



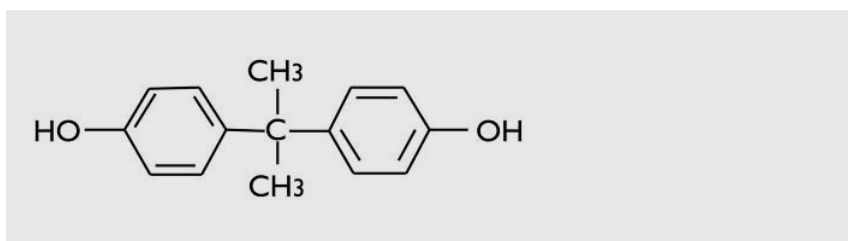
Toxics Link  
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# BISPHENOL – A (BPA)

## Introduction

Bisphenol A (BPA) is a carbon-based synthetic compound with the chemical formula  $(\text{CH}_3)_2\text{C}(\text{C}_6\text{H}_4\text{OH})_2$  belonging to the group of diphenylmethane derivatives and bisphenols. The commercial use of BPA started in 1957.

BPA is primarily used as a monomer in the manufacture of **polycarbonates**, a high performance transparent, rigid plastic. BPA is also used in flame retardants, unsaturated polyester resins, polysulfone (PS) resins and poly- etherimides resins, polysulfone (PS) resins and polyetherimides (PEIs). BPA has the potential to leach in small amounts into food and beverages stored in materials containing these substances. Human beings are exposed to BPA through their diet, inhalation of household dust, and dermal exposure.



**FIGURE 1 - Chemical structure of Bisphenol A**

## FACTS ABOUT BPA

- BPA was developed as a synthetic estrogen
- BPA is used to make epoxy resin & polycarbonate plastic
- 5.5 million metric tons of BPA was produced in 2011
- Designated as an “Endocrine Disrupting Chemical ”(EDC)
- Harmful to fetuses, infants and children
- Half-life in soil is 3-10 days
- Half-life in water is 3-6 days
- BPA concentration in air was reported in Chennai, India (avrg. 4550 pg/m-3)
- Major source of BPA in environment are:
  - Industrial production of BPA products
  - Open burning of plastics in domestic wastes
  - Combustion of computer printed circuit boards in electronic waste (e-waste)

## USES OF BPA

- |  |  |
|--|--|
| ■ Food and drink packaging                           | ■ Bicycle helmets                              |
| ■ Reusable water and infant bottles                  | ■ Car safety seats                             |
| ■ Impact-resistant safety equipment                  | ■ Water coolers                                |
| ■ Metal products                                     | ■ Medical devices                              |
| • Food & beverages cans                              | ■ CDs, credit cards, cell phones and computers |
| • Bottle tops  | ■ Sports equipments                            |
| • Water supply pipes                                 | ■ Household electronics                        |
| ■ Dental sealants and composites                     | ■ Electrical laminates                         |
| ■ Receipt Papers at grocery store & restaurants      |  |
| ■ Precursor of flame retardant tetrabromobisphenol A |  |

## BPA: AN ENDOCRINE DISRUPTING CHEMICAL (EDC)

Endocrine disruptors have been defined as an “exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in intact organisms or its progeny or populations”. There are certain chemicals which are being identified as potential endocrine disruptors and have been kept in a group known as EDCs. The issues of EDCs have been considered as a serious health issue globally and is now an emerging issue in the Strategic Approach to International Chemical Management (SAICM). BPA is one of the chemicals that has been designated as the EDC.

Research studies have found that BPA can interact with a number of systems in the body including those regulated by the female hormone, estrogen, and by thyroid hormones. Pregnant women and children are the most vulnerable to the BPA exposure. BPA can cause harm to the fetus developing inside the mother’s womb, can impact the developing brain and subsequent behavior of the child.

Though BPA was initially considered to be a weak environmental estrogen, recent studies have demonstrated that BPA has potential to cause serious health disorders.

### HEALTH IMPACT

- Altered brain development & behavior
- Endocrine disruption
- Reproductive effects
- Immune response
- Cardiovascular diseases
- Altered mammary gland development
- Increased adiposity
- Diabetes
- DNA alterations related to estrogen
- Neurological disorders
- Neoplasias & preneoplastic lesions

### LATEST FINDING ON BPA

- A report was published in April 2014 by Institute of Functional Genomics of Lyon, France & Deakin University Metabolic Research Unit, Australia, headed by Professor Vincent Laudet on harmful effects of BPA on unborn babies & infants.
- They have discovered a new pathway for BPA to spread through the body via a protein known as ERR $\gamma$  (oestrogen-related receptor). Researchers found that ERR $\gamma$  was 1000 times more sensitive to BPA than estrogen receptors and played an important role in metabolism and added weight.

### TOLERABLE DAILY INTAKE (TDI) OF BPA

BPA has a very common use in various day to day consumer products. The research studies show that BPA has the potential to leach into the environment and also enter into the food. Thus it can cause harm to human health. Many countries have fixed the limit of the Tolerable Daily Intake (TDI) of BPA. The European Food Safety Authority (EFSA), FDA EPA, Chinese food safety Authority and Korean Food Safety Authority have issued strict TDI for BPA intake. However no such standard is established by Indian Food Safety Authority.

Country/ Organization	TDI ( $\mu\text{g}/\text{kg bw}/\text{day}$ )
European Food Safety Authority (EFSA)	50 (soon to be 5.0 $\mu\text{g}$ )
FDA EPA	50
Australia	50
Chinese	50
Korean Food Safety Authority	50
India	No standards

*Tolerable daily Intake (TDI) is a value calculated as an index of the effects on health, when daily intake continues throughout life.*

## INDIAN SCENARIO ON BPA

In India BPA is very commonly used in various products. A global research study found high BPA concentration in the air samples collected from Chennai and Mumbai (avrg. 4550 pg/m<sup>3</sup>).

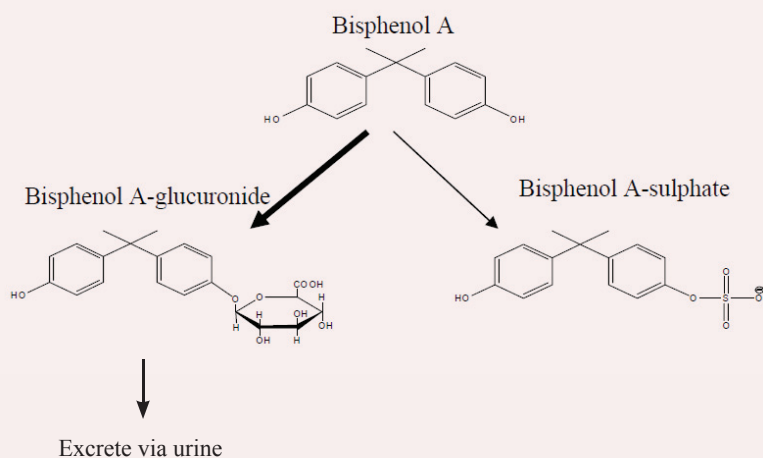
Further, in India, there is no prescribed standard available for BPA content in environment or food. Though Bureau of Indian Standards (BIS) issued a draft notification to eliminate BPA use in baby feeding bottles, yet there is no headway in this direction.

### FATE OF BPA IN HUMAN BODY

It has been reported that orally administered BPA is rapidly and efficiently (>95% of dose) absorbed from the gastrointestinal tract and is metabolised rapidly mainly into BPA glucuronide, which is water-soluble and can be excreted via the urine, making BPA no longer available for biological activity within the body. This deactivation of BPA is more effective in humans. Therefore due to the rapid biotransformation & excretion and plasma protein binding, peak concentrations of free BPA that are available for oestrogen receptor binding after oral exposure, are very low in humans.

Recent data from measurements of un-conjugated (free) BPA in human blood and urine however suggest higher internal exposure of humans to free BPA. There are also indications that transfer of BPA may take place from the mother to the foetus, which in turn may imply an exposure in pre-natal life following the mother's intake of BPA. Newborns are expected to be exposed to higher internal BPA values due to immature glucuronidation activity.

Biotransformation of BPA in humans and rodents to BPA glucuronide and BPA-sulphate



Source: Technical report of JRC (European Commission) 2010

## REGULATIONS ON BPA

There are many research studies which suggest that BPA can cause potential harm to the human health. Many national and international research institutions are reviewing and doing research to have a better understanding on the potential human health effects of exposure to BPA, especially when it impacts new born and young children.

Several risk assessments of BPA were performed by different regulatory bodies and expert groups in Europe, Canada, USA and Japan. Canada is the first country to recognize BPA as a toxic chemical and put restriction on use of BPA use for the various products. It was the first country, which imposed a ban on the use of BPA in baby feeding bottles and infant feeding caps. Later many other countries banned the use of BPA in baby feeding bottles. Many countries are also mulling on restricting use of BPA in other products where possibility of contamination is high.

## COUNTRIES POSITION ON BPA ACROSS THE GLOBE

Countries	Status on bay bottles/ products
Canada	Banned
USA	Banned
Australia	Voluntary phase out
Japan	Voluntary phase out
France	Temporary ban
Germany	Banned
Denmark	Temporary ban
Belgium	Banned (in all food contact plastics & thermal paper)
China	Banned
India	Under draft stage

### BPA IN CANNED FOODS

- Ministry of Health, Canada & WHO had jointly surveyed 78 canned food products from Canadian market. BPA was detected in all 77 samples except one. Max. **BPA detected was 534 parts per billion (ppb).**
- A report published by National Workgroup for Safe Markets, found BPA in 46 of 50 samples, i.e., 92% of the canned food samples collected from USA and Canada. The highest level of **BPA detected was 1,140 (ppb).**



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