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BPA incidence in babies drinking water available on romanian market

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Abstract

Bisphenol A, a chemical that disrupts the endocrine system, is widespread in the population. In addition to the action of the endocrine disruptor, this compound can help develop many other health problems, some of them even serious. Among the categories of subjects, the most vulnerable are babies and children under 3 years old. The ways in which their exposure to BPA can be achieved are multiple, such as baby feeding bottles from PC, containers from PC for preparing food, drinking water from PET bottles made from recycled PET, used for preparing food or milk formulas, or for consumption as such. The purpose of this study is to conduct a market study on the degree of BPA contamination of babies drinking water available on the Romanian market. For the BPA analysis, 13 water samples were used, the samples being analysed by a UV - VIS spectrophotometric method. The results were between 0.12 – 0.76 µg / L, being slightly higher compared to the data in the literature, but without exceeding the limit imposed by EU Regulation no. 213/2018 of 0.05 mg / kg.

Keywords: Baby, BPA, Drinking water, PET

1. Introduction

Bisphenol A, abbreviated BPA, [CAS No. 85-05-7] is a chemical compound widely used to obtain polycarbonate materials and epoxy resins, as a monomer or as an additive. Also, this compound can be used in small quantities for obtaining other polymeric materials, such as polyacrylate resins, polysulfone resins, polyester resins, flame retardants) [8], thermal paper, printing inks [4,9], electronic devices, kitchen utensils, medical equipment [5].

There are quite a few articles in the literature related to BPA levels in PET bottled water, although BPA is not used in the process of obtaining this material. A possible contamination of polyethylene terephthalate with BPA can be achieved by using recycled PET (r-PET) which may contain small amounts of BPA from printing inks or other materials used in the manufacture of the material. Another explanation could be the existence of cross-contamination, both in the PET recycling process and in the process of obtaining virgin PET [4].

Another source of food exposure to BPA may be through bottle closures, the environment, or even food products contaminated with BPA before packaging [9].

The main source of exposure of the body to BPA is through diet (consumption of food and beverages contaminated with this compound), or by exposure, indirectly, to air, dust, contaminated water [8].

Many studies in cell cultures and human subjects have shown that this compound acts as an endocrine disruptor chemical (EDC), which mimics the activity of estrogen hormones. Also, prolonged exposure to this compound can cause some health problems, such as changes in the neural system, diseases of the cardiovascular system, diseases of the immune system, diseases of the reproductive system in both women and men, diseases of the endocrine system, changes in DNA and some cancers [1,8].

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At the same time, studies have shown that the most vulnerable subjects to BPA exposure were fetuses, children under 3 years and babies [7,8], which is why the use of BPA in packaging materials and articles for children was banned (2011/8 / EU Directive) [2].

Because water is so commonly used in infants and baby food, as such or in reconstituting milk formulas, the aim of this study was to conduct a market study on the degree of BPA contamination of still bottled water for children, bottled in PET bottle, available on Romanian market.

2.Materials and methods

Sample collection

In this study, a total of 15 samples of baby drinking water, bottled in PET bottles from different producers, purchased from supermarkets in Bucharest (Romania) were used. The samples, briefly described in Table 1, were kept at room temperature, protected from direct sunlight, until the time of analysis.

Reagents

Bisphenol A (99% purity) was purchased from Sigma Aldrich. Nitric acid (HNO_3) and Potassium hydroxide (KOH) were purchased from Merck. Stock solutions of BPA were prepared in ethanol, and the stored at 4° in glass bottle in the dark, with an expiry date of one week. All dilutions were performed with ultrapure water (18 MΩ.cm), obtained with a Mili-Q Plus system (Millipore). The glassware used was cleaned and decontaminated with 10 % HNO_3.

Equipment

BPA analysis was performed using an UV – VIS Spectrophotometer (Jasco V500), with wavelength range between 190 and 900 nm, provided with two types of light source, Deuterium lamp and Halogen lamp. The optical system is single monochromator and the detector is a photomultiplier tube.

Preparation of standard solution

The calibration curve was obtained by preparing nine standard solutions with known concentration of BPA in ethanol. From the standard of BPA, were obtained 3 solutions of different concentrations, and from the last solution the 9 points for the calibration curve were obtained.

Sample preparation

The analysis of BPA in the samples is based on the reaction between nitric acid and BPA and obtaining yellow orthophenols. A 10 mL aliquot of each sample is added to a 25 mL test tube, acidified with HNO_3 65% and then boiled. After boiling, the samples are cooled and basified with 50% KOH. The final solution is the analysed at 430 nm.

3.Results and discussions

The calibration curve obtained is presented in Figure 1. The coefficient of regression (R^2) for this calibration curve was $R^2 > 0.997$. Also, a limit of detection of 0.1 ng/L was obtained. The detection limit was calculated from the standard deviation of ten replicates. Recovery rate of BPA for first standard was 95%.

Table 1.Characteristics of bottled drinking waters (from their labels)

Producer	*pH*	*Total dissolved solids (mg/L)*	*Na^+ (mg/L)*	*K^+ (mg/L)*	*Ca^{2+} (mg/L)*	*Mg^{2+} (mg/L)*	*HCO_3^- (mg/L)*	*NO_3^- (mg/L)*
Sample A	7.8	90	0.93	-	33.69	1.46	112.21	-
Sample B	7.94	197	0.6	-	50.10	15.50	222.0	0.6
Sample C	7.27	78	3.023	1.312	9.126	2.51	42.7	3.93
Sample D	7.2	345	6.5	1	80	26	360	3.8
Sample E	-	1084	5.2	-	240	42	384	4.4
Sample F	7.71	192	0.93	0.4	62.73	1.46	191.05	7.2
Sample G	7.2	147	1.51	-	47	1.7	151	-
Sample H	-	328.5	10	1.3	38.3	20.8	229	< 1
Sample I	-	494	1.8	0.6	63.8	32	381	-
Sample J	8	-	-	-	-	-	-	2
Sample K	-	59	12.1	0.8	2.4	0.7	37	1
Sample L	-	678.4	14.0	1.8	114.4	40.9	249	-
Sample M	7	30	-	0.4	6	0.4	12.8	0.7

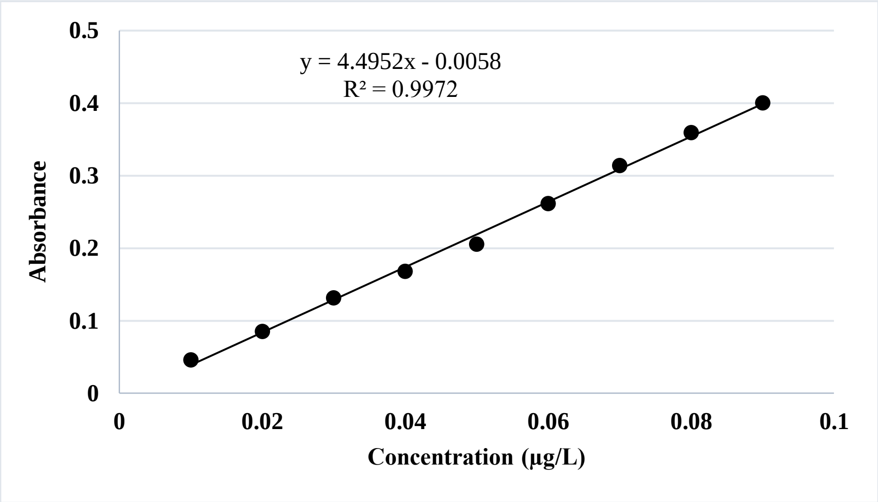

Figure 1. Bisphenol A calibration curve

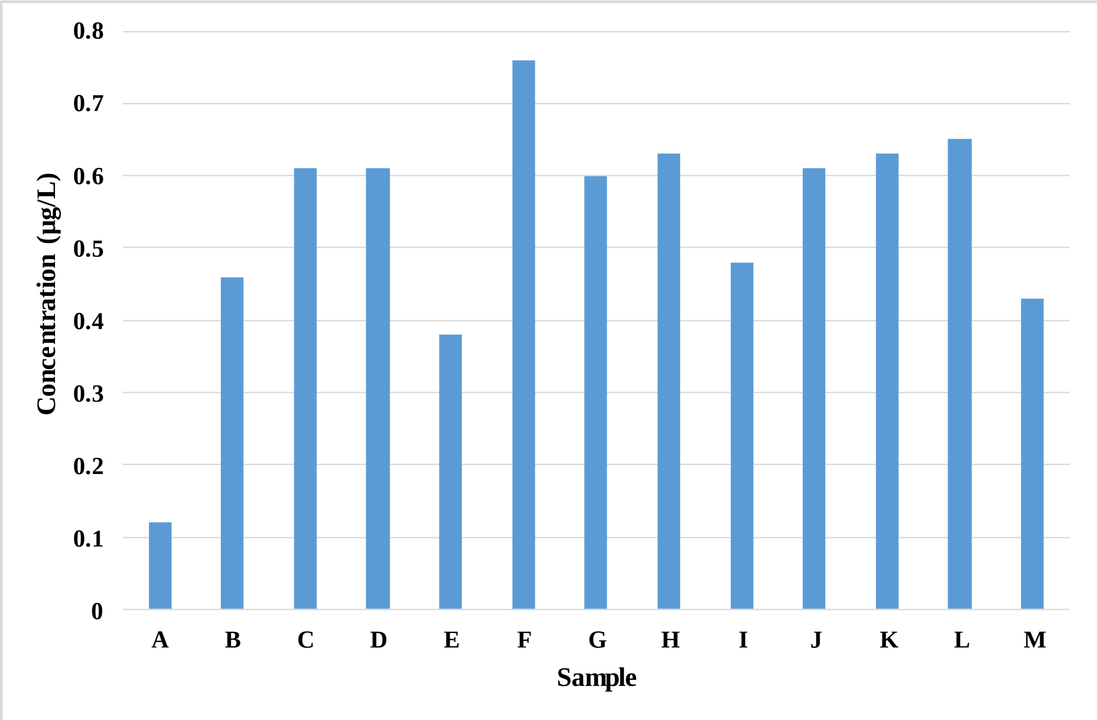

Figure 2. Bisphenol A levels in baby drinking water

As can be seen in Figure 1, results were in the range of 0.12 – 0.76 µg/L, with an average value of 0.54 ± 0.16 µg/L. These results, which are quite small, do not exceed the limit of 0.05 mg/kg of food simulant, imposed by EU Regulation no. 213/2018 [3].

Although BPA is banned in products for children and babies, we have found very low levels of this compound. One explanation may be that on most labels, it was specified that PET bottle is obtained from r-PET, probably contaminated with small amounts of BPA, which migrated under certain conditions to bottled water.

In order to avoid exposing children to BPA, it is important for parents to take certain preventive measures, such as avoiding the purchase of water bottled in PET bottles obtained from recycled material, keeping bottled water in optimal conditions, protected from direct sunlight, rapid consumption of water or transfer to containers made of another material, preferably glass, to avoid a long period of contact between the package and the product.

According to 8. Mujtuba, 2017 [8] and Metz, 2016 [6], children may be exposed to BPA from other sources, such as baby feeding bottles from polycarbonate, and the method of prevention would be to avoid heating or boiling these containers, using those that do not contain BPA "BPA - free", or baby feeding bottles obtained from other materials, polyethylene or polypropylene. Another preventive measure is the use of containers made of materials such as glass, paper, stainless steel or ceramics in the preparation of baby or children's food.

4. Conclusions

In this article a simple and rapid method for determining Bisphenol A from samples of baby drinking water bottled in PET bottles was used. The results obtained were very small, being below the maximum allowed limit, stated by Regulation (EU) no. 213/2018 [3].

The differences between the results obtained in this study and those in the literature may be due to the method used, the experimental conditions, but also the conditions in which the samples were kept before buying.

It is important to avoid exposure to this compound as much as possible, especially the most vulnerable categories, such as children and babies, as it can contribute to the development of many health problems, some of them even serious, such as cancer.

Compliance with Ethics Requirements. Authors declare that they respect the journal’s ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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