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Unpropitious Effect of Bisphenol-A and Its Impact on Human Health

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Abstract: Bisphenol A (BPA) is a chemical used in the lining of some food and beverage packaging to protect food from contamination and extend shelf life. It's also used in non-food products. It has been found that BPA has the potential to have a wide range of health effects on humans and other organisms, especially involving reproductive health. People are exposed to BPA throughout the day, mostly through diet, as it can leach from canned goods and plastic storage containers into food, but also through dust and water. The leaching increased dramatically when temperatures rose to 60 degrees. For each source of exposure (dietary; non-dietary oral, inhalation and dermal) and in each age group (infants (0–1 year), toddlers (1–3 years), children (3–10 years), adolescents (10–18 years), women (18–45 years), men (18–45 years), other adults (45–65 years), elderly and very elderly (over 65 years) (EFSA, 2011), a scenario for average exposure and a scenario for high exposure was developed. In order to quantify the relative impact of each source, the assumptions made in the exposure assessments aimed to obtain a similar degree of conservativeness among the different sources.

Keywords: Impact, Exposure, Metabolizes, disrupting chemical.

I. INTRODUCTION

Bisphenol A is used primarily to make plastics, and products using BPA-based plastics have been in commercial use since 1957. At present at least 3.6 million tonnes of BPA are used yearly by manufacturers in the world. It is a key monomer in production of epoxy resins and in the most common form of polycarbonate plastics. (Fiege et al 2002, Tokunaga et al 2008). BPA based polycarbonate plastics are clear and tough, and are made into a variety of common consumer goods, such as water and infant feeding bottles, (Shao H, Han J et al 2005) compact discs and digital versatile discs, impact-resistant safety equipments, eyeglass lenses, sports equipments, household electronic gadgets, foundry casting and medical devices .Fig-1 showing consumption of plastic containing bisphenol-A in different areas in global market.

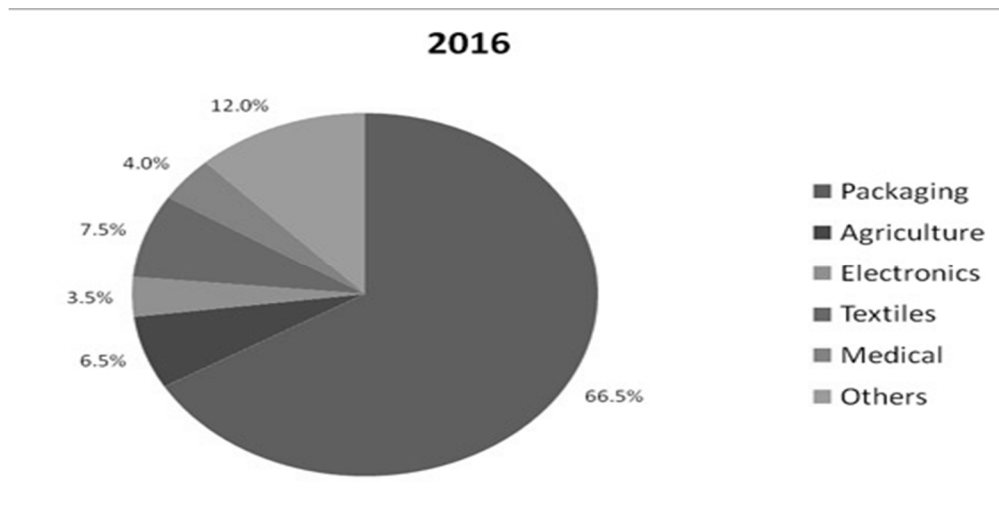


Figure 1: showing consumption of plastic in global market

Some dental fillings sealants and composites may also contain BPA. Epoxy resins are used as lacquers to coat metal products such

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as food and beverage cans, bottle tops, and to line water supply pipes.(KEMI 2012, 2013). BPA is used as a preferred colour developer in making carbonless copy paper and thermal paper such as used in sales receipts and ATM statements Persistent exposure to BPA, a chemical used to harden plastics, has been linked to disruption of normal hormone levels, behavioural problems, increased risk of cancer and many other health issues. (Eloheid et al 2008,Vom-Saal et al 2008). Several scientific studies have confirmed that BPA often leaches out from the bottles during boiling, brushing, or vigorous washing.

II. WHAT'S THE TOLERABLE DAILY INTAKE?

The tolerable daily intake (or TDI) is an internationally established safe level for chemicals like BPA. It's a conservative estimate of a safe level of BPA which applies to the whole population and estimates the amount of BPA in food that can be ingested daily over a lifetime without appreciable health risk. In other words it's the amount that can be safely consumed per day, every day. Extremely large amounts of foods and beverages would need to be consumed to reach the TDI for BPA. For example, a nine month old baby weighing 9 kg would have to eat more than 1 kg of canned baby custard containing BPA every day to reach the TDI, assuming that the custard contained the highest level of BPA found (420 parts per billion) in a survey by CHOICE.

III. IMPACT OF EXPOSURE OF PLASTIC CONTAINING BPA

People are exposed to BPA throughout the day, mostly through diet, as it can leach from canned goods and plastic storage containers into food, but also through dust and water. Within about 6 hours of exposure, our liver metabolizes about half the concentration. (FAO/WHO 2011) . Most of that about 80 to 90 percent is converted into a metabolite called BPA-Glucuronide, which is eventually excreted. In India, plastic bottles are everywhere, from milk bottles to medicine and water too. Some well-known products packaged in PET bottles were sent by an NGO to the National Test House, a government test house in Kolkata. Milk bottles, medicine bottles, and juice bottles were tested and significant heavy metal and phthalate leaching well above the acceptable norms was noticed. The leaching increased dramatically when temperatures rose to 60 degrees. For each source of exposure (dietary; non-dietary oral, inhalation and dermal) and in each age group (infants (0–1 year), toddlers (1–3 years), children (3–10 years), adolescents (10–18 years), women (18–45 years), men (18–45 years), other adults (45–65 years), elderly and very elderly (over 65 years) (EFSA, 2011), a scenario for average exposure and a scenario for high exposure was developed. Average exposures from the different sources have been added together by route to assess average exposure. High exposures from the different sources have been added together by route to assess high exposure. In order to quantify the relative impact of each source, the assumptions made in the exposure assessments aimed to obtain a similar degree of conservativeness among the different sources. Figure-2 showing different concentrations of bisphenol A in different age groups in urine sample.

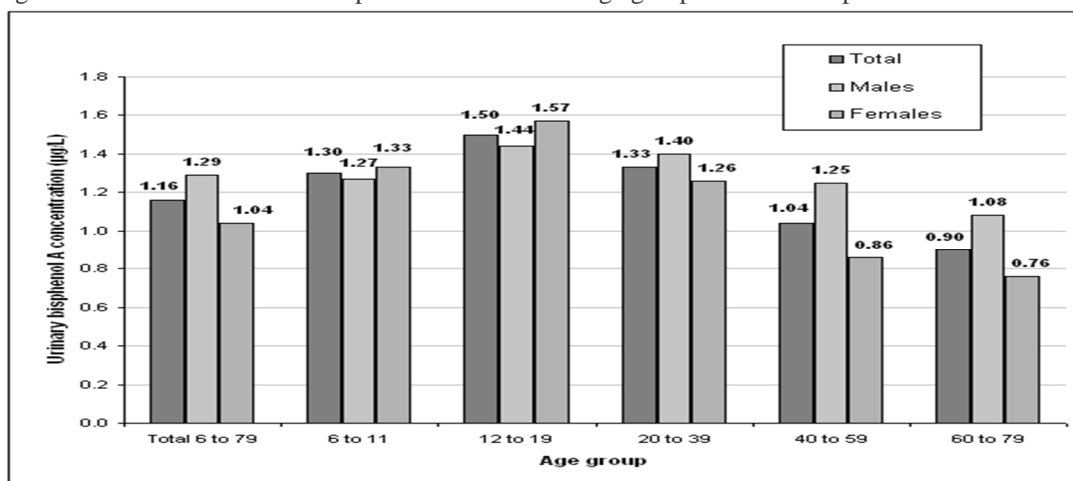


Figure 2: showing different BPA concentration in different age groups

IV. EFFECTS ON HUMAN HEALTH

Bisphenol A was first recognized to have a role similar to synthetic estrogen in 1936 long before it was used to form polycarbonate plastic and resins in the early 1950s. BPA's ability to mimic the effects of natural estrogen (Kuiper GG, Lemmen et al 1998) (like estradiol or E2) derives from the similarity of phenol groups on both BPA and estradiol. Long term BPA exposure has been associated with reproductive problems in both wildlife and humans.(Sheeler 2000, Thomas 2011) Studies have shown a decline in

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human sperm count and quality, genital abnormalities such as abnormal penile or urethra development in males, early onset of puberty in females, effects on fertility, miscarriage and birth defects. (Vandenberg 2011). Bisphenol A is a carcinogen and its deposition to human body boosts the risk of causing breast and prostate cancer. Moreover, exposure to BPA increases the possibility of brain tumour or meningioma. (University of Cincinnati Academic Health Center 2014). BPA is a thyroid-disrupting chemical, which may especially affect pregnant women, neonates and small children. (Rochester 2013). Recent research states that bisphenol A is responsible for malfunction of cell organelle centrosome. BPA is also associated with increasing neurobehavioral problems, increasing prevalence of obesity and type 2 diabetes, and immune system effects. (Kumar R, Balhuizen et al 2011). Obesity as well as gaining extra weights due to BPA exposure (Rubin 2011) may give rise to certain secondary complications to our body such as sleep apnea, abnormal lipid profile, high blood pressure, stroke, pulmonary blood clot, asthma, pancreatitis, liver cirrhosis, colon cancer, arthritis, and gout. (Newbold 2008, Tinne Geens et al 2011). Scientists now believe that there are at least two mechanisms by which BPA disrupts normal body function in human. (Pierik et al 2011). The endocrine system is the chemical communication system found in humans. (Beronius 2011). The endocrine system typically handles long term functions and processes, including the development of the brain, nervous system, and other organs and tissues, growth and metabolism, (Ginsberg et al 2011, Beronius 2009) and the functioning of the reproductive system. Hormones are the chemical messengers of the endocrine system. (Chunyang et al 2012). The nervous system, on the other hand, is the rapid communication system controlling functions such as heartbeat, breathing, and movement. BPA can act as a potent estrogen, binding to the estrogen receptor. (Mielke H 2009). Alternatively, BPA can block the effect of stronger natural estrogens, inhibiting estrogen function. They are commonly assumed to act through the estrogen receptors in the cell nucleus that regulate cell signaling and influences gene expression. In addition, bisphenol A produces changes in DNA structure by adding methyl groups to DNA, silencing their expression. (Galloway 2010).

V. ENVIRONMENTAL CONCERN/ DISCUSSION

Precisely to say, bisphenol A leaves its impact both on humans and environment. BPA can enter the environment either directly from chemical, plastics, coat and staining manufacturers, from paper or material recycling companies, foundries who use bisphenol A in casting sand, or indirectly leaching from plastic, paper and metal waste in landfills or ocean-borne plastic trash. Ubiquity makes BPA an important soil pollutant. (Ikezuki 2002). BPA can currently be found also in municipal waste water. It affects growth and development in aquatic organisms. Among freshwater organisms, fish appear to be the most sensitive species followed by aquatic invertebrates, amphibians, and reptiles. In addition, BPA affects reproduction in aquatic and terrestrial annelids, molluscs, insects, crustaceans, fish and amphibians; impairs development in crustaceans and amphibians and induces genetic aberrations.

VI. CONCLUSION

At present, bisphenol A is intimately and intricately related to our lifestyle. A study of people has suggested polycarbonate baby bottles as the most prominent role of exposure for infants, and canned food for adults and teenagers. Actually BPA exposure starts from the mother's womb. After the baby is born, maternal exposure can continue to affect the infant through transfer of this chemical compound to the infant via breast milk. To cope with bisphenol A toxicity, the European Union and Canada have banned BPA use in baby bottles. In Japan epoxy coating in cans is mostly replaced by PET (Polyethylene Terephthalate) film. Realizing the growing threat of bisphenol compounds, the first world countries all across the world, have already begun to check the indiscriminate use of BPA. In the due course, BPA in some plastic items has been replaced by another phenolic compound BPS (Bisphenol S) to lessen its toxicity. However, this effort becomes futile as BPS is more active than BPA in terms of human exposure. But, sorry to say, in the third world countries like India where bisphenol A is used widely in making various plastic and phenolic products, to common folk and the government are quite unconscious of the emerging threat. It has been found that BPA has the potential to have a wide range of health effects on humans and other organisms, especially involving reproductive health. There is still a lot of research to be done to determine what levels of BPA are safe for adults, children, and animals as well as the environment. Exposure to BPA poses risk to human health. Further research is required to study the broader effects and ingestion routes including food and water to make more realistic human health assessment of daily intake of BPA.

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