



Transaction With Toxins

Bisphenols in Cash Receipts!!



Transaction With Toxins: Bisphenols in Cash Receipts

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Executive Summary

THERE WAS A TIME WHEN IT WAS THOUGHT THAT HUMAN EXPOSURE TO BISPHENOLS COMES MAINLY FROM CANNED FOODS, WATER AND BEVERAGE BOTTLES, AND DENTAL SEALANTS. THIS PERCEPTION HAS CHANGED RAPIDLY WITH THE REALIZATION THAT THERMAL PAPER USED AT CASH REGISTERS CONTAINS UNUSUALLY HIGH AMOUNTS OF MONOMERIC BPA & BPS AND IT COULD BE A POTENTIAL SOURCE OF HUMAN EXPOSURE AND SUBSEQUENT ABSORPTION THROUGH SKIN AND, POSSIBLY, MUCO-CUTANEOUS JUNCTIONS.

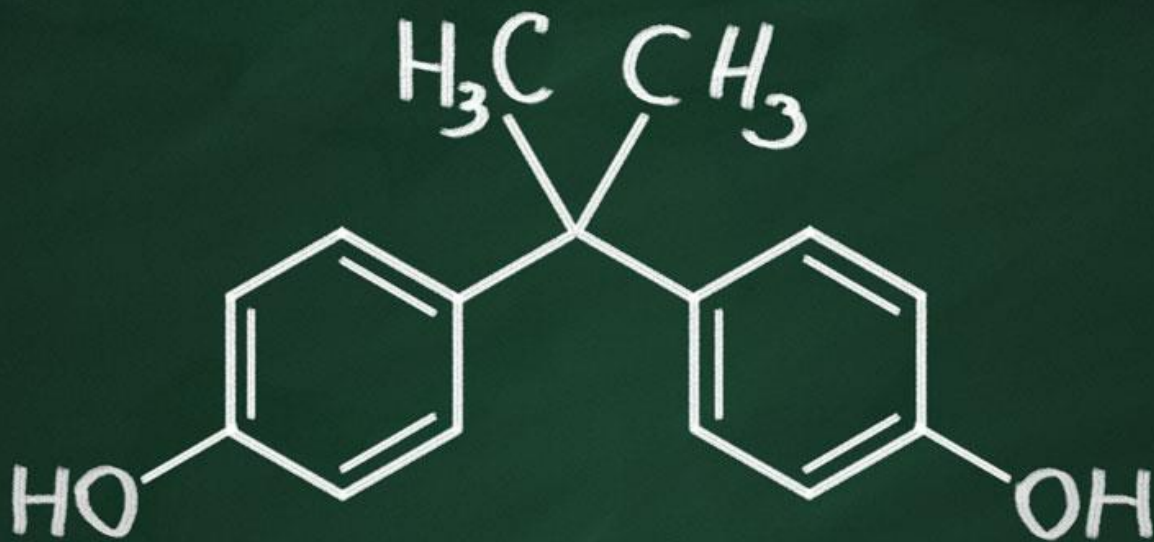
THE HUMAN EXPOSURE OF BPA THROUGH POLYCARBONATE PLASTICS (PPs) APPEARS TO BE REAL BUT MINOR WHEN COMPARED TO CERTAIN OTHER SOURCES, SUCH AS THE CASH REGISTER RECEIPT. IN GENERAL, PPs ARE THOUGHT TO CONTAIN SMALL AMOUNTS OF MONOMERIC AND UNPOLYMERIZED BPA WHICH COULD MIGRATE TO FOOD AND OTHER CONSUMABLES. THE PROCESS OF MIGRATION CAN BE FACILITATED BY HEATING AND VARIOUS METHODS OF STERILIZATION. LARGE AMOUNTS OF MONOMERIC BPA ARE USED IN THE MANUFACTURE OF THERMAL AND CARBONLESS PAPERS TO WHICH HUMANS ARE ROUTINELY EXPOSED. UNLIKE PPs, BPA IN THE CRs CAN BE RAPIDLY RELEASED INTO THE ENVIRONMENT AND BECOME A SIGNIFICANT SOURCE OF HUMAN EXPOSURE THROUGH DERMAL CONTACT AND ABSORPTION.

THERMAL PAPERS POSE PROBLEM TO HUMAN TOXICITY NOT ONLY DIRECTLY BUT ALSO THROUGH RECYCLING AND WASTE RUNOFF WATERS. EMERGING EVIDENCE SUGGESTS THAT BPA IS PRESENT IN THE INDUSTRIAL EFFLUENTS AND RECYCLED MUNICIPAL WATERS. THERMAL PAPER RECYCLING GENERATES POTENTIAL ENVIRONMENTAL AND ECOLOGICAL RISK TO PLANTS, AQUATIC SPECIES AND OTHER ORGANISMS. BPA EXPOSURE HAS SHOWN TO INCREASE NITRATE LEVELS IN PLANTS STUDIES HAVE SHOWN THAT HIGHER AMOUNTS OF BPA ARE PRESENT IN RECYCLED THERMAL PAPERS THAN THE VIRGIN PAPERS. BASED ON THE URINARY LEVELS AND BPA EXPOSURE STUDIES, THE TOTAL BPA EXPOSURE FROM THE DIETARY AND NON-DIETARY SOURCES EXCEEDS THE CURRENT TOLERABLE DAILY INTAKE OF 50 MG/KG BW/DAY. THE INCREASED BPA LEVELS IN THE ENVIRONMENT COULD BE DUE TO URBANIZATION AND THE INCREASED USE OF THERMAL AND BPA CONTAINING PAPERS. NOT ONLY BPA, BPS IS ALSO IS A MAJOR CONCERN AS THEY ARE ALSO FOUND IN THERMAL PAPERS.

TO ASSESS THE SITUATION AND PUBLIC PERCEPTION ON BISPHENOL-A (BPA) IN THERMAL PAPERS USED IN POPULAR OUTLETS IN BANGLADESH ESDO PREVIOUSLY CONDUCTED A BASELINE SURVEY PHYSICALLY THROUGH QUESTIONNAIRES AND CARRIED OUT FROM FEBRUARY 2019 TO JANUARY 2020 ON TOTAL 1350 PEOPLE (CONSUMER AND RETAILERS). BESIDES, AROUND 40 CASH RECEIPTS HAVE BEEN COLLECTED FROM LOCAL SHOPS (FAST FOOD SHOP, RESTAURANTS, PHARMACY ETC.) AND ATM BOOTHS OF THE SURVEYED AREAS. SURVEYED POPULATION RECOGNIZES THE THERMAL PAPERS AS SLIPS BUT UNFORTUNATELY, 0% SURVEYED POPULATION UNKNOWN OR UNAWARE OF BPA-CONTAINING THERMAL PAPER AND ITS HARMFUL EFFECTS. LABORATORY TESTS OF THERMAL PAPERS INDICATED THE PRESENCE OF BPA IN QUANTITIES RANGING FROM 10 – 53 $\mu\text{g}/\text{cm}^2$. ALL THE RECEIPT SAMPLES HAVE A HIGHER PERCENTAGE OF BPA (0.8% - 3.7% BY WEIGHT) THAN THE EU PERMISSIBLE LIMIT (0.02% BY WEIGHT) WHICH SHOWS US THE SEVERITY OF THE SITUATION.

IN 2021, ENVIRONMENT & SOCIAL DEVELOPMENT ASSOCIATION – ESDO IN ASSOCIATION WITH WONJIN INSTITUTE FOR OCCUPATIONAL AND ENVIRONMENTAL HEALTH STUDIED THE PRESENCE OF BISPHENOLS IN CASH RECEIPTS TO FOLLOW UP WITH THE ENDOCRINE DISRUPTING CHEMICAL'S PRESENCE IN CASH RECEIPTS. THIS TIME BPS PRESENCE WAS ALSO DETECTED ALONG WITH BPA. AMONG THE SAMPLES OF 39 PLACES WHICH WERE CONSIDERED AS THERMAL PAPERS, 27 OF THEM HAVE BPA, 10 OF THEM HAS BPS AND ONLY 2 SAMPLES WERE NOT DETECTED WITH THESE CHEMICALS. BPF, BPAF, BPB WERE NOT DETECTED IN ANY SAMPLES. IN THE COLLECTED SAMPLES, THE CONCENTRATION RANGE OF BPA WAS 0.83~1.71%, AND BPS WAS 0.61~0.96%. THIS IS TO UNDERLINE THAT AFTER OUR PREVIOUS STUDY, THE SITUATION HASN'T YET BEEN CHANGED. THE CONCENTRATION OF ALL SAMPLES IN WHICH BPA WAS DETECTED AGAIN EXCEEDED THE EU STANDARD OF 0.02%.



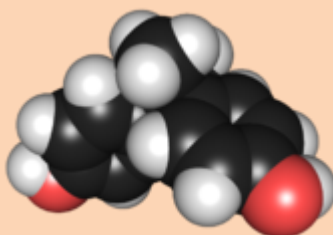


Background

Bisphenols comprise a family of chemicals with a common chemical structure formed by two phenol rings bonded with a variety of bridges, including a linear or branched alkyl hydrocarbon chain that can also contain other heteroatoms, such as sulphur or oxygen. These chemicals are widely used to manufacture polycarbonate plastics, epoxy resins and thermal papers.

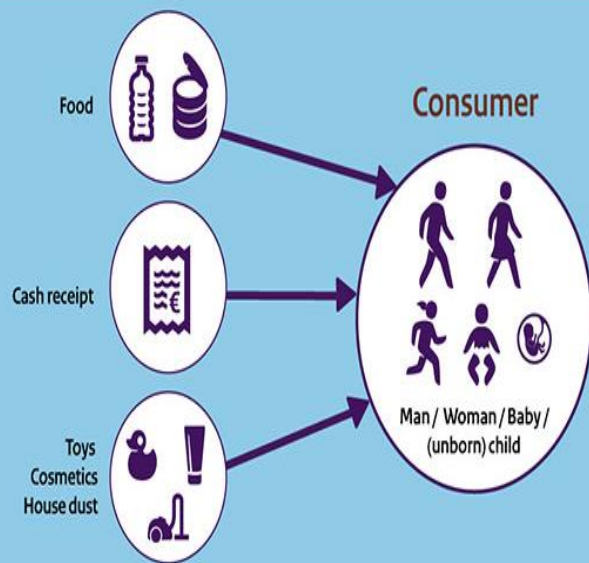
Bisphenol A (BPA) is a chemical compound (Preferred IUPAC name: 4,4'-(Propane-2,2-diyl) diphenol) and one of the simplest and best-known bisphenols. It is produced by the condensation of phenol and acetone, with an estimated 4 million tonnes of produced worldwide in 2015. It is a colorless solid which is soluble in organic solvents, but poorly soluble in water (0.344 wt % at 83 °C) (Fiege H, 2000).

BPA and its derivatives have many uses, most of which are centered around plastics. Its largest single application is as a co-monomer in the production of polycarbonates and, to a much lesser extent, polysulfones. Its epoxide derivative BADGE (also called DGEBA) is the starting material for most epoxy resins. Low levels of unpolymerised BPA and BADGE are also used in PVC plastisols, as an auxiliary antioxidant and acid scavenger respectively (Shah, et al., 2003). A common use is as a stabilizer in thermal paper (Björnsdotter, et al., 2017).



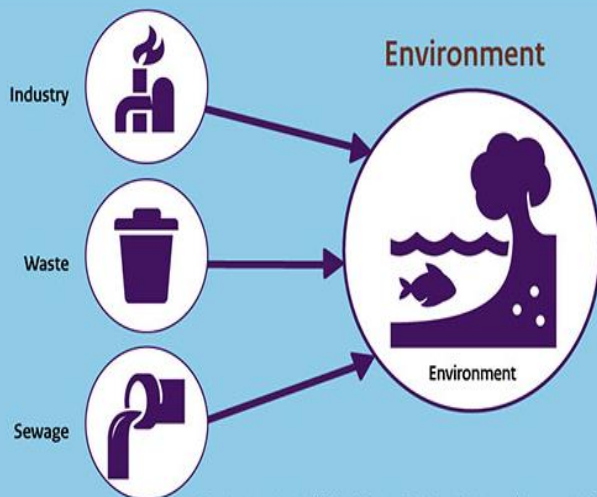
The xenoestrogen bisphenol A (BPA), have documented endocrine disruptive effects and has received much attention due to its high production volume and widespread human exposure (Izzotti A, 2009). Indeed, BPA has also been detected in a variety of environmental samples, including water, dust, sewage, and indoor and outdoor air samples. The release of BPA from polycarbonates is accelerated by UV light, aging, heating, and contact with acidic or basic compounds (Kang J, 2003). Moreover, it can leach from plastic products, food and drink packaging thus contaminating canned food. The BPA exposure is estimated to be from 0.48 to 1.6 $\mu\text{g}/\text{kg}$ body mass per day, for adults and children, respectively (Flint S, 2012). The global distribution of BPA is now extent but it has been found that the bioaccumulation factor (BCF) is moderate and it has been discussed whether or not BPA reach high enough concentrations in organisms to have biological effects. However, a large number of studies, mainly laboratory studies, have demonstrated a long range of biological effects following BPA exposure.

Possible sources of BPA exposure for consumers *



* Note: sources may differ in their contribution to the overall exposure to BPA.

Possible sources of BPA exposure for the environment *

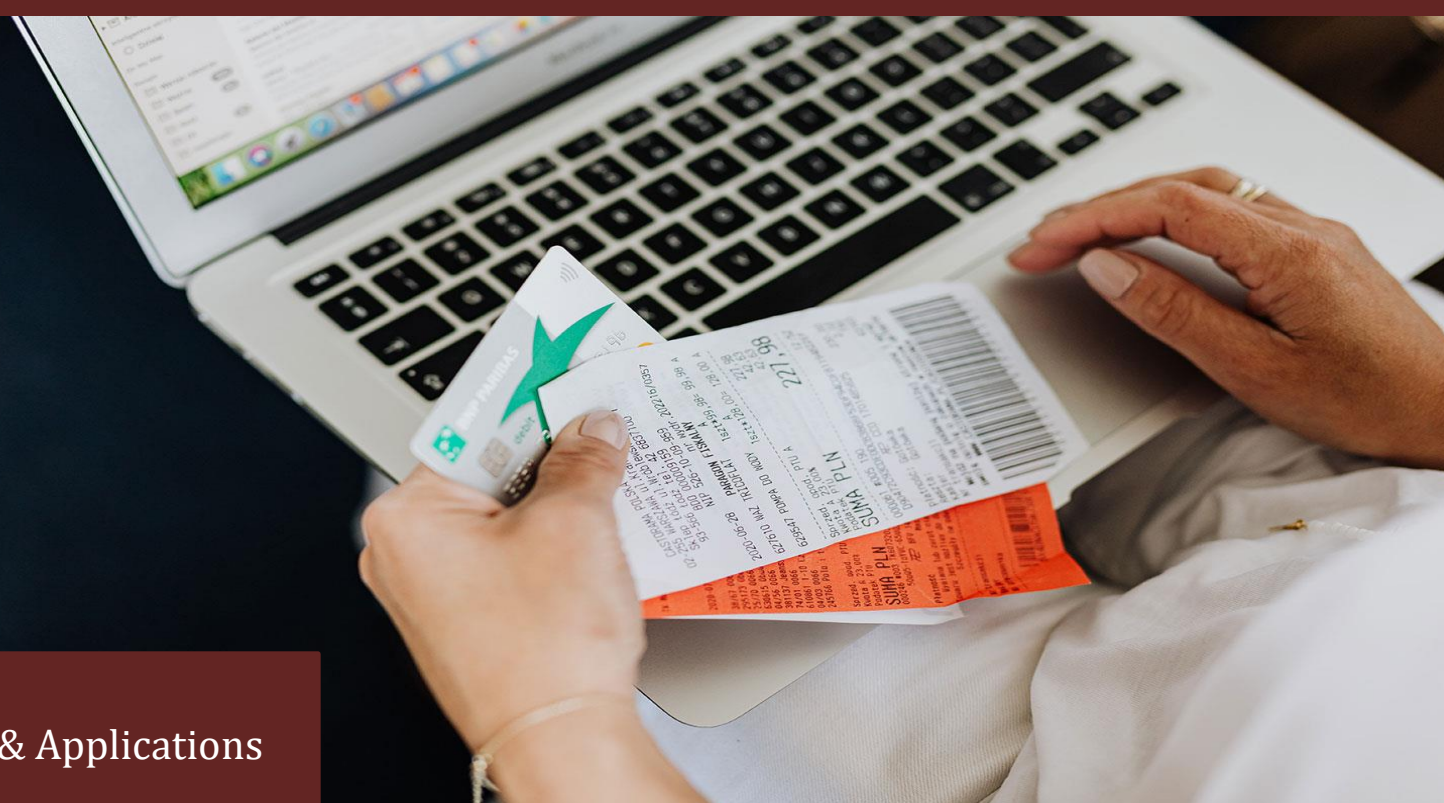


* Note: sources may differ in their contribution to the overall exposure to BPA.

One potential alternative to BPA in thermal paper is bisphenol S (BPS), which has no use restrictions to date and is being widely used in thermal paper receipts. Bisphenol S (BPS) is an organic compound with the formula $(\text{HOC}_6\text{H}_4)_2\text{SO}_2$ (Preferred IUPAC name 4,4'-Sulfonyldiphenol). It has two phenol functional groups on either side of a sulfonyl group. It is commonly used in curing fast-drying epoxy resin adhesives. It is classified as a bisphenol, and a close molecular analog of Bisphenol A (BPA). BPS differentiates from BPA by possessing a sulfone group (SO_2) as the stereocenter of the molecule instead of a dimethyl methylene group ($\text{C}(\text{CH}_3)_2$), which is the case of Bisphenol A.

Similar to BPA, BPS can act as an estrogen mimic or anti-androgen. Therefore, it is likely that BPS has the potential to interfere with, and disrupt the normal functions of endocrine system in organisms (Kuruto-Niwa R, 2005). Moreover, the genotoxic potential of BPS is also cause of concern since scientific literature reports conflicting results depending on the investigated experimental model (Kose O, 2020). As the usage of BPS as a substitute to BPA is increasing there is an urgent need to improve our knowledge about possible adverse effects of BPS on physiological functions in living organisms.





Uses & Applications

BPA is mostly used in polycarbonate plastics, epoxy resins and in thermal papers. Between about 65-70% of all bisphenol A is used to make polycarbonate plastics (European Commission. Joint Research Centre. Institute for Health Consumer Protection, 2010), which can consist of nearly 90% BPA by mass. About 25-30% of all BPA is used in the manufacture of epoxy resins and vinyl ester resins. The remaining 5% of BPA is used in a wide range of applications, many of which are also to do with plastic (Geens, et al., 2015). BPA is used as a developing agent in thermal paper which are used as cash receipts.

BPS is used in curing fast-drying epoxy glues and as a corrosion inhibitor. It is also commonly used as a reactant in polymer reactions. BPS has become increasingly common as a building block in polyethersulfone and some epoxies, following the public awareness that BPA has estrogen-mimicking properties, and widespread-belief that enough of it remains in the products to be dangerous. BPS is now used to a variety of common consumer products. In some cases, BPS is used where the legal prohibition on BPA allows products (esp. plastic containers) containing BPS to be labelled "BPA free". BPS also has the advantage of being more stable to heat and light than BPA. In recent study analyzing BPS in a variety of paper products worldwide, BPS was found in most of tickets, mailing envelopes, airplane boarding passes, and airplane luggage tags. Also, high concentration of BPS is found in cash receipts.

BPA is found in polycarbonate plastics and epoxy resins. Polycarbonate plastics are often used in containers that store food and beverages, such as water bottles. They may also be used in other consumer goods. Epoxy resins are used to coat the inside of metal products, such as food cans, bottle tops and water supply lines. Some dental sealants and composites also may contain BPA. PVC can contain BPA and its derivatives through multiple routes. BPA is sometimes used as an antioxidant in phthalates, which are extensively used as plasticizers for PVC (European Commission. , 2021). Bromination of BPA forms tetrabromobisphenol A (TBBPA), which is used as a flame retardant in plastics. BPA finds use as an antioxidant in several fields, particularly in brake fluids. BPA is used as a developing agent in thermal paper (shop receipts). Recycled paper products can also contain BPA as a result. Ethoxylated BPA finds minor use as a 'levelling agent' in tin electroplating. Bisphenol S (BPS), related to its chemical cousin Bisphenol A (BPA), is an organic compound used to make hard plastic and synthetic fibers. It is commonly used as a replacement for BPA in some types of paper receipts, can be used to lengthen color life in fabrics, and is a food packaging preservative. Bisphenol S can be found in thermal paper cash receipts, plastics, Indoor dust, linings of beverage and food cans, medical devices etc.





BPA & BPS in Cash Receipts

The receipts we receive when we buy groceries, prescriptions, gas, clothing, restaurant meals, and much more are generally printed on thermal paper coated with either Bisphenol-A (BPA) or its chemical cousin Bisphenol-S (BPS). BPA and BPS are developers that assist in the heat-activated printing process.

Studies have found that individual thermal receipts can contain BPA that is 250 to 1,000 times greater than the amount in a can of food.

BPA can be absorbed into the body through the skin. The chemicals have been shown to be hazardous to reproductive systems in humans and animals and are linked with obesity and attention disorders.

Bisphenol S is often used as a replacement for Bisphenol A. However, bisphenol S is not necessarily safer to use than Bisphenol A. Studies comparing the risk of BPS vs. BPA in thermal paper receipts yielded similar exposure risks and lists them both as chemicals to avoid (Miguel A Sogorb, 2019).

In receipt paper known as “thermal paper” because of the way the ink develops, BPA and BPS are added in their free form without being bound to the paper or polymerized.

And this type of “thermal paper” isn’t limited to receipts—it’s also used for movie and concert tickets, boarding passes and deli meat and cheese labels and this extent make it pretty hard to avoid. And studies have found that the body absorbs more BPA when thermal paper is handled with moist or greasy fingers. Using hand sanitizer and hand creams can make the body absorb BPA much more rapidly. Considering the time of pandemic, this endocrine disrupting chemical disorder may get even worse.

FACT SHEET

Bisphenol A (BPA) and Bisphenol S (BPS)

What is BPA/BPS?

Bisphenol A, more commonly known as BPA/BPS, was invented in the 1890s and was initially considered as an artificial estrogen as it strongly mimicked the effect of hormones in the body.

BPA and its alternative BPS used in thermal receipts are endocrine disrupting compounds known to disrupt normal hormone functions.

Where is BPA/BPS found?

BPA/BPS are chemicals widely used to make polycarbonate plastics and epoxy resins and used in the production of everything from thermal paper receipts, plastic water bottles, beverage cans, food storage containers, to food cans, children's toys, garden hoses, etc.

How does BPA/BPS get into the body?

Studies show that BPA/BPS is easily transferred from the receipt paper onto people's hands and absorbed through the skin.

Wet hands dramatically increase the absorption rate of the BPA/BPS by seven times. Cashiers and wait staff often have wet hands by using hand sanitizer and handling wet produce or wet table ware.

What are some potential health effects?

Exposure to BPA/BPS is especially dangerous for pregnant women and infants.

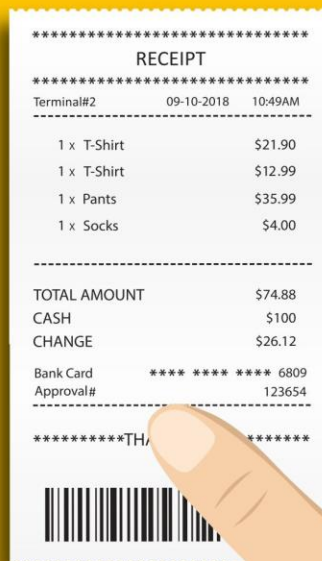
BPA/BPS is a synthetic estrogen that can disrupt the endocrine system and may lead to early onset puberty, childhood obesity and breast cancer. Exposure to BPA/BPS is especially dangerous for pregnant women and infants, and a high percentage of cashiers and waitresses handling these toxic receipts are women in their childbearing years.

What can customers and workers do about it?

If you are a customer, ask management if the receipt paper contains the toxic chemicals BPA or BPS.

If you are a worker, speak with your employer and your Health and Safety Committee.

For more information, contact your Union Representative or your Local Union's Health and Safety department.



Source: UFCW

Human Exposure To BPA & BPS Through Cash Receipt

BPA & BPS are endocrine disruptors that mimic hormones like estrogen and thyroid hormone, disrupting the body's normal functioning. Studies have found links between BPA exposure and numerous health problems like breast cancer, prostate cancer, diabetes and obesity. These chemicals can easily transfer to anything a receipt touches—our hand, the money in our wallet or even the groceries in our shopping bag. Several studies have found that handling receipts, even briefly, leads to significant BPA or BPS absorption into the body.

While virtually every person who has been tested has had BPA and BPS in their bodies, cashiers and other workers who handle thermal paper have more of these chemicals in their body than the rest of us. The fetuses of pregnant workers who handle toxic receipts may be the most vulnerable to exposure.





The BPA in receipts is present in loose powder, which easily leaves a very high concentration of the chemical on peoples' fingers. A recent study looked at BPA in participants' urine levels before and after two hours of continuously handling receipts. Initially, all participants handled the receipts without wearing gloves. After a washout period of at least a week, about half of the participants handled receipts again, but this time they wore gloves. Two hours after touching the receipts without gloves, the BPA levels in the participants' urine was significantly elevated, rising from 1.8 micrograms of BPA per liter to 5.8 micrograms per liter. After 8 hours, the study authors tested some of the gloveless participants again, and found that the BPA levels went up to 11.1 micrograms per liter, an almost five-fold increase. A 2012 University of Missouri-Columbia report warned that the FDA's estimates for safe exposure to BPA is based on oral ingestion only and around 50 percent of all thermal paper used to print store receipts is coated with BPA (SCHLANGER, 2014).

Bisphenols in Cash Receipts Available in Bangladesh

Environment & Social Development Organization - ESDO in association with Wonjin Institute For Occupational and Environmental Health – WIOEH conducted this study to assess situation of BPA & BPS presence in cash receipts, where samples were collected and sent to test for presence of this endocrine disrupting chemicals.

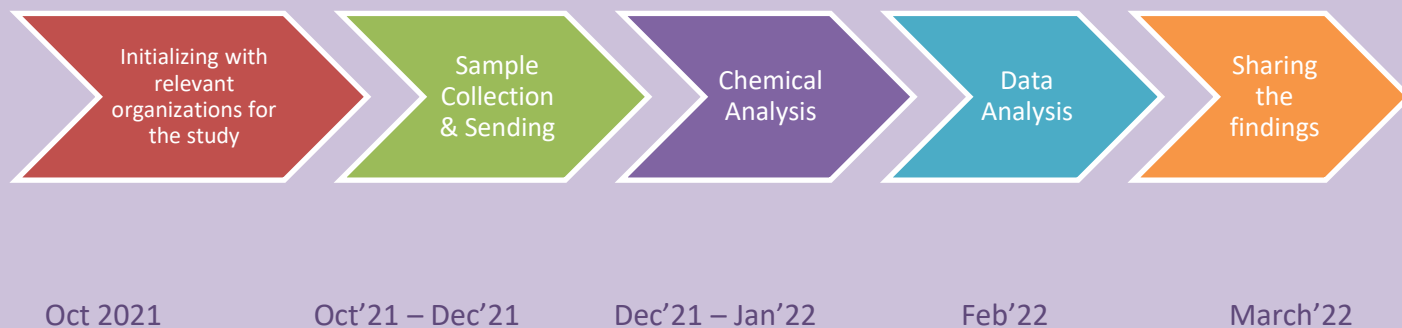
Objective of the study

- To find out the current status of presence of endocrine disrupting chemicals in cash receipts regularly used in shops.
- To promote further study requirement
- To design awareness campaign and policy advocacy

Methodology

To prepare this extensive report, the relevant study for data have been collected from both primary and secondary sources. The initial review was expanded relevant terms and included the following websites and sources –National Geographic, The Guardian, Goggle Scholar, United Nations Environment Programme and local media releases - using an advanced search by country, with key words and filters for the evaluations, most relevant to least relevant, special evaluations, and other ESDO supported study/documents. The primary data collection methodology has divided into two parts – Sample Collection & Sample analysis which have elaborated in this section. Then the data was compiled and analyses were made to make relevant assessments.

Study Timeline



Sample Collection

Amid the Covid-19 pandemic, ESDO team members had gone physically in different locations of Dhaka and collected samples from 7 different categories which are:

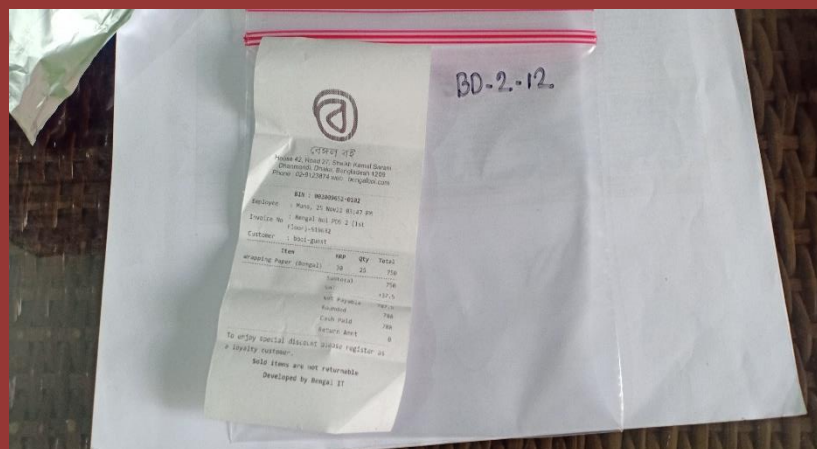
- Public Office
- Local franchise stores
- Global franchise stores
- Large major supermarkets
- Small supermarkets or convenience stores
- Bank number tickets
- Delivery receipts or general retail shops

Sample Size & Details

Total 67 samples were collected from the following different places from October'21 to November'21.

Date of Collection (MM/DD) in 2021	Categories	Place	Sample No	Quantity
11/19	Public Office	NBR	BD-1-1	5
10/24, 1/11	Local franchise stores	Arong	BD-2-7	4
10/30	Local franchise stores	Apex	BD-2-8	1
11/11	Local franchise stores	Puro	BD-2-9	1
11/5	Local franchise stores	Star Hotel & Kabab	BD-2-10	1
11/7	Local franchise stores	Persona Hair & Beauty Limited	BD-2-11	1
11/25	Local franchise stores	Bengal Boi	BD-2-12	1
11/22	Local franchise stores	UniCafe	BD-2-13	2
11/12	Local franchise stores	Bexifabrics	BD-2-14	1
11/17	Local franchise stores	Little Angles	BD-2-15	1
10/28, 11/8	Global franchise stores	Bata	BD-3-13	2
10/19	Global franchise stores	Movenpick	BD-3-14	1
11/7	Global franchise stores	Miniso	BD-3-15	1
10/26, 10/30, 11/3, 11/6, 11/8	Large major supermarkets	Unimart	BD-4-18	5
10/20, 10/30	Large major supermarkets	Swopno	BD-4-19	2
11/1	Large major supermarkets	Meena Bazar	BD-4-20	1
10/29	Large major supermarkets	CSD	BD-4-23	1
11/19	Large major supermarkets	Agora	BD-4-24	1
11/1	Small supermarkets or convenience stores	Meena Sweets	BD-5-24-1	1
11/2	Small supermarkets or convenience stores	Meena Sweets	BD-5-24-2	1
11/2	Small supermarkets or convenience stores	Modern Optics	BD-5-25	1
10/26, 11/8	Small supermarkets or convenience stores	Wellbieng Pharmacy	BD-5-26	2
11/2	Small supermarkets or convenience stores	Dhanmondi Pharmacy	BD-5-27	1
11/1	Small supermarkets or convenience stores	FG	BD-5-28	1
11/2	Small supermarkets or convenience stores	Prescription Aid	BD-5-29	1
30/10	Small supermarkets or convenience stores	Lailati	BD-5-30	1
11/22	Small supermarkets or convenience stores	Laz Pharma	BD-5-33	1

Date of Collection (MM/DD) in 2021	Categories	Place	Sample No	Quantity
11/1	Bank number tickets	IFIC Bank	BD-6-32	1
10/26, 10/28, 10/29, 11/1, 11/6, 11/7,	Bank number tickets	City Bank	BD-6-33	6
11/6	Bank number tickets	United Commercial Bank	BD-6-34	1
11/8	Bank number tickets	BRAC Bank	BD-6-35	1
10/26	Bank number tickets	Mutual Trust Bank	BD-6-36	1
11/8	Bank number tickets	Eastern Bank	BD-6-37	1
11/23	Bank number tickets	Dutch Bangla Bank	BD-6-40	1
10/22	Bank number tickets	Standard Chatard Bank	BD-6-41	2
10/24	Delivery receipts or general retail shops	e-courier	BD-8-45	1
11/23	Delivery receipts or general retail shops	Pathao Courier	BD-8-48	1
11/15	Delivery receipts or general retail shops	Foodpanda	BD-8-51	1
11/8	Others	Gadget A to Z BD	BD-9-55	1
10/21	Others	Jing Ling	BD-9-56	1



Data Analysis Method For Detecting Bisphenols

This analysis was done in two phase: Thermal Paper Detection & Analysis for the chemicals.

Some samples are considered normal paper, not thermal paper. As a result of the analysis, samples that were not detected bisphenols were reconfirmed using a hot plate at 200°C. If no color change is observed, it is determined that it is not thermal paper.

The chemical analysis was done by Liquid Chromatography Mass Spectrometry technique. This is an exceedingly sensitive and specific analytical technique that can precisely determine the identities and concentration of compounds within sample.



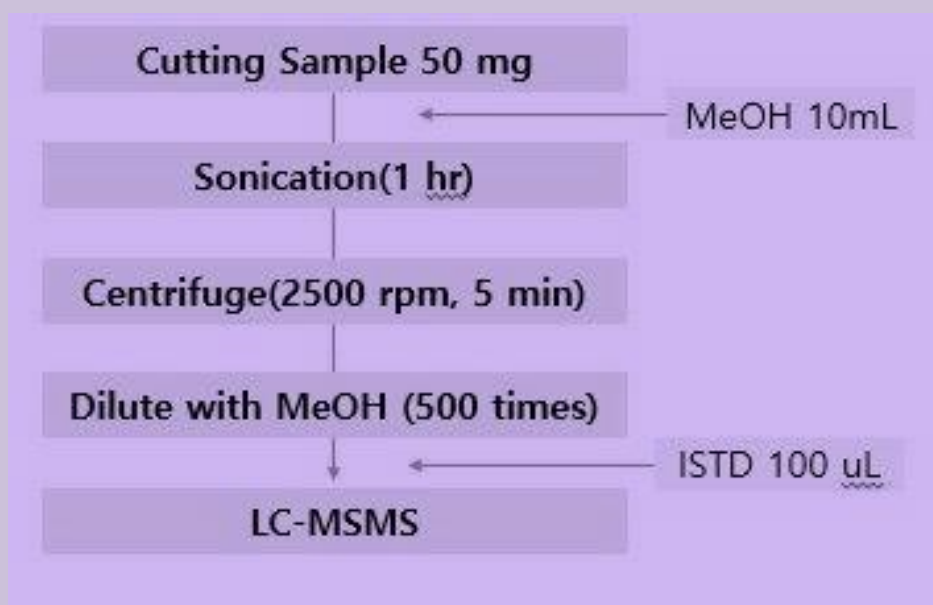
Target compounds

Analysis Condition

Bisphenols		Abbr.	Parameters		Condition
Bisphenol A		BPA	Interface		Electrospray negative ionization (ESI)
Bisphenol S		BPS	Column		ACE5-C18-PFP column (150 × 2.1 mm, 5 μm)
Bisphenol F		BPF	Eluent		Pump A: Water
Bisphenol B		BPB	Flow		Pump B: Methanol
Bisphenol AF		BPAF	Injection volume		Pump A+B: 0.3 mL/min
					5 μl



Pretreatment

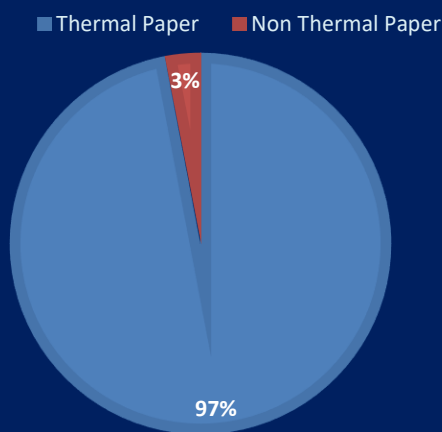


Findings

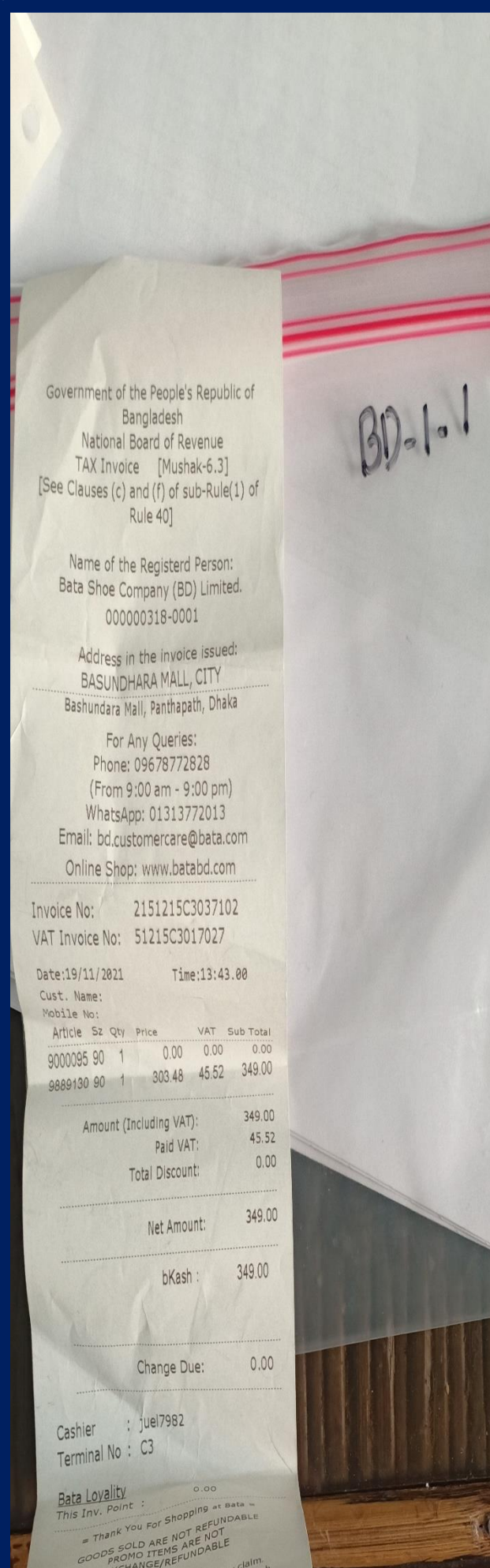
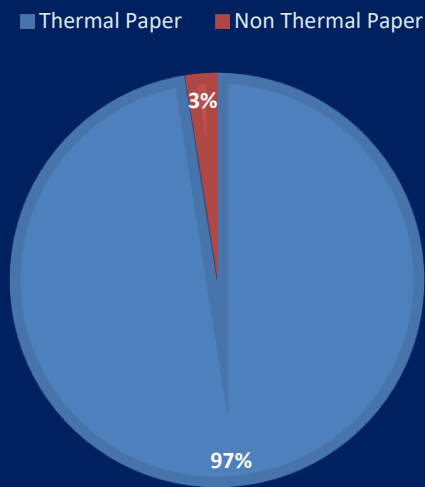
Thermal Paper Detection

Among the 67 collected sample, only 2 collected samples from one local franchise store was detected as “not thermal paper”. Among the collected receipts from 40 places only 1 store’s receipts were detected as non-thermal paper.

THERMAL PAPER DETECTION (FROM TOTAL NUMBER OF PAPER)



THERMAL PAPER (FROM TOTAL NUMBER OF CATEGORIES)

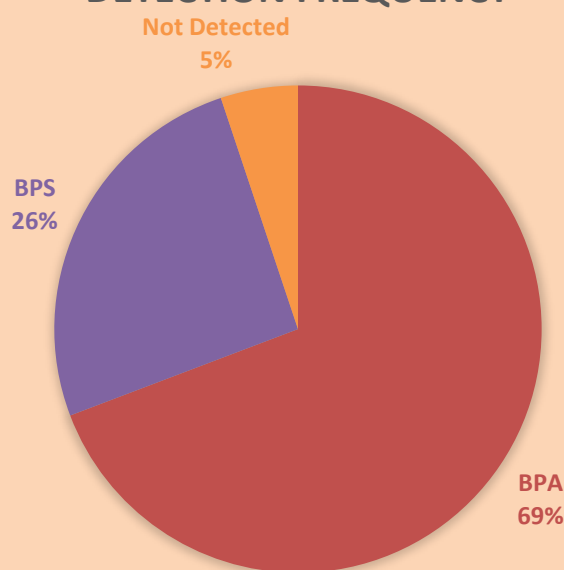


Bisphenol Detection

Among the samples of 39 places which were considered as thermal papers, 27 of them have BPA, 10 of them has BPS and only 2 samples were not detected with these chemicals. BPF, BPAF, BPB were not detected in any samples.



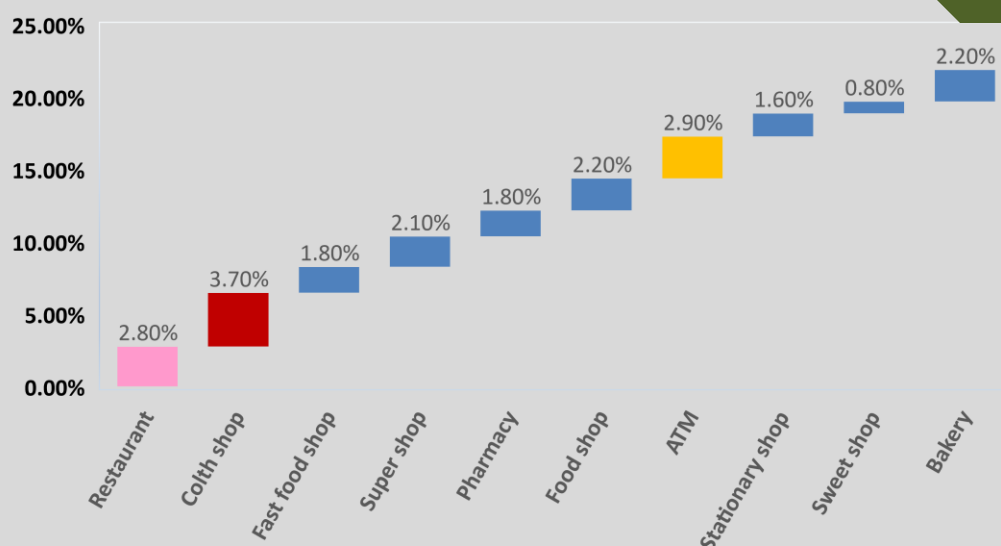
DETECTION FREQUENCY



In our collected samples (2021), the concentration range of BPA was 0.83~1.71%, and BPS was 0.61~0.96%. This is to underline that the concentration of all samples in which BPA was detected exceeded the EU standard of 0.02%.

In our previous study, we collected 36 samples in 2019 and tested for BPA. Among the 36 sample receipts, 5 receipts are from ATM booth, 6 from fast food shops, 2 from bakery and 3 each from restaurants, stationery, sweet, brand and pharmacy. 3 receipts were collected from ATM machines, 2 from cash register machines and rest of the 8 receipts are from card machines All the samples have BPA which shows us the severity of the situation ranges from 10 – 53 $\mu\text{g}/\text{cm}^2$ which is 0.8% - 3.7% by weight, that exceeded the EU standard of 0.02%.

% Mass of BPA relative to mass of receipt weight



Detection Details

Categories	Place	Quantity	Thermal/ Non-Thermal	Weight	BPA%	BPS%
Public Office	NBR	5	Thermal	0.0519	1.710	ND
Local franchise stores	Arong	4	Non-Thermal	0.0524	ND	ND
Local franchise stores	Apex	1	Thermal	0.0537	1.127	ND
Local franchise stores	Puro	1	Thermal	0.0527	1.311	ND
Local franchise stores	Star Hotel & Kabab	1	Thermal	0.0544	1.043	ND
Local franchise stores	Persona Hair & Beauty Limited	1	Thermal	0.0515	ND	0.671
Local franchise stores	Bengal Boi	1	Thermal	0.0512	1.229	ND
Local franchise stores	UniCafe	2	Thermal	0.0521	ND	0.697
Local franchise stores	Bexifabrics	1	Thermal	0.0516	1.437	ND
Local franchise stores	Little Angles	1	Thermal	0.0521	0.832	ND
Global franchise stores	Bata	2	Thermal	0.0545	1.057	ND
Global franchise stores	Movenpick	1	Thermal	0.0525	1.059	ND
Global franchise stores	Miniso	1	Thermal	0.0516	0.880	ND
Large major supermarkets	Unimart	5	Thermal	0.052	ND	0.645
Large major supermarkets	Swopno	2	Thermal	0.0536	1.116	ND
Large major supermarkets	Meena Bazar	1	Thermal	0.0516	1.022	ND
Large major supermarkets	CSD	1	Thermal	0.0505	ND	0.735
Large major supermarkets	Agora	1	Thermal	0.0519	1.024	ND

Categories	Place	Quantity	Thermal/ Non-Thermal	Weight	BPA%	BPS%
Small supermarkets or convenience stores	Meena Sweets	1	Thermal	0.0534	1.388	ND
Small supermarkets or convenience stores	Meena Sweets	1	Thermal	0.05	1.205	ND
Small supermarkets or convenience stores	Modern Optics	1	Thermal	0.0521	1.309	ND
Small supermarkets or convenience stores	Wellbeing Pharmacy	2	Thermal	0.0523	ND	0.659
Small supermarkets or convenience stores	Dhanmondi Pharmacy	1	Thermal	0.0523	ND	0.713
Small supermarkets or convenience stores	FG	1	Thermal	0.0524	1.413	ND
Small supermarkets or convenience stores	Prescription Aid	1	Thermal	0.0516	1.210	ND
Small supermarkets or convenience stores	Lailati	1	Thermal	0.0542	ND	0.659
Small supermarkets or convenience stores	Laz Pharma	1	Thermal	0.0535	ND	0.609
Bank number tickets	IFIC Bank	1	Thermal	0.0509	1.242	ND
Bank number tickets	City Bank	6	Thermal	0.0537	1.165	ND
Bank number tickets	United Commercial Bank	1	Thermal	0.0505	1.204	ND
Bank number tickets	BRAC Bank	1	Thermal	0.0523	1.324	ND
Bank number tickets	Mutual Trust Bank	1	Thermal	0.053	1.081	ND
Bank number tickets	Eastern Bank	1	Thermal	0.0561	1.213	ND
Bank number tickets	Dutch Bangla Bank	1	Thermal	0.0505	1.107	ND
Bank number tickets	Standard Chartered Bank	1	Thermal	0.0525	ND	0.816
Delivery receipts or general retail shops	e-courier	1	Thermal	0.0543	ND	ND
Delivery receipts or general retail shops	Pathao Courier	1	Thermal	0.0502	1.021	ND
Delivery receipts or general retail shops	Foodpanda	1	Thermal	0.0517	ND	ND
Others	Gadget A to Z BD	1	Thermal	0.0527	ND	0.959
Others	Jing Ling	1	Thermal	0.0557	1.088	ND

Bisphenols in Cash Receipts: South Asian Scenario

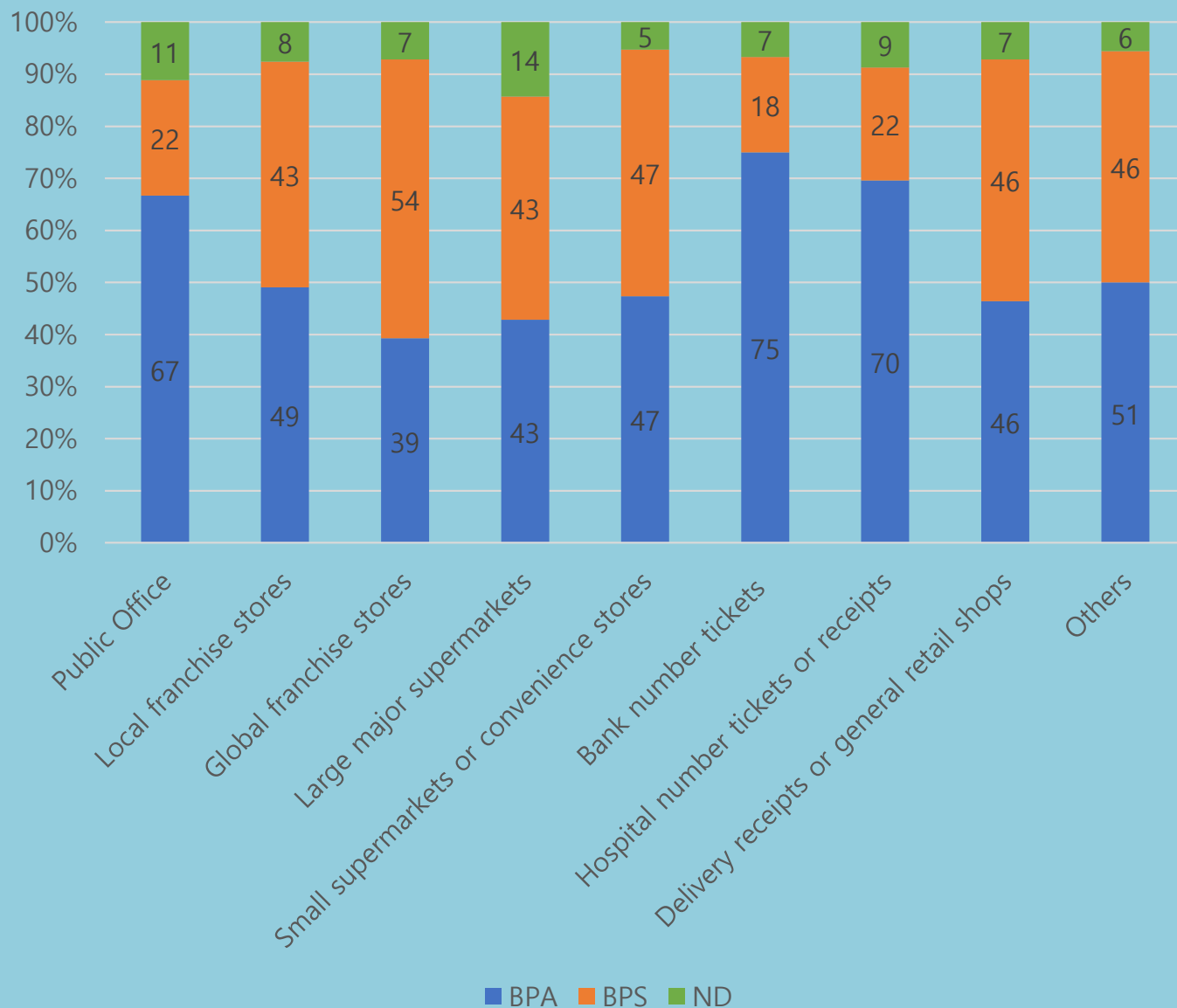
Samples from other south Asian countries were also collected by other organization from the following countries and sent to Wonjin Institute For Occupational and Environmental Health – WIOEH for analysis.

Country	Institution	ID	N
Bangladesh	ESDO	BD	40
Indonesia	Gita Pertiwi & ECOTON	ID	52
Sri Lanka	CEJ	LK	41
Malaysia	CAP	MY	44
Nepal	CEPHED	NP	42
Philippines	IDIS & EWC	PH	59
Vietnam	CGFED	VN	41
Japan	TWN	JP	36
Total			355

Thermal Paper Detection

Country	Institution	ID	N
Bangladesh	ESDO	BD	39
Indonesia	Gita Pertiwi & ECOTON	ID	45
Sri Lanka	CEJ	LK	31
Malaysia	CAP	MY	44
Nepal	CEPHED	NP	31
Philippines	IDIS & EWC	PH	53
Vietnam	CGFED	VN	40
Japan	TWN	JP	35
Total			318

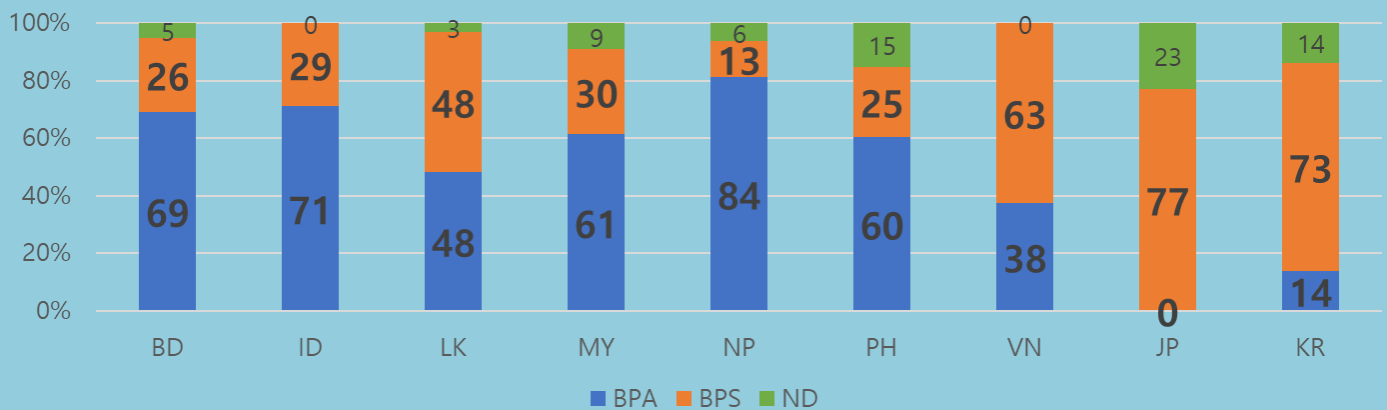
Category wise Detection Frequency



Country-wise Detection Frequency

BPA detection frequency was higher in most Southeast Asian countries: Bangladesh, India, Malaysia, Nepal, Philippines.

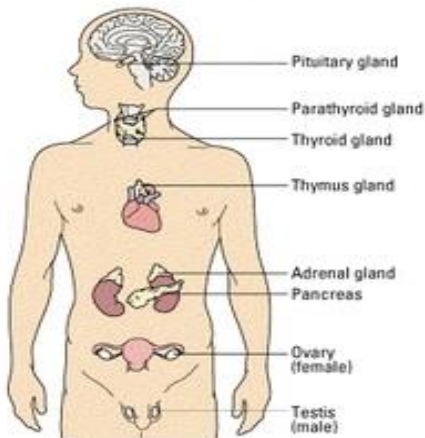
In Vietnam, Japan (along with Korea where pilot study was done) the detection frequency of BPS was higher.



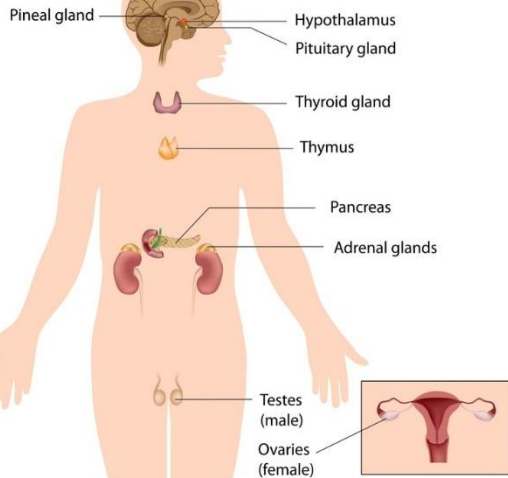


The Endocrine System

Glands which release chemicals directly into the blood stream.



The Endocrine System

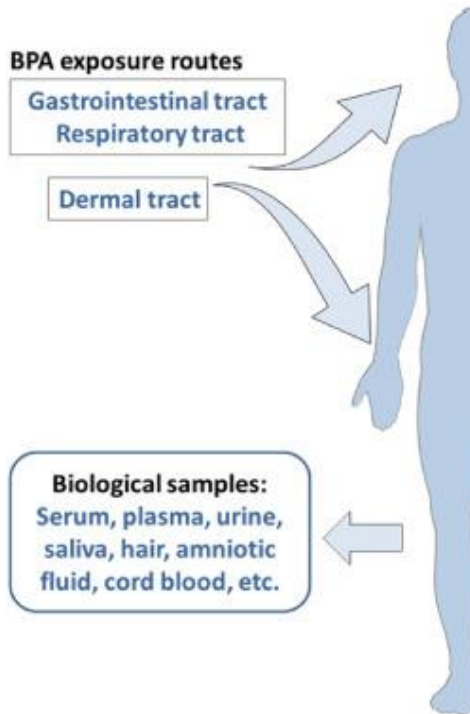


Impacts of BPA & BPS on Human Health

BPA is considered an endocrine disruptor and several studies have proposed a relationship between exposure to BPA and the appearance of adverse health effects, such as cancer, infertility, diabetes, and obesity, among others.

BPA is said to mimic the structure and function of the hormone estrogen (Tinne Geens, 2012). Due to its estrogen-like shape, BPA can bind to estrogen receptors and influence bodily processes, such as growth, cell repair, fetal development, energy levels, and reproduction. In addition, BPA may also interact with other hormone receptors, such as those for your thyroid, thus altering their function (Evanthia Diamanti-Kandarakis, 2009). Our body is sensitive to changes in hormone levels, which is the reason why BPA's ability to mimic estrogen is believed to affect our health.

Bisphenol S is often used as a replacement for Bisphenol A. Those products which are labeled as “BPA Free” may have BPS which might not necessarily be safer to use than Bisphenol A.



THE BPA CONTROVERSY

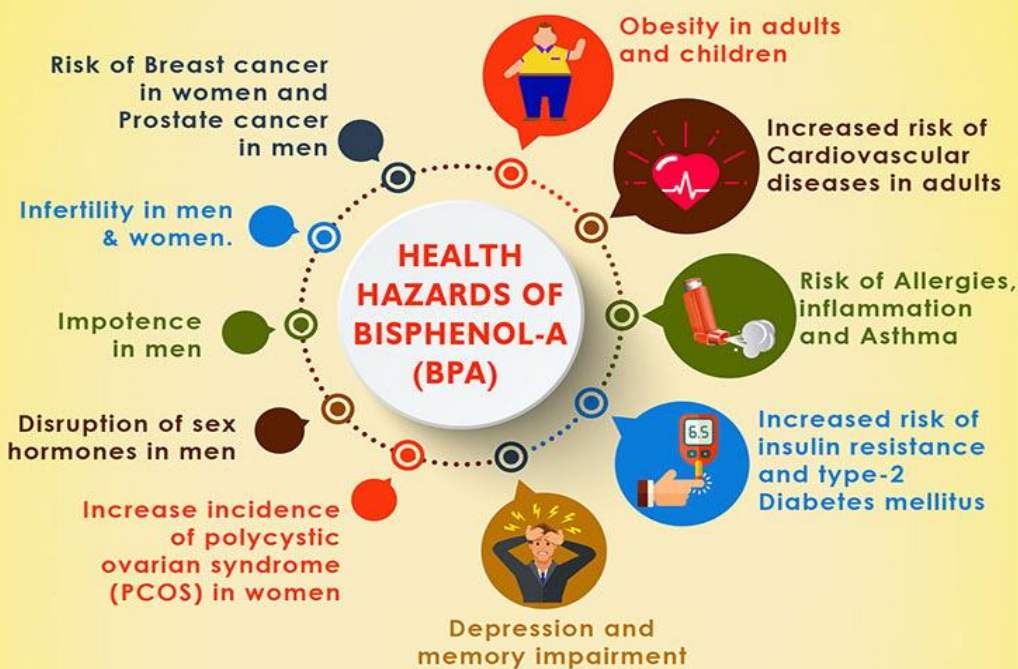
BPA’s use has already been restricted in the EU, Canada, China, and Malaysia — particularly in products for babies and young children. Some US states have followed suit, but no federal regulations have been instituted. In 2014, the FDA released its latest report, which confirmed the original 1980s daily exposure limit of 23 mcg per pound of body weight (50 mcg per kg) and concluded that BPA is probably safe at the levels currently allowed (Public Health Service, Food and Drug Administration).

However, research in rodents shows negative effects of BPA at much lower levels — as little as 4.5 mcg per pound (10 mcg per kg) daily. What’s more, research in monkeys shows that levels equivalent to those currently measured in humans have negative effects on reproduction (Paloma Alonso-Magdalena, 2006). One review revealed that all the industry-funded studies found no effects of BPA exposure, while 92% of the studies not funded by industry found significant negative effects (Frederick S vom Saal, 2006).

BISPHENOL-A



NEGATIVE HEALTH EFFECTS ASSOCIATED WITH BISPHENOL-A(BPA) EXPOSURE



Some areas of concern for BPA (Dan Brennan, 2021):

- **Hormone levels:** Some experts believe that BPA could theoretically act like a hormone in the body, disrupting normal hormone levels and development in fetuses, babies, and children. Animal studies have had mixed results.
- **Brain and behavior problems:** After a review of the evidence, the National Toxicology Program at the FDA expressed concern about BPA's possible effects on the brain and behavior of infants and young children.
- **Cancer:** Some animal studies have shown a possible link between BPA exposure and a later increased risk of cancer.
- **Heart problems:** Two studies have found that adults with the highest levels of BPA in their bodies seem to have a higher incidence of heart problems. However, the higher incidence could be unrelated to BPA.
- **Other conditions:** Some experts have looked into a connection between BPA exposure and many conditions -- obesity, diabetes, ADHD, and others. The evidence isn't strong enough to show a link.
- **Increased risk to children:** Some studies suggest that possible effects from BPA could be most pronounced in infants and young children. Their bodies are still developing and they are less efficient at eliminating substances from their systems.



BISPHENOLS | WHAT YOU NEED TO KNOW

1 Possible sources of exposure

- Plastic tableware
- Cans
- Toys
- Dental material
- Occupational exposure (cashiers handling receipts)
- Safety equipment
- Textiles
- Occupational exposure (BPA manufacturing)
- Air & dust contaminated

2 How can Bisphenols enter your body?

- Via digestion**
Diet is the primary source of exposure (BPA)
- Via dermal absorption**
- Via inhalation**

3 How might Bisphenols affect your health?

- Neurodevelopmental effects (BPA)
- Immunodevelopmental effects
- Cardiovascular diseases (BPA)
- Hormone-related cancer risk (BPA)
- Low birth weight
- Obesity and metabolic disease
- Infertility

4 How can you reduce your exposure to Bisphenols?

- Do not microwave plastic utensils containing Bisphenols
- Limit using polycarbonate containers for hot food or drinks
- Do not use damaged plastic food containers
- Avoid infant exposure by choosing BPA-free child products
- Reduce consumption canned food
- Use glass or stainless-steel bottles
- Eat food from metal or ceramic plates
- Use a product only for the intended use

Where can they possibly be found?

Bisphenols may be present in plastics with the following pictograms:

* The information provided is mainly for Bisphenol A (BPA). However, bisphenols F, M and S are suspected to have many of the same adverse health effects as BPA.

The European Union has taken action to reduce citizen's exposure to BPA and to prevent regrettable substitution, such as banning BPA from baby bottles across the EU since 1 June 2011 and setting an amount of BPA that is allowed to leach out of toys for children up to the age of three and in any toys that are intended to be placed in a child's mouth.

Source: HBM4EU

Bisphenol S is an endocrine disruptor and has comparable health risks to that of Bisphenol A. BPS has been shown to increase the expression of breast cancer carcinogens and the proliferation of positive breast cancer cells.

Additionally, BPS exposure has been linked to impaired neural function. High levels have been found to be significantly correlated with insulin resistance, albuminuria, and irregular vascular function in children (Michael Thoene, 2020). Pregnant women or women looking to become pregnant should reduce their exposure to Bisphenol S because it has been shown to reduce egg viability and may reduce fertility outcomes (Anglina Kataria, 2017).

Although there is no direct link established between BPS and cardiac disease, it is thought that BPS may operate by a similar mechanism to BPA and could cause cardiac toxicity (Zhang YF, 2020).

BPS has the potential to have an effect on a wide range of neurological functions. A recent study showed that exposure to BPS during pregnancy may disrupt thyroid hormone levels. These are important in fetal neurodevelopment and prenatal exposure to BPS has been linked to impaired psychomotor development in children. In a study using human embryonic stem cells, BPS was shown to cause a reduction in length of neurites in neuron-like cells. This disruption could lead to neurobehavioral problems such as ASD (Naderi M, 2020).

BPS, like BPA, can cross the placenta in sheep and alter the endocrine functionality of the placenta. It does this by reducing the maternal serum concentration of trophoblastic proteins. BPS shows almost identical effects on the placenta as BPA, with both BPS and BPS altering almost identical sets of genes (Basak S, 2020).

It has been proposed that BPS has the potential to affect body weight, and several studies have found a correlation between exposure to bisphenols and increased body weight. This is thought to be due to an accumulation of lipids in adipocytes i.e., a build-up of fat in fat cells. It has also been suggested that BPS leads to the formation of new adipocytes as exposure to it increases the expression of related markers. A correlation between exposure to BPS before birth and being overweight has been found in mice, although this was only found when they were also fed a high fat diet (Thoene M, 2020).

BPS levels in the human body can be measured in the urine. In one study of children, there was a significant correlation between urinary levels of BPS and insulin resistance, abnormal kidney function and abnormal vascular function. It has been suggested that there is a link between gestational diabetes mellitus and urinary BPS (Thoene M, 2020).

The endocrine disrupting nature of BPS has encouraged investigations into its affinity to estrogenic receptors, showing BPS to be a weak agonist; similar in potency to BPA, which it has come to substitute. Select studies show BPS to be capable of mimicking estradiol, and sometimes being more effective. The estrogenic activity of BPS has been demonstrated through in vivo rodent studies, inducing growth of the womb, with a range of dosages (Siracusa JS, 2018).

PLASTICIZERS

BISPHENOLS
(BPA, BPB, BPF, BPS)

PFAS
(PFOA, Gen-X, PFBS)

MERCURY

PESTICIDES

PHTHALATES

PERC and TCE

LEAD

FLAME RETARDANTS
(PBDEs, OPFRs)

AVOID TOXICS DURING AND AFTER PREGNANCY

WHAT HEALTH PROFESSIONALS AND POLICYMAKERS CAN DO

- Advocate for policies to prevent exposure to toxic environmental chemicals
- Work to ensure a healthy food system for all
- Make environmental health part of health care
- Champion environmental justice

Global Regulations

Worldwide many countries had already banned the use of BPA in baby bottles and in food packaging. Countries mentioning Canada, USA, Australia, European Union, France, Denmark, Germany, Belgium, South Africa banned BPA from baby bottle and among the Asian countries Japan, China, Malaysia had banned BPA from Food packaging and baby sippy cups, bottles. In India Bureau of Indian Standards (BIS) banned BPA use in feeding bottles of babies in 2015 but till now there is no regulations over thermal papers BPA contents.

Country	Regulation & year
European Union	BPA concentration in thermal paper to be reduced to less than or equal to 0.02% weight (200 ppm) before 2 January 2020
Japan	Banned BPA since 2001
Belgium	Banned BPA in thermal papers in 2011
South Korea	Proposed to restrict BPA in the thermal paper by May 2022 or later.
Switzerland	Banned both bisphenol A (BPA) and bisphenol S (BPS) in the thermal paper – in a concentration of 0.02% or higher by weight – implemented in January 2020
Connecticut State, USA	The act prohibits the manufacture, sale, or distribution of thermal receipt or cash register receipt paper containing BPA in Connecticut effective on 1 October 2013
Illinois State, USA	Illinois becomes the latest state in the US to ban BPA in thermal paper effective on January 1, 2020.

Regulations in Asia

Country	BPA
Vietnam	<ul style="list-style-type: none"> Plastic packaging for food(Bisphenol A (SML = 3 mg/kg), Bisphenol S (60 mg/kg or 10 mg/dm²)) PC plastic packaging: < 500 μ g/g BPA Plastic packaging and tools for small children: not use
Philippine	<ul style="list-style-type: none"> Ban on BPA in baby feeding bottles and sippy cups as childcare articles
Japan	<ul style="list-style-type: none"> Plastic ingredients and additives for food utensils: BPA content limit according to synthetic resin type
Nepal	<ul style="list-style-type: none"> Children Toys Standards 2017 BPA(free)
Malaysia	<ul style="list-style-type: none"> Section 27A of the Food Regulations 1985 Ban on bottles containing BPA
Bangladesh	<ul style="list-style-type: none"> No
Sri Lanka	<ul style="list-style-type: none"> No
Indonesia	<ul style="list-style-type: none"> BPA migration limit of 0.6 bpj (600 micrograms/kg) from PC packaging
Korea	<ul style="list-style-type: none"> Plastic packaging and tools for small children: not use Plastic packaging for food(Bisphenol A: 60 mg/kg)

Understanding Potency

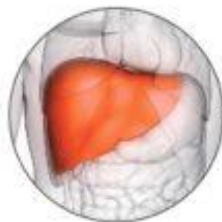
An EDC does not have a single potency, so it should not be used for regulatory decisions.

The BPA Example



BPA has **LOW** potency

when measured in the liver and uterus



Assessing the liver and uterus using standard regulatory tests reveals only small changes in weight of those organs.



BPA has **HIGH** potency

when measured in the brain and breast



Assessing the structure and function of the brain and breast reveals effects that can lead to breast cancer and harmful changes in IQ, learning, memory and behavior.



An EDC's potency depends on which organs you measure and how.

As measured in laboratory experiments

Source: Health & Environment Alliance



Recommendation

- Taking initiatives to create public awareness about endocrine disrupting chemicals like BPA, BPS and its presence in everyday products, particularly in cash receipts.
- Product label should specify about its details on BPA, BPS content
- Prevent the exposure of this chemicals, particularly in children
- Specific regulation should be imposed on restricting these toxic chemicals content in products, particularly in daily products
- Market monitoring should be done for effectively limiting or eliminating endocrine disrupting chemicals.
- More research should be executed for better understanding the effects of bisphenols
- Whenever possible not to accept thermal paper receipts.
- Trying to touch only the nonglossy backside of the receipt. It contains much less BPA/BPS.
- Trying not to use a hand sanitizer after touching a possible thermal receipt to limit the exposure.
- Segregating and separating receipts from other waste for formal chemical processing as BPA/BPS of unsegregated thermal paper waste can end up in wastewater and pollute environment.
- Effective laws against BPA/BPS use in thermal papers should be imposed.

Conclusion

BPA, BPS are endocrine disruptors and their exposure should be limited until proper regulation is imposed to limit their use. Products that are BPA-free labeled needs to be chosen to avoid the exposure. Unfortunately, it's not always easy to tell from the list of ingredients. As BPS is using as the substitute

People should use glass and stainless steel instead of plastic (for water bottles, storage containers, and baby bottles, for example) to avoid BPA. It is also to be noted that we shouldn't microwave food in plastic, and should not put plastic containers in the dishwasher. High temperatures cause the chemicals to leach out of the plastics.

With all limitations, ESDO completed the previous study which was very important study as a startup. In the previous study, we found the presence of a high level of BPA in thermal paper. Although this few samples testing is not sufficient for drawing conclusions about the toxicity of thermal paper overall. However, this study finding was good enough to give maximum attention and emphasis to action immediately.

This current study focuses on not only the presence of BPA but other bisphenols also. This study clearly underlines the need of effective regulation on all endocrine disrupting chemicals as around 26% of the total samples contained BPS.

It is high time we take all the necessary step as soon as possible to limit the human and environmental exposure of this toxic chemical.



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Transaction With **Toxins**



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