Bisphenols in Czech children´s urine

The collection of samples took place in 2016 as part of preventive health examinations of children aged 5 and 9 at cooperating general practitioners for children and adolescents in Prague, Liberec, Ostrava, Žďár nad Sázavou and Kutná Hora. A total of 379 urine samples were analyzed in accredited laboratories of the SZÚ in Prague by liquid chromatography with tandem mass spectrometric detection of the triple quadrupole type (LC-MS / MS). Creatinine content was determined by high performance liquid chromatography (HPLC).

Bisphenol A (BPA) is widely used in the production of polycarbonate plastics and epoxy resins. Polycarbonate plastics are used to make a range of everyday products, such as beverage and food packaging, plastic tableware, sports drinking bottles or toys. BPA is also contained in flame retardants, home electronics, DVDs, etc. Epoxy resins are used to coat metal products such as food cans, metal bottle caps and water pipes. BPA can be released from packaging into food and beverages, depending in particular on the temperature and storage time. Exposure of the general population to low BPA concentrations is widespread and usually occurs from the consumption of food or beverages stored in BPA containers. Young children may be exposed to direct oral contact with BPA-containing materials. Some dental sealants and composites may also contribute to BPA exposure.

There are hundreds of published scientific studies on the adverse effects of BPA on human health, which have examined mainly neurobehavioral effects (neurotoxicity), effects on the reproductive and endocrine system (infertility, estrogenic effects, hormonal damage, etc.), effects on metabolic syndrome with obesity, diabetes, hypertension and related cardiovascular diseases, oncological diseases (breast and prostate cancer), etc.

Until now, adverse health effects for the general human population upon low BPA exposures have not been considered sufficiently evidenced, in particular due to significant discrepancies in published studies as to the nature of the effects observed and the question of dose-response. However, the European Chemicals Agency (ECHA) encouraged the inclusion of bisphenol A into the list of substances of very high concern being the subject to authorization under REACH for use due to endocrine disruptive and reprotoxic properties. In 2011, the use of bisphenol A in infant products (commonly referred to as BPA free) was banned in all EU countries. Some countries regulate the use of this substance also in other products. Bisphenol A is gradually being replaced by bisphenols F and S, which, however, show similar negative effects on the endocrine system.

The European Food Safety Authority (EFSA) in its Scientific Opinion on Bisphenol A [1] assesses the health risks of BPA from dietary exposure for the general population as negligible. It estimates the exposure to be many times lower than the established tolerable daily exposure of 4 µg/kg body weight. However, the concurrent effect of a number of hormonal disruptors to which the general population is exposed today remains a question. EFSA experts are currently working on update of the BPA risk assessment.

Bisphenols are relatively rapidly metabolised and excreted from the body, therefore their urinary content indicates recent exposure. The content of bisphenols in the urine of children found by monitoring was in a wide range of values. The highest positive capture was for bisphenol A (97%, limit of quantification LOQ=0.15 ng/ml), for bisphenol S (53%, LOQ=0.083 ng/ml), and the lowest for bisphenol F (45%, LOQ=0.26 ng/ml). The highest levels were found for bisphenol A with median of 1.33 ng/ml, those for bisphenol S were orders of magnitude lower (median 0.096 ng/ml). The content of

bisphenol F was below the limit of quantification in more than 50% of the samples. Basic statistical characteristics are given in Tab.1.

The German Commission for Biomonitoring set the limit value of BPA in urine in terms of health risk at 100 ng/ml [2]. This value was exceeded in two samples in a group of 5-year-old children. In the group of 9-year-old children, this value was not reached in any sample.

In some published studies, the dependence of BPA content in urine on age is reported. In the group children, the difference in the mean values of BPA or BPS between two age groups was not statistically significant ($p>0.05$), even after conversion to the content of urinary creatinine. No significant difference was found between boys and girls as well.

The results of this study in the Czech children are comparable with studies from the other European countries. For example, in the German study GerES (2003-2006), a median BPA value of 2.7 ng/ml was found in children aged 3–14 years [3]. A Portuguese study reported a median urinary BPA value in children (4–18 years) 1.9 ng / ml [4], and a Greek (2 years of age) 2.0 ng/ml [5].

Tab. 1 Urinary Bisphenol A and S (BPA and BPS) in children, 2016

	BPA		BPS	
	ng/ml urine	µg/g creat.	ng/ml urine	µg/g creat.
Number of samples	368	368	379	379
Geomean	1,40	1,43	0,10	0,11
Median	1,32	1,38	0,10	0,10
25thPercentile	0,75	0,77	0,04	0,05
75thPercentile	2,48	2,39	0,18	0,18
95thPercentile	7,24	7,10	0,79	0,67
Minimum	< LOQ	< LOQ	< LOQ	< LOQ
Maximum	203,55	225,16	8,09	9,87

Note: LOQ BPA=0,15 ng/ml, LOQ BPS=0,083 ng/ml

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