

Rapid Analysis of some Endocrine Disruptor Chemicals Leaching from Baby Milk Feeding Bottles Using SPME and SDME Techniques

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Abstract The sample preparation methods such as the solid-phase microextraction (SPME) and the single-drop microextraction (SDME) for preconcentration of some endocrine disruptor chemicals (EDCs) leaching from baby milk feeding bottles were developed. Afterwards, all analytes were determined by using the GC-MS technique. The parameters affecting extraction efficiency of both methods including fiber coating, extraction time, extraction temperature, salting-out effect, desorption time, organic solvent, drop volume, pH of the solution, and stirring rate were also investigated. Under the optimum extraction conditions, the results from the developed methods revealed that the analysis time used was somewhat short (<8 min). The detection limits was low (LOD, 0.02–0.12 µg/mL for direct-SPME and 0.07–0.17 µg/mL for direct-SDME). The precision was slightly satisfactory (RSD, <5.9% of intra-day, <7.9% of inter-day for direct-SPME and <4.3% of intra-day, <4.7% of inter-day for direct-SDME). Moreover, the recoveries in both techniques were slightly high (85–102% for direct-SPME and 84–103% for direct-SDME). In this regard, both direct-SPME and direct-SDME methods could be used as alternative ways for the sensitive determination of some EDCs. Besides, the simple, rapid, and efficient features of the proposed method were demonstrated by the analysis of these compounds in aqueous solution.

Keywords Endocrine disruptor chemicals · SPME · SDME · Microextraction · GC-MS

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Introduction

During the last decade, endocrine disruptor chemicals (EDCs) are special pollutants in environment because of their widespread use in several industrial processes, such as the manufacture of plastics, dyes, drugs, detergents, and pesticides. These compounds are of great environmental concern owing to their high toxicity (Braun et al. 2003). Currently, EDCs are frequently illegally used to improve feed conversion and growth rate in animal husbandry and aquaculture. Long-term or a large number of use not only may lead to an accumulation of EDCs in animal but also release partial EDCs into environment through animal waste. As a result, these compounds may be finally transferred into ecosystems and food chains which may bring great harm to human health and ecological environment in a long time (Wu et al. 2016).

Firstly, alkylphenol (AP) groups include 4-tert-octylphenol (4-t-OP), 4-octylphenol (4-OP), and 4-nonylphenol (4-NP). Secondly, chlorophenol (CP) groups include 2,4-dichlorophenol (2,4-DCP), 2,4,6-trichlorophenol (2,4,6-TCP), and pentachlorophenol (PCP). Finally, bisphenol A (BPA) has been indicated to exhibit endocrine-disrupting chemical properties as mentioned above (Basheer and Lee 2004; Wu et al. 2016). In addition, the AP groups mainly insert municipal wastewater treatment plants via industrial effluents. Generally, due to their polarity, persistence and water solubility APs can pass through wastewater treatment plant (Braun et al. 2003). For example, 4-NP has an estrogenic effect in nature, which can cause the feminization of male fish, resulting in a lack of reproductive success (Helaleh et al. 2001). Certainly, CPs are widely used as wood preservative agents, herbicide, pesticide, and disinfectants and used as intermediates in several industrial processes (Sarrion et al. 2002). CP toxicity depends on the pH and the total number of chlorine atom in the molecule, PCP being the most toxic of the 19 members of this family (Campillo et al. 2006). Especially, BPA is one of the