] The simulant can then be processed for analysis. Several different laboratory techniques are used to determine the concentration of BPA. We grouped the values from various laboratory techniques together because the levels detected by different laboratory methods were similar. The various techniques do lead to differences in the lowest levels of BPA that can be detected, and we treated undetectable levels as zero in our calculations, which could lead to underestimating BPA levels in our calculations.

In some of the studies we reviewed, the actual food from food packages was measured. In general, BPA levels in the actual food were higher than BPA levels in food simulants. A significantly higher level of BPA was found in canned beans when the BPA in actual food content was measured. Meals packaged in polypropylene with metal peel-off lids also had considerably higher BPA levels, although only a couple of items from this kind of packaging were tested. In the polypropylene containers, 7 total items were tested. Five of these used food stimulants and had less than .1 ppb; 2 tested the homogenized food and had 1 ppb and 17.7 ppb respectively. It is plausible that these differences reflect the fact that stimulants rested in the polypropylene containers, but did not contact the epoxy lids, which the homogenized food could have contacted the epoxy-lined lids in transit.

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