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1 **Analytical Methods for the Determination of Biomarkers of Exposure to**
2 **Phthalates in Human Urine Samples**

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10 **Highlights**

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- 12 • We review analytical methods for the quantitation of urinary phthalate metabolites
- 13 • We discuss extraction and clean-up strategies for GC-MS and LC-MS/MS
- 14 • We outline intra- and inter-individual variations of biomarker levels
- 15 • Suggestions for minimizing uncertainties in phthalate metabolite data

16

Abstract

17 This article presents an overview of the analytical methods for the determination of
18 biomarkers of exposure to phthalates in human urine samples. Phthalates are non-persistent
19 chemicals; hence urine is the ideal matrix for biomonitoring besides being non-invasive and
20 simple to collect. Phthalate monoesters and oxidative secondary metabolites are the suitable
21 biomarkers of exposure to short chain and long chain phthalates, respectively. The
22 determination of urinary phthalate metabolites greatly reduces the “phthalate blank problem”
23 which arises due to the ubiquitous presence of this chemical in laboratory atmosphere. We

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