Safety of Plastics Used for Food and Water Storage

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Term Paper

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Plastics are organic polymers of high molecular mass, but they often contain other substances. Most commonly, plastics are derived from petrochemicals, which are synthetic for the most part, but may be partially natural. The development of plastic started in the seventeenth century and was made of such natural materials as cattle horn only. The first fully synthetic product was developed in the beginning of the twentieth century (History of Plastics, n.d.). Nowadays, it is almost impossible to imagine our life without plastic. This lab engineered product has taken over the world market. Almost everything can be made of plastic – plates, silverware, eye glasses, windows, car parts and the list never seems to end. The invention of plastics has changed our lives forever. The U.S. plastics industry employs nearly 900,000 American workers, polyvinyl chloride has taken over the health care industry for over 40 years. Over 25 percent of all medical plastics and over 70% of all disposable medical applications are made of vinyl, including blood and IV bags and the supporting tubing. Since the invention of rayon (the first commercial synthetic fabric) in 1914, polymer science has brought us fashion textiles made from nylons, polyesters, spandex, polypropylene and acrylics — and often protective clothing coatings made from polyurethane or thermoplastic fluoropolymers (Plastics, n.d.). Plastics are cheap and extremely useful. They make everything more convenient and affordable, but at what cost? What are the health effects when plastic leaves our homes and goes to landfills? Most of the food packaging is made of plastic and most of the food storage containers are plastic. Is that safe?

Polycarbonate  (Chemical: Bisphenol-A)

Polycarbonate is the most talked about plastic at this moment, as it caused a big scandal due to one of its contents –Bisphenol-A or BPA. It gained its popularity because polycarbonate

was a popular material for making baby bottles and some baby drinking cups. BPA is no longer in baby bottles, but the chemical is still around: it's in eye glasses, CDs, cash register receipts, food containers and water bottles. Bisphenol-A is an estrogenic chemical and a hormone disruptor. The chemical leaches into water or food when it is being heated, exposed acidic solutions, or after a long use (Schardt, 2012). Surprisingly, "microwave safe" labeling does not mean that the chemical will not leach onto the food or water, all it means is that the material will not melt or lose its shape. National Institute of Environmental Health Services claims that the new toxicity studies on animals prove BPA's negative effect "on the brain, human behavior, and prostate gland in fetuses, infants, and children" (Bisphenol A, 2013) While it is still hard to prove the effects of human exposure to BPA, there are some correlations that have been observed. In Cincinnati pregnant mothers with higher concentration of BPA in their urine had daughter with more anxiety problems, they were more depressed and hyperactive and they had poor emotional control at the age of three (Braun, J., et al., 2011). In Massachusetts fertility clinic, men who were seeking treatment were also checked for BPA levels in their urine. Turns out, the higher the concentration of BPA, the lower was men's sperm concentration and motility damage to sperm DNA (Meeker, JD, et al., 2010). Figure 1 demonstrates the visual finding of the study. However, not only BPA affects reproductive system, but it also causes heart problems. "British men and women who were diagnosed with cardiovascular disease were more likely to have had higher levels of BPA in their urine 11 years earlier than similar people who weren't diagnosed with heart disease." (Melzer, D. et al., 2012). In the U.S., Nutritional Examination Surveys revealed that people with higher levels of BPA in their urine were more likely to have coronary heart disease or type 2 diabetes (Melzer. D. et al., 2010).

Chemical: Phthalates

Phthalate diesters are compounds used to increase flexibility of plastics used for food and water storage. Phthalates are not chemically bounded to polymeric matrix, which allows them to leach into the food. In case of phthalates, chronic exposure in the most concerning factor. Phthalates have been associated with toxicity to the neural, reproductive and developmental systems. They also cause alterations to the kidneys and the liver, fetal malformation and fertility impairments. As well as BPA, phthalates alter human sperm motility. In addition, according to Kim et al, there is a correlation between the amount of phthalate in plasma systems and advanced stage endometriosis in women (Kim, S. et al., 2011). Meeker and Ferguson suggest that phthalates alter thyroid hormone levels (Meeker, D.; Ferguson, K., 2007-2008). Unfortunately, phthalates are not so hard to find in our everyday life. They are in many foods, such as olive oil, wine, and milk. Also, some food containers and other plastic food packaging release phthalates into food when it is microwaved. Figure 2 represents phthalate concentrations in people of the U.S. from 2001 to 2010 divided by the source of exposure.

Polyvinyl Chloride (PVC)  (Chemical: Dioxin)

PVC is known for releasing dioxins, which are carcinogens and hormone disruptors. In 1997, The International Agency for Research on Cancer classified dioxin as a known human carcinogen. Unfortunately, that kind of plastic is commonly used in supermarkets. Most of the cling wrap used in delis for wrapping cheese and meats is made of PVC. EPA projected an excess cancer risk of one in 100 for the most sensitive people who consume a diet high in animal fats. For the average person, EPA estimates a risk level of one in 1,000 (Environmental, 2000). The reason for such danger is high absorption and storage qualities of dioxin in animal fat.

Dioxins are found everywhere in the environment, and it accumulates in food chains, mainly in fatty tissues of animal, in fish and shellfish. So, by avoiding plastic containers there is not reduction of direct risk of leaching of the chemical, but there is also smaller release of toxic chemicals in the environment. “More than 90% of human exposure to is through food, mainly meat and dairy products, fish and shellfish” (Dioxins, 2010).

Polystyrene  (Chemical: Styrene)

Polystyrene is a popular plastic used in restaurants for “take out” containers and boxes for left overs. It is also found in many offices in form of foam cups. A problem is that polystyrene contains styrene, a chemical compound that is not considered to be safe. In the 12th edition of its Report on Carcinogens, the National Toxicology Program (NTP) stated that styrene is "reasonably anticipated to be a carcinogen," and the International Agency for Research on Cancer has classified styrene as a "possible human carcinogen." However, the good news is that styrene does not leach out of hard plastic containers, only foam cups and foam food containers, and only when the contents are hot. Styrene is neurotoxin and it attacks the central and peripheral nervous systems. In case of a chronic exposure and accumulation in the lipid-rich tissues of the brain, spinal cord, and peripheral nerves, there is a chance for acute or chronic functional impairment of the nervous system. Figure 3 shows the average annual styrene intake (at the high end of the range) based on sources of exposure (Tang W. et al, 2000).

Since the government does regulate the levels of human exposure to most of the chemicals, there is no need to be worried about serious outcomes. However, the government's regulations constantly change under the pressure of research, corporations, budget and a lot more, so it would be a good idea to take certain precautions. As it is often mentioned, the greatest risk comes from chronic exposure to a certain toxin. By avoiding repeated use of plastic materials for food and water storage as well as packaging, the risk of serious health effect gets significantly lower. Avoiding BPA is very challenging since it is almost everywhere and everyone has it in their bodies, but in different. Knowing where it comes from and avoiding it would significantly reduce the concentration. BPA is found in polycarbonate, so avoiding plastics that have recycling number seven on the bottom and everything else that has seven on it would be a major step. Also, many canned foods and drinks contain BPA. Although, there are many popular companies, such as Campbell's, Trader Joe's, Whole Foods, Eden, and Del Monte, that have started using BPA-free packaging. Harvard researchers found out that when volunteers ate a serving of canned soup every day for five days, BPA levels in their urine jumped more than tenfold (Carwile J. et al., 2011)Plastic containers should not be subjected to heat, since that is the triggering factor for the leaching process. Food should not be microwaved in plastic containers, especially, the ones marked with recycling labels 3, 6 and 7, even if it says "microwave safe." Dishwashing those containers also triggers the release of toxins. Avoiding use of plastic containers and food packaging would greatly help the environment also, which in turn improves the quality of animal and fish product that get on people's plates. Using and reusing alternatives, such as glass containers and metal coffee mugs, is the healthiest option.

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Appendix

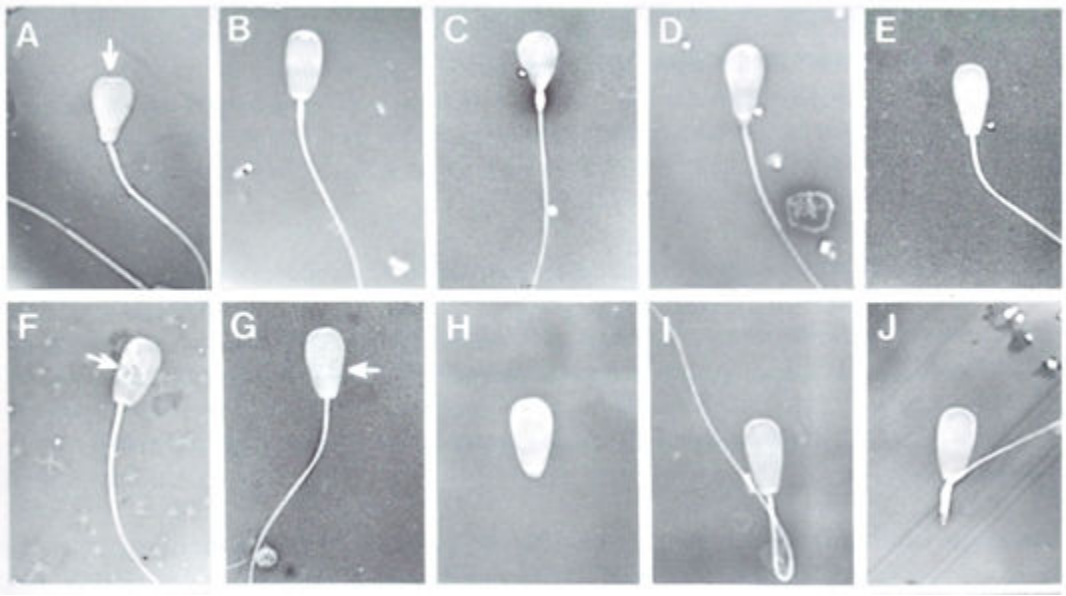

Figure 1. Picktures from the study of Meeker, JD, showing the difference in sperm of men with different BPA concentrations in urine.

Phthalate trends in U.S. people 2001-2010

Phthalate	Common sources	Trend
DEP	Fragrance, cosmetics, medication	↓42%
DnBP	Cosmetics, medication, food packaging, PVC plastics	↓17%
BBzP	PVC flooring, food packaging	↓32%
DEHP	Toys, cosmetics, food packaging, PVC plastics	↓37%
DiBP	Cosmetics, food packaging	↑ 206%
DnOP	Food packaging, PVC plastics	↑25%
DiNP	Toys, flooring, wall coverings, PVC plastics	↑ 149%
DiDP	Toys, wire and cables, flooring, PVC plastics	↑ 15%

Figure 2. Phthalate trends in US people 2001-2010.

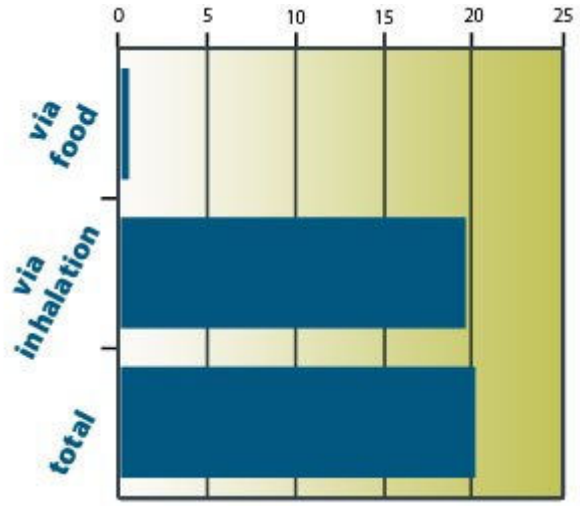

Figure 3. Average annual Styrene Intake – High End Range.