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**Comparison of migration from polyethersulphone baby bottles with that of polycarbonate baby bottles**

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Methods/Techniques:	Chromatography - HPLC, Chromatography - LC/MS
Additives/Contaminants:	Baby bottles, Bis-phenol A, Migration, Food contact materials
Food Types:	Infant formulae, Milk
Abstract:	<p>This work presents two analytical methods developed for measuring three components of polyethersulphone (PES) and applying them to the migration testing of 30 baby bottles made of PES. The study also provides migration results under the same conditions for Bisphenol A (BPA) from 40 polycarbonate baby bottles using a well established method adapted to low concentrations. For PES bottles migration analysis of diphenyl sulphone (DPS), 4, 4'-dichlorodiphenyl sulphone (DCPS) and 4,4'-dihydroxydiphenyl sulphone (DHPS; also known as bisphenol S), was done using the two different analytical methods with detection limits around 0.1 – 0.3 µg/kg, and therefore much below their respective legislative limits of migration of 50-3000 µg/kg, respectively (EU, 2002). In parallel, 40 bottles made of polycarbonate were analysed for the migration of BPA using a method validated at EU level and modified to a lower detection limit of 0.1µg/kg. Migration tests were conducted into the simulant for milk 50% EtOH (EU, 2011) according to the test conditions from the guidelines on test conditions for articles in contact with foodstuffs (with a focus on kitchenware) prepared by the European Union Reference Laboratory and its Network of National Reference Laboratories. None of the 30 bottles made of PES released any detectable amounts of DCPS or DHPS and only 2 bottles released a very low amount of DPS of around 1 µg/kg in the milk food simulant compared to a limit of 3000</p>

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	<p>µg/kg. For PC bottles, 32 bottles out of 40 (80 %) did not release BPA beyond the LOD of 0.1 µg/kg (in any of the three migration tests performed on each bottle). The other 20 % of bottles exhibited only very minor migration, where the highest level in the first migration was of 1.83 µg/kg and most bottles did not release detectable BPA in the second and third round. Only one bottle with a migration level of 1.08 µg/kg in the first round still showed a detectable level in the last migration (i.e. 0.42 µg/kg). It is important to note that the legal limit was still 600 µg/kg for polycarbonate bottles at the time of purchase (EU, 2002), preceding the precautionary ban taking effect from 1 June 2011 (EU 2011a; EU 2011b). This confirms results that the likelihood of migration of BPA is very low and remains in very minute amounts. The results also suggest the absence of release from PES bottles based on the set of bottles investigated.</p>
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## Comparison of migration from polyethersulphone and polycarbonate baby bottles

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### Abstract

This work presents two analytical methods developed for measuring three components of polyethersulphone (PES) and applying them to the migration testing of 30 baby bottles made of PES. The study also provides migration results under the same conditions for bisphenol A (BPA) from 40 polycarbonate baby bottles using a well established method adapted to low concentrations. For PES bottles migration of diphenyl sulphone (DPS), 4, 4'-dichlorodiphenyl sulphone (DCPS) and 4,4'-dihydroxydiphenyl sulphone (DHPS; also known as bisphenol S), was carried out using two different analytical methods with detection limits around 0.1 – 0.3 µg/kg, and therefore much below their respective legislative migration limits of 50-3000 µg/kg, respectively (EU, 2002). In parallel, 40 bottles made of polycarbonate were analysed for the migration of BPA using a method validated at EU level and modified to give a lower detection limit of 0.1µg/kg. Migration tests were conducted into the simulant for milk 50% EtOH (EU, 2011) according to the test conditions from the guidelines on test conditions for articles in contact with foodstuffs (with a focus on kitchenware) prepared by the EU Reference Laboratory and its network of National Reference Laboratories. None of the 30 bottles made of PES released any detectable amounts of DCPS or DHPS and only 2 bottles released a very low amount of DPS of around 1 µg/kg in the milk food simulant compared to a regulatory limit of 3000 µg/kg. For PC bottles, 32 bottles out of 40 (80 %) did not release BPA above the LOD of 0.1 µg/kg (in any of the three migration tests performed on each bottle). The other 20 % of bottles exhibited only very minor migration, where the highest level in the first migration test was 1.83 µg/kg and most bottles did not release detectable BPA in the second and third test. Only one bottle with a migration level of 1.08 µg/kg in the

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3 first test still showed a detectable level in the last migration test (i.e. 0.42 µg/kg). It is  
4 important to note that the legal limit was still 600 µg/kg for polycarbonate bottles at the time  
5 of purchase (EU, 2002), preceding the precautionary ban taking effect from 1 June 2011 (EU  
6 2011a; EU 2011b). This confirms results that the likelihood of migration of BPA is very low  
7 and remains in very minute amounts. The results also suggest the absence of release from PES  
8 bottles based on the set of bottles investigated.  
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### 13 **Introduction**

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18 Newborns come in contact with different types of plastic utensils such as feeding bottles.  
19 Chemical substances such as monomers or additives might migrate from the plastic into the  
20 foodstuffs. Since infants have a lower body weight compared to adults, their exposure to the  
21 food in contact with the plastic material is higher and ensuring no health concerns is of  
22 highest importance. Recent years have shown new concerns regarding the safety of  
23 polycarbonate (PC) plastic baby bottles due to the monomer bisphenol A (BPA) used in its  
24 production. In 1993 Krishnan et al. reported that BPA exhibited estrogenic activity. Since  
25 small amounts of BPA may leach from polycarbonate material into foodstuff many studies  
26 have since then been conducted and reviewed on BPA release from baby bottles from mild to  
27 harsh conditions as well as ageing (Hoekstra and Simoneau, 2011; Biedermann-Brem et al,  
28 2008; Brede et al, 2003; Ehlert et al, 2008; Food and Consumer Product Safety Authority,  
29 2005, 2008; Kubwabo, et al, 2009; Maragou, et al, 2008; Mountfort et al, 1997; Santillana et  
30 al, 2011).  
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41 The European Commission had set a specific migration limit of 600 µg/kg food for BPA (EU,  
42 2002). However, as a precautionary measure, and following the publication of the EFSA  
43 scientific opinion (EFSA, 2010), the European Commission recently decided to ban the use of  
44 BPA for the manufacture of polycarbonate infant feeding bottles (EU 2011a, EU 2011b). The  
45 market is thus facing a phasing out of polycarbonate (PC) baby bottles as a consequence of  
46 the EU legislation effectively prohibiting the manufacture as of 1 March 2011 and their  
47 placing on the market as of 1<sup>st</sup> June 2011. As direct consequence, plastic substitutes have  
48 massively appeared on the EU market. Such materials include for example polypropylene  
49 (PP), silicone, polyamide (PA), a new co-polyester, and polyether sulphone (PES). In  
50 particular, PES has the interesting characteristics that its potential starting components are  
51 diphenyl sulphone (DPS), 4, 4'-dichlorodiphenyl sulphone (DCPS) and 4,4'-  
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3 dihydroxydiphenyl sulphone (DHPS) also known as bisphenol S (BPS). Recent studies  
4 demonstrated the likelihood that bisphenol S may have similar endocrine disrupting  
5 characteristics as BPA (Kuruto-Niwa et al, 2005; Grignard and Bremer, 2011). Since PES is  
6 one of the materials available on the European market to replace PC baby bottles, our study  
7 focused first on developing specific methods measuring three components (including BPS)  
8 migrating from PES. The methods were then applied to the migration testing of 30 PES baby  
9 bottles. In addition, 40 PC baby bottles were analysed for migration of BPA using a method  
10 validated at EU level (Bratinova et al, 2010). Considering the lack of data on migration from  
11 substitute baby bottles (Aschberger et al, 2010) and yet the structural similarities of some of  
12 components of PES with BPA, we felt it there was a strong need to evaluate the safety of a  
13 potential relevant replacement of PC with materials including in particular PES in some  
14 countries.  
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## 24 **Materials and methods**

### 25 *Samples:*

26 40 PC baby bottles were analysed from 9 European countries (including one box of duplicates  
27 and two boxes of triplicates). Additionally, 30 PES baby bottles were analysed from 12  
28 countries (including four boxes of duplicates one box of three baby bottles). The samples  
29 were purchased or obtained via the collaboration of our network of National Reference  
30 Laboratories for Food Contact Materials. These were collected and purchased in the period  
31 November 2009 –January 2011.  
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### 40 *Chemicals:*

41 Ultrapure water was prepared from a Milli-Q purification system (Millipore); Methanol and  
42 ethanol, HPLC grade quality  $\geq 99.95\%$ , and Ammonium acetate was purchased from Sigma  
43 Aldrich (Italy) with  $>99.9\%$  quality. Standards of 4,4'-dichlorodiphenyl sulphone (DCPS) and  
44 4,4'-dihydroxydiphenyl sulphone (DHPS) were obtained from Aldrich (Italy) and were of  
45 98% quality. Diphenyl sulphone (DPS) was purchased from Riedel-de Haën with 99.4%  
46 quality. 2,2-bis(4-hydroxyphenyl)propane (Bisphenol A) was obtained from Aldrich with  
47  $>99\%$  quality.  
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54 The calibration curves were prepared on a 5 point basis (and 7 for UPLC-MS) for the range of  
55 concentration 0.3  $\mu\text{g/L}$  to 6  $\mu\text{g/L}$  in the food simulant 50% EtOH in water (v/v) for BPA, and  
56 0.5  $\mu\text{g/L}$  to 5  $\mu\text{g/L}$  for the target analytes 4,4'-dihydroxydiphenyl sulphone (DHPS) and  
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3 Diphenyl sulphone (DPS) in UPLC-MS. The regression coefficients were respectively 0.9997  
4 for BPA, 0.9998 for DPS, 0.9994 for DHPS. In the case of HPLC DAD and HPLC FLD, the  
5 quantification was aimed at screening and therefore was performed semi quantitatively  
6 against the benchmark concentrations at the SMLs of these substances, i.e. 50 µg/kg for 4,4'-  
7 dichlorodiphenyl sulphone (DCPS), 50 µg/kg for 4,4'-dihydroxydiphenyl sulphone (DHPS)  
8 and 3000 µg/kg (ie. 3 mg/kg) for Diphenyl sulphone (DPS).  
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### 13 ***Confirmation of materials of baby bottles***

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16 FT-IR was used to confirm the nature of the material of the baby bottles in the case of  
17 polycarbonate since it was not always stated. A Perkin Elmer FT-IR (Spectrum One) was  
18 applied using the attenuated total reflectance mode. ATR spectra were measured with a  
19 resolution of 4 cm<sup>-1</sup> in the range of 4000-650 cm<sup>-1</sup>, each generated from 4 scans. The polymer  
20 identification was achieved based on comparisons with reference spectra from our internal  
21 standard materials. In the case of PES, this identification was superfluous as the bottles were  
22 labelled, their colour (yellowish tint) recognisable and the presence of BPA could be  
23 immediately seen from any LC-MS spectrum running for the quantification of the other  
24 sulphone based compounds.  
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### 32 ***Migration tests***

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34 Since most manufacturers recommended sterilization of the baby bottle prior to use (specified  
35 on the leaflet) the bottles were sterilized. The common treatment was selected as boiling in  
36 water for 5 min. The bottles were then subjected to the conventional migration test for hot fill  
37 conditions i.e 2 hours at 70°C. The simulant used was as specified in the EU legislation  
38 2007/19/EC for milk, i.e. 50% EtOH. This was identified as the worst case simulant for this  
39 study since for juices which would be modelled by acetic acid 3%, the age group of the infant  
40 would be older than the most sensitive population of newborn where the simulant for milk  
41 would apply.  
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50 The simulant was pre-heated to 70°C, and a volume corresponding to the specified volume to  
51 the baby bottles was added to the item. The test specimens were covered with a glass plate  
52 weighted to ensure absence of evaporation and placed in a convection oven for 2 hours at 70  
53 °C. The loss of simulant was measured in preliminary tests and was shown not to exceed 3%.  
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56 Calibration curves were done in the 50% EtOH simulant in order to take into account  
57 recoveries. After treatment the migration solution was transferred from the baby bottle into a  
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3 glass bottle with PTFE lined cap and left to cool down prior to analysis. An aliquot was then  
4 used in glass GC vial with PTFE lined cap for analysis. Since the sample was a repeated use  
5 article, a second and third migration tests were performed according to the repeated use  
6 conditions for food contact material (82/711/EEC as amended). The bottles were quickly  
7 rinsed with deionised water between two migration tests. In a first phase only the first  
8 migration was analyzed. However, all three migration solutions conducted from PC bottles  
9 were analyzed to confirm migration of BPA. Blank samples were also prepared from a portion  
10 of the simulant used for the migration tests.  
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#### 16 17 18 *Analysis of migration solutions:*

19 The concentrations of migrants in the simulant were determined by high performance liquid  
20 chromatography (HPLC) with diode array (DAD) and fluorescence (FLD) detection, as well  
21 as by UPLC-MS for PES bottles.  
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#### 26 27 *HPLC for polycarbonate:*

28 BPA was analysed from the migration solutions using an HPLC (Hewlett Packard 1100)  
29 coupled with fluorescence detector based on a validated method at EU level (Bratinova et al,  
30 2010). Slight changes were further made to focus on very low calibration levels which do not  
31 necessarily correspond to those aimed at testing for compliance. The instrument was operated  
32 with a column Phenomenex (kinetex) C18, 150 x 3 mm x 2.6  $\mu\text{m}$ , operated at a temperature of  
33 30°C, using a flow rate of 0.27 ml/min and an injection volume of 20  $\mu\text{l}$ . The fluorescence  
34 detector was operated with the excitation wavelength of  $\lambda_{\text{exc}} = 235 \text{ nm}$  and an emission  
35 wavelength of  $\lambda_{\text{ems}} = 317 \text{ nm}$ . The mobile phase was composed of methanol water in  
36 proportion (68:32) held for 10 minutes in isocratic conditions. The limit of detection  
37 (LOD) was 0.1  $\mu\text{g/L}$  and limit of quantification (LOQ) was 0.3  $\mu\text{g/L}$ . The LOD was  
38 calculated based on a signal to noise ratio of 3, whereas the LOQ was based on 3 times the  
39 LOD.  
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#### 48 49 50 *HPLC for PES:*

51 This method was applicable for all 3 components but was used specifically for the  
52 quantification of 4,4'-dichlorodiphenyl sulphone, whereas for the other two components the  
53 LC-MS method gave greater sensitivity and was used as primary analytical method. The  
54 migration solutions were analysed by HPLC (Hewlett Packard 1100) coupled with a Diode  
55 Array Detector and Fluorescence detector. The instrument operated with a column Halo C18,  
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3 150 x 3 mm x 2.7 $\mu$ m operated at a temperature of 20°C, with a flow rate of 0.27 ml/min and  
4 an injection volume of 10  $\mu$ l. The diode array detection was performed at a wavelength set at  
5 260 nm, whereas the fluorescence detection was operated with an excitation wavelength of  
6  $\lambda_{exc} = 260$  nm and an emission wavelength of  $\lambda_{ems} = 317$  nm. The mobile phase used was a  
7 gradient of methanol water (60:40) to 90:10 in 10 min., and held at 90:10 for 3 min. The LOD  
8 was 0.3  $\mu$ g/kg and LOQ was 0.9  $\mu$ g/kg. The LOD and LOQ were calculated as previously  
9 described.  
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#### 14 15 16 17 *UPLC-MS for PES:*

18 This method was used for the analysis of diphenyl sulphone and 4,4'-dihydroxydiphenyl  
19 sulphone (Bisphenol S). The method was not adequate for 4,4'-dichlorodiphenyl sulphone.  
20 The migration solutions were analysed by UPLC-MS (Waters Xevo) coupled with an  
21 electrospray interface (ES+) in multiple reaction monitoring mode (MRM) using a column  
22 Waters Acuity BEH C18 (100 mm \* 2.1 mm \* 1.7 $\mu$ m) operated at 30°C with a flow rate of  
23 0.3 ml/min and an injection volume: 7.5  $\mu$ l. The chromatographic conditions used a mobile  
24 phase of water ammonium acetate 1mM /methanol in proportion of (60:40) held for 0.3 min,  
25 followed by a gradient to 20:80 in 2.7 min., and held at the ratio of 20:80 for 0.5 min. The  
26 spectrometric conditions are summarised in table 1. The LOD was 0.1  $\mu$ g/kg and LOQ was  
27 0.3  $\mu$ g/kg for both substances. The LOD and LOQ were calculated as previously described.  
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(Table 1 here please)

## 43 **Results and Discussion**

### 44 45 46 *Bottles made of polycarbonate*

47 In total, 40 bottles were subjected to migration testing in 50% EtOH simulant which was  
48 analysed to quantify the presence of BPA (Table 2). In 32 bottles (80 %) no BPA was found  
49 using an analytical method with a detection level of 0.1 $\mu$ g/kg (in none of the three migration  
50 tests performed on each bottle). The remaining 8 bottles exhibited only very minor migration,  
51 where the highest level in the first migration was of 1.83  $\mu$ g/kg and most bottles did not  
52 release detectable BPA in the second and third round. Only one bottle with a migration level  
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3 of 1.08  $\mu\text{g}/\text{kg}$  in the first test still showed a detectable level in the last migration test (i.e. 0.42  
4  $\mu\text{g}/\text{kg}$ ). It is important to note that the legal limit was still 600  $\mu\text{g}/\text{kg}$  polycarbonate bottles at  
5 the time of purchase, preceding the precautionary ban taking place from 1 June 2011 (EU,  
6 2011a; EU 2011b). This confirms results from a previous monitoring study carried out by the  
7 JRC in 2000 (Simoneau et al, 2000) and from the most recent studies and enforcement  
8 campaigns (Food and Consumer Product Safety Authority, 2008, Kubwabo et al, 2009,  
9 Santillana et al, 2011) that the likelihood of migration of BPA into the official simulant for  
10 milk 50% ethanol is very low and remains in very minute amounts. Bottles were also analysed  
11 for other compounds in a work currently in progress without showing any notable release  
12 (Simoneau et al, in preparation).  
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### 20 21 ***Bottles made of polyethersulphone***

22 Migration of diphenyl sulphone and 4,4'-dihydroxydiphenyl sulphone (bisphenol S) from PES  
23 baby bottles was specifically measured by UPLC-MS. 4,4'-dichlorodiphenyl sulphone was  
24 not visible with this method and was therefore analysed in parallel by HPLC-FLD. 2 out of 30  
25 bottles indicated low presence of diphenyl sulphone (1.45 and 1.73  $\mu\text{g}/\text{kg}$ ). Migration of  
26 Bisphenol S and 4,4'-dichlorodiphenyl sulphone was below the limit of detection (0.1 and 0.3  
27  $\mu\text{g}/\text{kg}$  respectively). Figure 1 illustrates the chromatograms obtained by UPLC-MS of the  
28 quantification for one PES baby bottles with the highest quantifiable diphenyl sulphone  
29 against standards of the two monomers that could be ionised, i.e. Diphenyl sulphone and  
30 dihydroxydiphenyl sulphone (BPS) at a level of 1  $\mu\text{g}/\text{L}$ , as well as of a standard of BPA also  
31 at a level of 1  $\mu\text{g}/\text{L}$ . The results are summarised in Table 2.  
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41 The data obtained thus showed that the migration of all 30 bottles remained much below their  
42 migration limits of 3000  $\mu\text{g}/\text{kg}$  for diphenyl sulphone and 50  $\mu\text{g}/\text{kg}$  for bisphenol S and 4,4'-  
43 dichlorodiphenyl sulphone after the first migration test. All the analyzed baby bottles made of  
44 PES were therefore compliant with the European regulations concerning the migration of  
45 bisphenol S, diphenyl sulphone and 4,4'-dichlorodiphenyl sulphone.  
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### 51 **Conclusion**

52 The results on BPA release confirmed results that the likelihood of migration of BPA is very  
53 low. There is no data to our knowledge published in the literature on migration from PES  
54 baby bottles. Therefore this initial method development indicates that it is possible to identify  
55 and quantify the potential monomers from PES using HPLC-DAD and FLD and UPLC-MS.  
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3 The sensitivity was much greater for UPLC MS as expected but the 4,4'-dichlorodiphenyl  
4 sulphone was not visible. The HPLC method was adequate for the purpose of targeted  
5 screening and can also include BPA together with the 3 analytes in one run.  
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10 The subsequent survey conducted on PES bottles suggests that with regard to migration, no  
11 issue was found so far for bottles made of PES for the release of 4,4'-dihydroxydiphenyl  
12 sulphone (bisphenol S), diphenyl sulphone, and 4,4'-dichlorodiphenyl sulphone using the food  
13 contact materials worst-case state-of-the-art protocols as reviewed in particular in the  
14 guidelines on testing conditions for articles in contact with foodstuffs (with a focus on  
15 kitchenware) (Simoneau, 2009).  
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**Table 1:** Spectrometric conditions used in LC-MS for the quantification of diphenyl sulphone and 4,4'-dihydroxydiphenyl sulphone (bisphenol S) from 50% ethanol migration solutions..

Compound	Parent ion	Daughter ion	Cone voltage	Collision voltage
Diphenyl sulfone	219	77	26	18
Diphenyl sulfone	219	145	26	8
4,4'-dihydroxydiphenyl sulphone (bisphenol S)	251	93	32	25
4,4'-dihydroxydiphenyl sulphone (bisphenol S)	251	157	32	16

**Table 2:** Migration from polycarbonate baby bottles analysed by HPLC

Sample code	Volume of bottle (ml)	first migration ( $\mu\text{g}/\text{kg}$ )	second migration ( $\mu\text{g}/\text{kg}$ )	third migration ( $\mu\text{g}/\text{kg}$ )
CH002	250	n.d.	n.d.	n.d.
CH003	240	n.d.	n.d.	n.d.
DE001	110	n.d.	n.d.	n.d.
ES001	240	< LOQ	n.d.	n.d.
FIN002	120	0.32	n.d.	n.d.
FIN003	250	n.d.	n.d.	n.d.
FIN004	260	n.d.	n.d.	n.d.
FIN005	250	n.d.	n.d.	n.d.
FIN006	200	n.d.	n.d.	n.d.
FIN007	300	n.d.	n.d.	n.d.
FIN008	200	n.d.	n.d.	n.d.
FIN009	250	0.33	n.d.	n.d.
FIN010	280	n.d.	n.d.	n.d.
FR004	120	n.d.	n.d.	n.d.
FR005	250	n.d.	n.d.	n.d.
FR006	300	n.d.	n.d.	n.d.
FR007	260	n.d.	n.d.	n.d.
FR008	240	n.d.	n.d.	n.d.
FR009	260	n.d.	n.d.	n.d.
IT001	125	< LOQ	n.d.	n.d.
IT005	300	n.d.	n.d.	n.d.
IT016	130	n.d.	n.d.	n.d.
IT017	130	n.d.	n.d.	n.d.
IT019	150	n.d.	n.d.	n.d.
IT020	100	1.08	0.54	0.42
IT021A	150	n.d.	n.d.	n.d.
IT021B	150	n.d.	n.d.	n.d.
IT022	100	n.d.	n.d.	n.d.
LT001	250	n.d.	n.d.	n.d.
LT002	125	n.d.	n.d.	n.d.
LT003	125	0.44	n.d.	n.d.
LT004	120	n.d.	n.d.	n.d.
LT005	180	0.45	n.d.	n.d.
NL001A	125	n.d.	n.d.	n.d.
NL001B	125	n.d.	n.d.	n.d.
NL001C	125	n.d.	n.d.	n.d.
NL002A	250	n.d.	n.d.	n.d.
NL002B	250	1.83	n.d.	n.d.
NL002C	250	n.d.	n.d.	n.d.
SW002	250	n.d.	n.d.	n.d.

**Note:** n.d.: non detectable; < LOQ is used for values in between n.d. and LOQ.

Table 3: Migration from PES baby bottles analysed by UPLC-MS and HPLC

Sample code	Volume of bottle (ml)	UPLC-MS first migration		HPLC first migration
		diphenyl sulphone (µg/kg)	Bisphenol S (µg/kg)	4,4'-dichlorodiphenyl sulphone (µg/kg)
BE002	170	n.d.	n.d.	n.d.
BE007	170	n.d.	n.d.	n.d.
BE008	170	n.d.	n.d.	n.d.
BG007	150	n.d.	n.d.	n.d.
DE012	330	n.d.	n.d.	n.d.
DK001	125	n.d.	n.d.	n.d.
ES006A	300	n.d.	n.d.	n.d.
ES006B	300	n.d.	n.d.	n.d.
FR003	260	n.d.	n.d.	n.d.
FR019	250	n.d.	n.d.	n.d.
IT003	300	n.d.	n.d.	n.d.
IT004	150	n.d.	n.d.	n.d.
IT007	140	1.45	n.d.	n.d.
IT008	150	n.d.	n.d.	n.d.
IT013A	125	n.d.	n.d.	n.d.
IT013B	125	n.d.	n.d.	n.d.
IT014	140	1.73	n.d.	n.d.
IT015A	150	n.d.	n.d.	n.d.
IT015B	150	n.d.	n.d.	n.d.
IT018A	280	n.d.	n.d.	n.d.
IT018B	280	n.d.	n.d.	n.d.
IT018D	280	n.d.	n.d.	n.d.
LT010	250	n.d.	n.d.	n.d.
MT007A	160	n.d.	n.d.	n.d.
MT007B	160	n.d.	n.d.	n.d.
PL004	125	n.d.	n.d.	n.d.
UK006	260	n.d.	n.d.	n.d.
USA003	160	n.d.	n.d.	n.d.
USA008	125	n.d.	n.d.	n.d.



Figure 1: Illustration of the quantification for one PES baby bottles with the highest quantifiable diphenyl sulphone in UPLC-MS vs the quantification of standards of BPA, Diphenyl sulphone and dihydroxydiphenyl sulphone (BPS)

