

TOX/2016/22

COMMITTEE ON TOXICITY OF CHEMICALS IN FOOD, CONSUMER PRODUCTS AND THE ENVIRONMENT

Review of potential risks from polybrominated diphenyl ethers in the diet of children aged 1 to 5 years and updated exposures for infants aged 0 to 12 months.

Background

1. The Scientific Advisory Committee on Nutrition (SACN) is undertaking a review of scientific evidence that will influence the Government's dietary recommendations for infants and young children. SACN is examining the nutritional basis of the advice. The Committee on Toxicity in Food, Consumer Products and the Environment (COT) was asked to review the risks of toxicity from chemicals in the diet of infants, most of which has been completed, and young children. The reviews will identify new evidence that has emerged since the Government's recommendations were formulated, and will appraise that evidence to determine whether the advice should be revised. The recommendations cover diet from birth to age five years, but are being considered in two stages, focusing first on infants aged nought to 12 months, and now on advice for young children aged one to five years.
2. This discussion paper focusses on polybrominated diphenyl ethers (PBDEs). There are currently no Government dietary recommendations for infants and young children which relate to PBDEs.
3. The 2015 COT statement on potential risks from PBDEs in the infant diet is included in Annex A¹. This discussion paper provides estimated PBDE exposures for children in the UK aged one to five years and also provides an update to exposures for infants aged 0-12 months as new data have become available since the 2015 COT statement.
4. There are no new reviews on PBDEs from international bodies to consider updating or revising the toxicology section from the 2015 statement. Therefore the risks associated with exposure to PBDEs are assessed in this discussion paper using the BMDL₁₀ values and corresponding reference points as previously agreed by the COT. The reference points are 172ng/kg bw /day, 4.2ng/kg bw/day, 9.6ng/kg bw/day and 19640 ng/kg bw/day, for BDE-47, BDE-99, BDE-153 and BDE-209, respectively.

¹ <http://cot.food.gov.uk/sites/default/files/PBDEstatementfinal.pdf>

PBDE exposures in infants and young children aged 4 months to 5 years

Sources of PBDE exposure

Dietary occurrence of PBDEs

Human milk

5. There were no new UK data for PBDE levels in human milk.

Infant formula

6. Data on the concentrations of PBDEs in infant formula were not available previously. The concentrations of selected PBDEs (BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154, -183 and 209) in different varieties of infant formula were measured recently in a FSA Survey (Fera 2015). The data presented in Table 1 are for BDEs 47, 99, 153, 209 since reference points are available for these congeners. The highest concentrations were reported for BDE-209. Levels of BDE-209 in 'Comfort Milk', 'First Milk' and 'Follow on Milk' were at least an order of magnitude higher than other BDEs.

Table 1: Concentrations of selected PBDEs in Infant Formula.

Food Group	PBDE Concentrations (µg/kg) ^a									
	BDE 47		BDE 99		BDE 153		Total Excluding BDE 209 ^b		BDE 209	
	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
Comfort (Powder)	0.006	0.006	0.006	0.006	0	0.002	0.012	0.040	0.155	0.155
First Milk: From Birth (Powder)	0.005	0.005	0.005	0.005	0.001	0.002	0.012	0.039	0.102	0.102
Follow On Milk: 6 Months (Powder)	0.007	0.007	0.009	0.010	0.002	0.003	0.025	0.051	0.19	0.202
Growing Up Milk: 12 Months (Powder)	0.004	0.004	0.005	0.005	0	0.002	0.009	0.036	0.038	0.058
Goat Milk Formula	0.010	0.010	0.010	0.010	0	0.002	0.022	0.048	0.025	0.045
Hipp Organic	0	0.002	0	0.002	0	0.002	0	0.032	0.01	0.01
Soy	0.004	0.004	0.005	0.005	0	0.002	10.008	0.036	0.027	0.031

First Milk: From Birth (Ready to Feed)	0	0.002	0	0.002	0	0.002	0	0.032	0	0.006
Follow on: 6 Months (Ready to Feed)	0	0.002	0	0.002	0	0.002	0	0.032	0.004	0.007
Growing up Milk: 12 Months (Ready to Feed)	0	0.002	0	0.002	0	0.002	0	0.032	0.004	0.006

^a Values are presented as lower-bound (LB) and upper-bound (UB). LB was calculated by treating occurrence data < LOD as 0. UB was determined by treating values < LOD as the LOD. If LB=UB the congener was detected.

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

Commercial Infant Foods

7. Data on the concentrations of PBDEs in commercial infant foods were not available previously. Concentrations of selected PBDEs (BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154, -183 and 209) were measured recently in different varieties of commercially available infant foods in a FSA survey (Fera, 2015). The data presented in Table 2 are for BDEs 47, 99, 153, 209 since reference points are available for these congeners. Individual foods were grouped according to their listed ingredients. As with concentrations in infant formula, BDE-209 was the predominant congener in commercially available infant foods, with levels relatively higher in meat-based dishes than in others.

Table 2: Concentrations of selected PBDEs in Commercial Infant Foods.

Food Group	PBDE Concentrations (µg/kg) ^a									
	BDE 47		BDE 99		BDE 153		Sum Excluding BDE 209 ^b		BDE 209	
	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
Cereal Based Dishes	0.004	0.010	0.002	0.007	0	0.002	0.007	0.047	0.034	0.045
Fruit Based Dishes	0	0.002	0	0.002	0	0.002	0	0.032	0.003	0.007
Meat Based Dishes	0.001	0.003	0	0.002	0	0.002	0.003	0.034	0.053	0.056
Dairy Based Dishes	0	0.002	0	0.002	0	0.002	0.001	0.032	0.016	0.010
Snacks - sweet and savoury	0.004	0.01	0.003	0.007	0	0.002	0.007	0.047	0.034	0.050

Other savoury based dishes	0.001	0.004	0.001	0.004	0	0.002	0.002	0.037	0.021	0.025
Drinks	0	0.002	0	0.002	0	0.002	0	0.032	0	0.008

^a Values are presented as lower-bound (LB) and upper-bound (UB). LB was calculated by treating occurrence data < LOD as 0. UB was determined by treating values < LOD as the LOD. If LB=UB the congener was detected.

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

Other food (Total Diet Study)

8. The most recent measurements of PBDEs in other foods sampled in the UK were for the composite food groups of the 2012 Total Diet Study (TDS) (Fernandes *et al.*, 2012) and the analytical results were presented in Table 7 of Annex A.

Environmental

Air

9. There were no new UK data on PBDE levels in indoor air. Occurrence data used previously for estimating exposure from air (Annex A) were used to estimate exposure from this route in this paper.

Dust

10. There were no new UK data on PBDE levels in dust or soil. Occurrence data used previously for estimating exposure from dust in infants (Table 4 of Annex A) were used to estimate exposure from this route in this paper.

Exposure

11. Consumption data from the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) (DH, 2013), and from years 1-4 of the National Diet and Nutrition Survey Rolling Programme years 1-4 (NDNS) (Bates *et al.*, 2014) have been used for the estimation of dietary exposures. Average body weight data used in the estimation of exposures are shown in Table 3 below.

Table 3: Body weights used in exposure assessments.

Age bands (months)	Weighted bodyweight
0 - <4	5.9 kg ^a
≥4 - <6	7.8 kg ^b

≥6 - <9	8.7 kg ^b
≥9 - <12	9.6 kg ^b
≥12 - <15	10.6 kg ^b
≥15 - <18	11.2 kg ^b
≥18 - <24	12.0 kg ^c
≥24 - <60	16.1 kg ^c

^a DH, 1994.

^b DH, 2013.

^c Bates et al., 2014.

Dietary exposure to PBDEs

Human milk

12. The estimated exposures of exclusively breastfed infants, aged 0 to 6 months for a range of PBDEs were previously reported in Table 9 of Annex A.

13. Data on breast milk consumption have now become available from DNSIYC and these were used in estimating exposure from breast milk in the 4 - <18 months age groups (Table 4). There were too few records of breast milk consumption for children older than 18 months in NDNS to allow a reliable exposure assessment, and breast milk is expected to contribute minimally in this age group.

14. Mean and high level exposure estimates for BDE 47, 99, and 153 ranged from 3.3 -47 and 6.8-79 ng/kg bw/day, respectively. For BDE 209, mean and high level exposure estimates ranged from 0.92-3.4 and 1.9-5.8 ng/kg bw/day, respectively.

Table 4: Estimated exposure to PBDEs from breastmilk in infants and young children aged 0 to <18 months.

Congener (s) (concentrations in µg/kg whole weight)	PBDE Exposure from Breast Milk (ng/kg bw/d) by age group (months)									
	≥4 - <6		≥6 - <9		≥9 - <12		≥12 - <15		≥15 - <18	
	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5
BDE 47 (513)	47	79	34	79	20	59	15	39	13	27
BDE 99 (131)	12	20	8.7	21	5.0	15	3.9	9.8	3.3	6.8
BDE 153 (156)	14	24	10	25	5.9	18	4.6	12	4.0	8.1
BDE 209 (36.4)	3.4	5.6	2.4	5.8	1.4	4.2	1.1	2.7	0.9	1.9

Values rounded to 2 significant figures (SF).

Food

Infant Formulae

Exclusive feeding on formula

15. Possible PBDE exposure levels from infant formulae were calculated for infants up to 6 months of age assuming exclusive feeding on formula (Table 5). Exposure estimates were derived using the occurrence data for 'comfort milk' infant formula (Table 1), due to its relevance for 0 to 6 month old infants. Exposures to BDEs 47, 99 and 153 based on consumption of either 800mL or 1200mL formulae, did not exceed 0.18 ng/kg bw/day in 0 to 6 month old infants. Exposure to a sum of 16 PBDEs (see legend to Table 8) excluding BDE 209 was up to 1.2 ng/kg bw/day. Exposure to BDE 209 alone was higher in 0 to <4 month old infants (up to 4.7 ng/kg bw/day) than for >4 to <6 month old babies (up to 3.6 ng/kg bw/day).

Table 5: Estimated exposures to PBDEs from exclusively infant formula fed infants aged 0 to <6 months.

Congener	LB to UB PBDE Exposures from Infant Formula (comfort milk) (ng/kg bw/day)			
	0 - <4 months		≥4 - <6 months	
	800 mL ^a	1200 mL ^a	800 mL ^a	1200 mL ^a
BDE 47	0.12	0.18	0.092	0.14
BDE 99	0.12	0.18	0.092	0.14
BDE 153	0-0.041	0-0.061	0-0.031	0-0.046
Sum excluding 209 ^b	0.24-0.81	0.37-1.2	0.18-0.62	0.28-0.92
BDE 209	3.2	4.7	2.4	3.6

Values rounded to 2 SF.

^a Mean and high level exposures were based on exclusive feeding on infant formula and consumption of 800 and 1,200mL, respectively (COT, 2013).

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

Infants 4 to 18 months

16. Exposures of infants and children aged 4.0 to <18 months from infant formula were also estimated using DNSIYC consumption data (DH 2013) (Table 6) and the concentrations reported in Table 1. The detailed data are presented in Annex B.

17. For BDEs 47, 99 and 153, the lowest LB to highest UB mean and 97.5th percentile exposures from infant formulae ranged from 0.00-0.13 and 0.00--0.28 ng/kg bw/day, respectively. For the sum of all BDEs excluding BDE 209, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 0.10-2.1 and 0.00-4.5 ng/kg bw/day, respectively. For BDE 209, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 0.04-0.40 and 0.19-0.84 ng/kg bw/day, respectively. The detailed exposure assessments are presented in Annex B.

Commercial Infant Foods

18. Table 7 summarises the total exposure from commercial infant foods to PBDEs estimated for infants and young children up to 18 months using DNSIYC consumption data (DH 2013). For BDEs 47, 99 and 153, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 0.00-0.05 and 0.00-0.19 ng/kg bw/day, respectively. For the sum of all BDEs excluding BDE 209, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 0.01-0.49 and 0.05-1.8 ng/kg bw/day, respectively. For BDE 209, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 0.09-0.43 and 0.64-1.7 ng/kg bw/day, respectively. The detailed exposure assessments are presented in Annex B.

This is a background paper for discussion.
It does not reflect the views of the Committee and should not be cited.

Table 6: Estimated exposure to PBDEs from Infant Formula in infants and young children aged 4 to <18 months.

Congener	LB to UB ^a dietary exposure to PBDEs (ng/kg bw/day) by age group (months)									
	≥4 - <6		≥6 - <9		≥9 - <12		≥12 - <15		≥15 - <18	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th Percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE 47	0.00065-0.13	0.0077-0.28	0.0013-0.11	0.0042-0.22	0.0013-0.078	0.023-0.18	0.00019-0.030	0.00-0.14	0.00015-0.017	0.00-0.085
BDE 99	0.00078-0.13	0.0083-0.28	0.0015-0.11	0.0046-0.22	0.0016-0.078	0.029-0.18	0.00025-0.030	0.00-0.14	0.00019-0.017	0.00-0.085
BDE 153	0.000028-0.13	0.000057-0.28	0.00015-0.10	0.00023-0.22	0.00019-0.077	0.0018-0.18	0.0000095-0.030	0.00-0.14	0.000024-0.017	0.00-0.085
Sum Excluding 209 ^b	1.1-2.1	0.020-4.5	0.56-1.7	0.011-3.5	0.58-1.2	0.075-2.9	0.16-0.48	0.00-2.2	0.10-0.27	0.00-1.6
BDE 209	0.039-0.40	0.32-0.84	0.14-0.35	0.46-0.76	0.14-0.28	0.43-0.69	0.053-0.10	0.27-0.44	0.032-0.054	0.19-0.31

Values rounded to 2 SF.

^a Treating occurrence data < LOD as 0 and as the LOD, respectively. If there is only one figure all data were > LOD.

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

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Table 7: Estimated exposures to PBDEs from commercial infant foods in infants and young children aged 4 to <18 months.

Congener	LB to UB ^a dietary exposure to PBDEs (ng/kg bw/day) by age group (months)									
	≥4 - <6		≥6 - <9		≥9 - <12		≥12 - <15		≥15 - <18	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th Percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE 47	0.011-0.039	0.047-0.17	0.014-0.052	0.055-0.18	0.012-0.045	0.057-0.19	0.006-0.024	0.033-0.12	0.003-0.013	0.020-0.066
BDE 99	0.0050-0.031	0.019-0.14	0.006-0.042	0.024-0.15	0.005-0.036	0.026-0.16	0.003-0.019	0.015-0.092	0.001-0.010	0.009-0.051
BDE 153	0.000-0.020	0.000-0.092	0.000-0.028	0.00-0.11	0.000-0.025	0.00-0.10	0.000-0.013	0.000-0.071	0.000-0.008	0.000-0.044
Sum Excluding 209 ^b	0.024-0.36	0.11-1.6	0.032-0.49	0.12-1.8	0.028-0.44	0.12-1.8	0.015-0.23	0.074-1.2	0.007-0.13	0.046-0.72
BDE 209	0.25-0.30	1.2-1.4	0.37-0.43	1.43-1.6	0.33-0.39	1.53-1.7	0.18-0.21	1.06-1.2	0.091-0.11	0.64-0.72

Values rounded to 2 SF.

^a Treating occurrence data < LOD as 0 and as the LOD, respectively. If there is only one figure all data were > LOD.

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

Other foods (from TDS)

19. Table 8 summarises LB and UB dietary exposures to PBDEs for 12 to 60 month old infants, estimated using the 19 composite food groups of the 2012 TDS (Table 7 of Annex A) together with consumption data from the DNSIYC (DH 2013) and NDNS (Bates *et al.*, 2014).

20. For BDEs 47, 99 and 153, the mean and 97.5th percentile exposures from 12 to 60 month old children ranged from 0.10-0.69 and 0.18-1.57 ng/kg bw/day, respectively. For the sum of all BDEs excluding BDE 209, the lowest LB to the highest UB mean and 97.5th percentile exposures ranged from 1.6-3.2 and 1.3-6.7 ng/kg bw/day, respectively. For BDE 209, the mean and 97.5th percentile exposures in 12 to 60 month old children ranged from 7.9-9.4 and 15-20 ng/kg bw/day, respectively. The detailed exposure data are presented in Annex B.

21. For BDEs 47, 99 and 153, and the sum of BDEs excluding BDE 209 the food group contributing most to total exposure was dairy products. For BDE 209, the groups making the largest contributions to total exposure were in the order milk > miscellaneous cereals (includes foods such as pasta, bakery products, rice) > sugars (e.g. jam, marmalade, and jelly) in children up to 24 months and milk > sugars > miscellaneous cereals for 24 to 60 month old children

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Table 8: Estimated exposure of toddlers to PBDEs from food in infants and young children aged 12 to 60 months.

Congener	LB to UB ^a dietary exposure to PBDEs (ng/kg bw/day) by age group (months)							
	≥12 - <15		≥15 - <18		≥18 - <24		≥24 - <60	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	0.61	1.5	0.61	1.4	0.69	1.4	0.57	1.1
BDE-99	0.53	1.6	0.54	1.3	0.57	1.3	0.45	0.80
BDE-153	0.13	0.36	0.12-0.13	0.29	0.13-0.14	0.31	0.10	0.18
Sum Excluding 209 ^b	1.7-3.0	4.2-6.0	1.7-3.1	1.3-1.4	1.9-3.2	3.9-6.7	1.6-2.5	3.0-4.6
BDE-209	7.9	15	8.8	16	9.4	20	8.3	15

Values rounded to 2 SF.

^a Treating occurrence data < LOD as 0 and as the LOD, respectively. If there is only one figure all data were > LOD.

^b Sum of BDE-17, -28, -47, -49, -66, -71, -77, -85, -99, -100, -119, -126, -138, -153, -154 and -183.

Environmental exposures to PBDEs

Dust

22. Exposure to BDEs 47, 99, 153 and 209 in 6 to 12 month old children through ingestion of dust (and soil) were estimated (Table 9), assuming ingestion of 60mg dust (and soil)/day (US EPA, 2011) and based on the mean and maximum concentrations used previously for dust only (Table 4 of Annex A).

Table 9: Estimated exposure to PBDEs from dust in infants aged 6 to 12 months.

Congeners (mean and max concentrations in µg/kg)	Dust exposure to PBDEs (ng/kg bw/d)			
	≥6 to <9		≥9 to <12	
	Mean ^a	Max ^b	Mean ^a	Max ^b
BDE 47 (15, 58)	0.10	0.40	0.09	0.36
BDE 99 (36, 180)	0.25	1.2	0.22	1.1
BDE 153 (14, 110)	0.10	0.76	0.09	0.69
BDE 209 (260,000, 2,200,000)	1800	15000	1600	14000

Values are rounded to 2 SF.

^a Congener present at mean measured concentration (Table 4 of Annex A).

^b Congener present at maximum measured concentration (Table 4 of Annex A).

23. Exposure to BDEs 47, 99, 153 and 209 in 12 to 60 month old children through ingestion of dust and soil, assuming ingestion of 100mg dust (and soil)/day (US EPA, 2011) and based on the mean and maximum concentrations reported for dust only (Table 4 of Annex A) are presented in Table 10. Since the dust was sampled in 2006 (Table 4 of Annex A), and there have been changes in usage of PBDEs since then, it is possible that these estimates are not representative of current exposures. Exposures of up to 21000 ng/kg bw/day were noted for BDE 209 when using a maximum concentration of 2200 mg/kg for this congener.

Table 10: Estimated exposure to PBDEs from dust in infants and children aged 12 to <60 months.

Congeners (mean and max concentrations in µg/kg)	Dust exposure to PBDEs (ng/kg bw/d) by age group (months)							
	≥12 - <15		≥15 - <18		≥18 - <24		≥24 - <60	
	Mean ^a	Max ^b	Mean ^a	Max ^b	Mean ^a	Max ^b	Mean ^a	Max ^b
BDE 47 (15, 58)	0.14	0.55	0.13	0.52	0.13	0.48	0.09	0.36
BDE 99 (36, 180)	0.34	1.70	0.32	1.6	0.30	1.5	0.22	1.1
BDE 153 (14, 110)	0.13	1.0	0.13	0.98	0.12	0.92	0.09	0.68
BDE 209 (260,000, 2,200,000)	2500	21000	2300	20000	2200	18000	1600	14000

Values are rounded to 2 SF.

^a Congener present at mean measured concentration (Table 4 of Annex A).

^b Congener present at maximum measured concentration (Table 4 of Annex A).

Air

24. The estimated exposures to the sum of PBDEs (28, 47, 49, 66, 99, 100, 153, and 154) from air that were reported for infants previously (Annex A) are updated in Table 11 on the basis of ventilation rates for infants and young children of similar age (US EPA, 2011) using the median reported occurrence value of 24 pg/m³ (from Annex A). Table 11 also provides exposure to the same sum of BDEs in 12 to 60 month old children. The concentration of BDE 209 was not measured. The exposure to the sum of BDEs via air in 0 to 60 month old children ranged from 0.013 to 0.018 ng/kg bw/day.

Table 11: Estimated exposure to PBDEs from air in children aged 0 to 5 years.

ΣPBDE excl. 209 median concentration	Air exposure to PBDEs (ng/kg bw/d) by Age Group (months)							
	0 to 4 ^a	4 to 6 ^b	6 to 9 ^c	9 to 12 ^d	12 to 15 ^e	15 to 18 ^f	18 to 24 ^g	24 to 60 ^h
24pg/m3	0.015	0.013	0.015	0.014	0.018	0.017	0.016	0.015

^a Based on a ventilation rate of 3.6 m³/day and a bodyweight of 5.9 kg.

^b Based on a ventilation rate of 4.1 m³/day and a bodyweight of 7.8 kg.

^c Based on a ventilation rate of 5.4 m³/day and a bodyweight of 8.7 kg.

^d Based on a ventilation rate of 5.4 m³/day and a bodyweight of 9.6 kg.

^e Based on a ventilation rate of 8.0 m³/day and a bodyweight of 10.6 kg.

^f Based on a ventilation rate of 8.0 m³/day and a bodyweight of 11.2 kg.

^g Based on a ventilation rate of 8.0 m³/day and a bodyweight of 12 kg.

^h Based on a ventilation rate of 10.1 m³/day and a bodyweight of 16.1kg.

Risk characterisation

27. Potential risks from the exposure of infants and young children to PBDEs were characterised by margins of exposure (MOEs), calculated as the ratio of the reference points previously agreed by COT (Annex A) to the estimated exposures for dietary and non-dietary sources.

28. EFSA (2011) considered the potential inter and intra-species kinetic differences to be accounted for, as the approach to MOEs was based on a body burden comparison between humans and animals, using the higher end of the reported range for elimination half-life in humans. EFSA also thought that individual differences in susceptibility had been accounted for as the body burden associated with a BMDL₁₀ for neurobehavioural effects in mice induced during a relevant period for brain development was applied. EFSA therefore concluded that an MOE greater than 2.5 might indicate that there was no concern for health.

29. The COT previously concluded that *'inter-species differences in toxicokinetics were accounted for by the body burden approach, and that the use of a relatively high elimination half-life for humans, and of data relating to a critical period of development, reduced uncertainties in the risk assessment. However, they considered that MOEs should be rather higher than 2.5 to provide assurance of safety'*.

30. Table 13 shows MOEs for exposure to breast milk for infants and children aged between four and 18 months. The MOEs for BDE-209 all exceed 3000 and therefore would not be considered to indicate a cause for concern. The MOEs for BDE-47 range from two to ten and those for BDE-99 and -153 are less than two.

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Table 13. MOEs for exposure to PBDEs from consumption of breast milk.

Congener	≥4 - <6 months		≥6 - <9 months		≥9 - <12 months		≥12 - <15 months		≥15 - <18 months	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE 47	4	2	5	2	9	3	10	5	10	7
BDE 99	0.3	0.2	0.5	0.2	0.8	0.3	1	0.4	1	0.6
BDE 153	0.7	0.4	0.9	0.4	2	0.5	2	0.8	2	1
BDE 209	6000	3000	8000	3000	10000	5000	20000	7000	20000	10000

All MOEs are rounded to 1 significant figure.

31. Table 14 summarises the MOEs for the exposure to PBDEs for infants aged nought to six months fed exclusively infant formula. The MOEs for BDE-47 are at least 1000, with those for BDE-209 all greater than 4000. BDE-153 has MOEs greater than 200 and BDE-99 has MOEs that range from 20 to 50.

Table 14. MOEs for exposure to PBDEs for infants aged 0-6 months exclusively fed infant formula.

Congener	0-4 months		4-6 months	
	800 mL	1200 mL	800 mL	1200 mL
BDE-47	1000	1000	2000	1000
BDE-99	40	20	50	30
BDE-153	200	200	300	200
BDE-209	6000	4000	8000	5000

All MOEs are rounded to 1 significant figure.

32. Tables 15 and 16 show the MOEs for exposure to infant formula in infants and children aged four to 18 months. For infants (Table 15) the MOEs for BDE-99 using upper bound estimates range from ten to 50, whilst those using the lower bound estimates range from 100 to 2000. Actual MOEs would fall between the lower and upper bound. For BDE-153 the MOEs using upper bound estimates range from 30 to 100. The MOEs for BDE-47 are all greater than 600 and for BDE-209 greater than 20000. For children (Table 16) BDE-99 has MOEs for the 97.5th percentile of 30 and 40, whilst the values for the mean are 100 and 200. BDE-153 has MOEs of 70 and 100 for the 97.5th percentile and for the mean 300 and 600. MOEs for BDE-47 range from 1000 to 10000, whilst those for BDE-209 are all greater than 40000.

Table 15. MOEs for exposures to PBDEs from infant formulae for infants aged 4 to 12 months.

Congener	MOEs by age group (months) based on UB ^a to LB ^b exposures					
	≥4-<6		≥6-<9		≥9-<12	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	1000-200000	600-20000	2000-200000	800-40000	2000-200000	1000-7000

BDE-99	30-4000	10-500	40-2000	20-800	50-2000	20-100
BDE-153	≥ 70	30-10000	≥ 90	≥ 40	≥ 100	50-5000
BDE-209	50000-500000	20000-60000	60000-100000	30000-40000	70000-100000	30000-50000

All MOEs are rounded to 1 significant figure.

Where ≥ values are provided these are based on upper bound estimates of exposure, as lower bound exposures were zero and therefore MOEs would be infinite.

^a Upper bound

^b Lower bound

Table 16. MOEs for exposures to PBDEs from infant formulae for children aged 12 to 18 months.

Congener	MOEs by age group (months) based on UB ^a to LB ^b exposures			
	≥12-<15		≥15-<18	
	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	≥ 6000	≥ 1000	≥ 10000	≥ 2000
BDE-99	≥ 100	≥ 30	≥ 200	≥ 40
BDE-153	≥ 300	≥ 70	≥ 600	≥ 100
BDE-209	200000-400000	40000-70000	400000-600000	60000-100000

All MOEs are rounded to 1 significant figure.

Where ≥ values are provided these are based on upper bound estimates of exposure, as lower bound exposures were zero and therefore MOEs would be infinite.

^a Upper bound.

^b Lower bound.

33. Tables 17 and 18 summarise the MOEs for exposure from commercial infant foods for infants and children aged four to 18 months. For infants (Table 17) BDE-99 has MOEs for the 97.5th percentile that range from 30 to 200, for the mean values the MOEs range from 100 to 700. For BDE-153 the MOEs range from 90 to 500. The MOEs for BDE-47 range from 900 to 20000 and for BDE-209 the values are all greater than 10000. For children (Table 18) the MOEs for BDE-99 range from 50 to 500 for the 97.5th percentile and 200 to 4000 for the mean. For BDE-153 the MOEs range from 100 to 1000. For BDE-47 the MOEs are all greater than 1000 and for BDE209 they are all greater than 20000.

Table 17. MOEs for exposures to PBDEs from commercial foods for infants aged 4 to 12 months.

Congener	MOEs by age group (months) based on UB ^a to LB ^b exposure					
	≥4-<6		≥6-<9		≥9-<12	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	4000-20000	1000-4000	3000-10000	900-3000	4000-10000	900-3000
BDE-99	100-800	30-200	100-700	30-200	100-800	30-200
BDE-153	≥ 500 ^c	≥ 100 ^c	≥ 300 ^c	≥ 90 ^c	≥ 400 ^c	≥ 90 ^c
BDE-209	70000-80000	10000-20000	50000 ^d	10000 ^d	50000-60000	10000 ^d

All MOEs are rounded to 1 significant figure.

^a Upper bound.

^b Lower bound.

^c Where ≥ values are provided these are based on upper bound estimates of exposure, as lower bound exposures were zero and MOEs would be infinite.

^d Only one value is shown when the rounded MOEs derived from upper and lower bound exposures have the same value

Table 18. MOEs for exposures to PBDEs from commercial foods for children aged 12 to 18 months.

Congener	MOEs by age group (months) based on UB ^a to LB ^b exposure			
	≥12-<15		≥15-<18	
	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	7000-30000	1000-5000	10000-60000	3000-9000
BDE-99	200-1000	50-300	400-4000	80-500
BDE-153	≥700 ^c	≥100 ^c	≥1000 ^c	≥200 ^c
BDE-209	90000-100000	20000 ^d	20000-200000	30000 ^d

All MOEs are rounded to 1 significant figure.

^a Upper bound.

^b Lower bound.

^c Where ≥ values are provided these are based on upper bound estimates of exposure, as lower bound exposures were below zero and MOEs would be infinite.

^d Only one value is shown when the rounded MOEs derived from upper and lower bound exposures have the same value

34. Table 19 summarises the MOEs for exposures from foods for children aged 12 to 60 months. The MOEs for BDE-99 range from three to nine, whilst those for BDE-153 range from 30 to 90. MOEs for BDE-47 all exceed 100, whilst those for BDE-209 are all greater than 1000.

Table 19. MOEs for exposures to PBDEs from food for children aged 12 to 60 months.

Congener	≥12-<15 months		≥15-<18 months		≥18-<24 months		≥24-<60 months	
	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile	Mean	97.5 th percentile
BDE-47	300	100	300	100	200	100	300	200
BDE-99	8	3	8	3	7	3	9	5
BDE-153	80	30	80	30	70	30	90	50
BDE-209	2000	1000	2000	1000	2000	1000	2000	1000

All MOEs are rounded to 1 significant figure.

35. Tables 20 and 21 show the MOEs for exposures to PBDEs from ingestion of dust for infants aged six to 12 months and children aged 12 to 60 months. For infants the maximum concentrations the MOEs for BDE-99 in infants (Table 20) are three and four, with the MOEs using the mean concentrations being 20. For BDE-209 the MOEs calculated using the maximum concentration are one, and using the mean concentration they are ten. For BDE-153 the MOEs using maximum concentrations are 10 and using the mean they are 100. BDE-47 has MOEs that all exceed 400. For children (Table 21) for BDE-209 MOEs range from 0.9 to 10. The MOEs for BDE-99 range from three to ten, for BDE-153 they range from 10 to 100. ALL MOES for BDE-47 exceed 300. For both infants and children BDE-99 and -209 make the largest contributions to exposure from dust.

Table 20. MOEs for exposure to PBDEs from consumption of dust in homes for infants aged 6 to 9 months and 9 to 12 months.

Congener	≥6 - <9 months		≥9 - <12 months	
	Mean ^a	Max ^b	Mean ^a	Max ^b
BDE-47	2000	400	2000	500

BDE-99	20	3	20	4
BDE-153	100	10	100	10
BDE-209	10	1	10	1

All MOEs are rounded to 1 significant figure.

^a Congener present at mean measured concentration (Table 4 of Annex A).

^b Congener present at maximum measured concentration (Table 4 of Annex A).

Table 21. MOEs for exposures to PBDEs from consumption of dust in homes for children aged between 12 to 60 months.

Congener	≥12-<15 months		≥15-<18 months		≥18-<24 months		≥24-<60 months	
	Mean ^a	Max ^b	Mean ^a	Max ^b	Mean ^a	Max ^b	Mean ^a	Max ^b
BDE-47	1000	300	1000	300	1000	400	2000	500
BDE-99	10	3	10	3	10	3	20	4
BDE-153	70	10	70	10	80	10	100	10
BDE-209	8	0.9	9	1	9	1	10	1

All MOEs are rounded to 1 significant figure.

^a Congener present at mean measured concentration (Table 4 of Annex A).

^b Congener present at maximum measured concentration (Table 4 of Annex A).

36. Table 22 shows the MOEs for exposure to PBDEs from air for infants and children aged nought to 60 months. All values are at least 200, thus exposure to PBDEs from air may only have a small contribution to the overall exposure.

Table 22. MOEs for exposures to PBDEs from inhalation of air for infants and children aged 0 to 60 months.

Congener	Age Group (months)							
	0-<4	≥4-<6	≥6-<9	≥9-<12	≥12-<15	≥15-<18	≥18-<24	≥24-<60
ΣPBDEs^a excl. 209	300	300	300	300	200	200	300	300

All MOEs are rounded to 1 significant figure.

^a Sum of BDE-28, -47, -49, -66, -99, -100, -153, and -154.

Questions on which the views of the Committee are sought

37. Members are invited to comment on the information provided in this paper and to answer the following questions.

- i. Should the information in this paper be summarised in an addendum to the 2015 statement?
- ii. Should the exposures from different sources (diet, dust, air) be aggregated considering that different congeners are reported for the different media?
- iii. If Members consider that the different sources of exposure should be aggregated, how should this be done and what reference points should be used in the risk characterisation
- iv. How would members interpret the MOEs?

**Secretariat
May 2016**

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TOX/2016/22 ANNEX A

**COMMITTEE ON TOXICITY OF CHEMICALS IN FOOD,
CONSUMER PRODUCTS AND THE ENVIRONMENT**

**Review of potential risks from polybrominated biphenyls (PBDEs) in the
diet of infants and 1 to 5 year old children**

Statement on polybrominated biphenyls (PBDEs) in the infant diet

Available at: <http://cot.food.gov.uk/sites/default/files/PBDEstatementfinal.pdf>

**Secretariat
May 2016**

**COMMITTEE ON TOXICITY OF CHEMICALS IN FOOD,
CONSUMER PRODUCTS AND THE ENVIRONMENT**

**Review of potential risks from polybrominated biphenyls (PBDEs) in the
diet of infants and 1 to 5 year old children**

Exposures to PBDEs in infants and 1 to 5 year old children.

**Secretariat
May 2016**

This is a background paper for discussion.
It does not reflect the views of the Committee and should not be cited.

Infant Formula Exposures

Food Group	Output	4 to 5.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	Mean	0	0	0	0	0
First Milk: From Birth (Powder)	Mean	0	0	0	0.001-0.002	0.006
Follow On Milk: 6 Months (Powder)	Mean	0	0	0	0	0
Growing Up Milk: 12 Months (Powder)	Mean	0	0	0	0	0
Goat Milk Formula	Mean	0	0	0	0	0
Hipp Organic	Mean	0	0	0	0	0
Soy	Mean	0	0.001	0	0.001-0.004	0.003
First Milk: From Birth (Ready to Feed)	Mean	0.000-0.114	0.000-0.114	0.000-0.114	0.000-1.824	0.000-0.342
Follow on: 6 Months (Ready to Feed)	Mean	0.000-0.015	0.000-0.015	0.000-0.015	0.000-0.247	0.031-0.050
Growing up Milk: 12 Months (Ready to Feed)	Mean	0	0	0	0	0
Total	Mean	0.001-0.130	0.001-0.130	0.000-0.130	1.121-2.077	0.040-0.401
Food Group	Output	4 to 5.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	P97.5	0	0	0	0	0
First Milk: From Birth (Powder)	P97.5	0.005-0.006	0.006	0.001-0.002	0.014-0.045	0
Follow On Milk: 6 Months (Powder)	P97.5	0	0	0	0	0
Growing Up Milk: 12 Months (Powder)	P97.5	0	0	0	0	0
Goat Milk Formula	P97.5	0	0	0	0	0
Hipp Organic	P97.5	0	0	0	0	0
Soy	P97.5	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	P97.5	0.000-0.281	0.000-0.281	0.000-0.281	0.000-4.494	0.000-0.843
Follow on: 6 Months (Ready to Feed)	P97.5	0.000-0.159	0.000-0.159	0.000-0.159	0.000-2.547	0.318-0.517
Growing up Milk: 12 Months (Ready to Feed)	P97.5	0	0	0	0	0
Total	P97.5	0.008-0.281	0.008-0.281	0.001-0.281	0.020-4.494	0.318-0.843

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Food Group	Output	6 to 8.00 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	Mean	0	0	0	0.000-0.001	0.003
First Milk: From Birth (Powder)	Mean	0	0	0	0.001-0.003	0.008
Follow On Milk: 6 Months (Powder)	Mean	0	0	0	0.001-0.002	0.009-0.010
Growing Up Milk: 12 Months (Powder)	Mean	0	0	0	0	0
Goat Milk Formula	Mean	0	0	0	0.001	0.001
Hipp Organic	Mean	0	0	0	0	0
Soy	Mean	0	0	0	0.000-0.002	0.002
First Milk: From Birth (Ready to Feed)	Mean	0.000-0.047	0.000-0.047	0.000-0.047	0.000-0.753	0.000-0.141
Follow on: 6 Months (Ready to Feed)	Mean	0.000-0.056	0.000-0.056	0.000-0.056	0.000-0.898	0.112-0.182
Growing up Milk: 12 Months (Ready to Feed)	Mean	0	0	0	0.000-0.002	0
Total	Mean	0.001-0.105	0.002-0.105	0.000-0.104	0.563-1.662	0.135-0.348
Food Group	Output	6 to 8.00 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	P97.5	0	0	0	0	0
First Milk: From Birth (Powder)	P97.5	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	P97.5	0	0	0	0	0
Growing Up Milk: 12 Months (Powder)	P97.5	0	0	0	0	0
Goat Milk Formula	P97.5	0	0	0	0	0
Hipp Organic	P97.5	0	0	0	0	0
Soy	P97.5	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	P97.5	0.000-0.210	0.000-0.210	0.000-0.210	0.000-3.360	0.000-0.630
Follow on: 6 Months (Ready to Feed)	P97.5	0.000-0.193	0.000-0.193	0.000-0.193	0.000-3.088	0.386-0.627
Growing up Milk: 12 Months (Ready to Feed)	P97.5	0	0	0	0	0
Total	P97.5	0.004-0.221	0.005-0.221	0.000-0.221	0.011-3.535	0.457-0.758
Food Group	Output	9 to 11.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding	BDE 209

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					209	
Comfort	Mean	0	0	0	0.001-0.003	0.011
First Milk: From Birth (Powder)	Mean	0	0	0	0.000-0.001	0.002
Follow On Milk: 6 Months (Powder)	Mean	0.001	0.001	0	0.002-0.004	0.016-0.017
Growing Up Milk: 12 Months (Powder)	Mean	0	0	0	0	0
Goat Milk Formula	Mean	0	0	0	0	0
Hipp Organic	Mean	0	0	0	0	0
Soy	Mean	0	0	0	0.001-0.002	0.002
First Milk: From Birth (Ready to Feed)	Mean	0.000-0.020	0.000-0.020	0.000-0.020	0.000-0.325	0.000-0.061
Follow on: 6 Months (Ready to Feed)	Mean	0.000-0.055	0.000-0.055	0.000-0.055	0.000-0.873	0.109-0.177
Growing up Milk: 12 Months (Ready to Feed)	Mean	0	0	0	0	0
Total	Mean	0.001-0.078	0.002-0.078	0.000-0.077	0.576-1.233	0.143-0.275
Food Group	Output	9 to 11.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	P97.5	0	0	0	0	0
First Milk: From Birth (Powder)	P97.5	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	P97.5	0.004	0.005-0.006	0.001-0.002	0.015-0.029	0.109-0.116
Growing Up Milk: 12 Months (Powder)	P97.5	0	0	0	0	0
Goat Milk Formula	P97.5	0	0	0	0	0
Hipp Organic	P97.5	0	0	0	0	0
Soy	P97.5	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	P97.5	0.000-0.131	0.000-0.131	0.000-0.131	0.000-2.102	0.000-0.394
Follow on: 6 Months (Ready to Feed)	P97.5	0.000-0.175	0.000-0.175	0.000-0.175	0.000-2.805	0.351-0.570
Growing up Milk: 12 Months (Ready to Feed)	P97.5	0	0	0	0	0
Total	P97.5	0.023-0.181	0.029-0.181	0.002-0.181	0.075-2.902	0.434-0.687

Food Group	Output	12 to 14.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209

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Comfort	Mean	0	0	0	0	0
First Milk: From Birth (Powder)	Mean	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	Mean	0	0	0	0	0.001
Growing Up Milk: 12 Months (Powder)	Mean	0	0	0	0.000-0.001	0.001-0.002
Goat Milk Formula	Mean	0	0	0	0	0
Hipp Organic	Mean	0	0	0	0	0
Soy	Mean	0	0	0	0.000-0.001	0.000-0.001
First Milk: From Birth (Ready to Feed)	Mean	0.000-0.003	0.000-0.003	0.000-0.003	0.000-0.048	0.000-0.009
Follow on: 6 Months (Ready to Feed)	Mean	0.000-0.013	0.000-0.013	0.000-0.013	0.000-0.214	0.027-0.043
Growing up Milk: 12 Months (Ready to Feed)	Mean	0.000-0.014	0.000-0.014	0.000-0.014	0.000-0.221	0.024-0.041
Total	Mean	0.000-0.030	0.000-0.030	0.000-0.030	0.165-0.484	0.053-0.097

Food Group	Output	12 to 14.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	P97.5	0	0	0	0	0
First Milk: From Birth (Powder)	P97.5	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	P97.5	0	0	0	0	0
Growing Up Milk: 12 Months (Powder)	P97.5	0	0	0	0	0
Goat Milk Formula	P97.5	0	0	0	0	0
Hipp Organic	P97.5	0	0	0	0	0
Soy	P97.5	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	P97.5	0.000-0.056	0.000-0.056	0.000-0.056	0.000-0.896	0.000-0.168
Follow on: 6 Months (Ready to Feed)	P97.5	0.000-0.113	0.000-0.113	0.000-0.113	0.000-1.806	0.226-0.367
Growing up Milk: 12 Months (Ready to Feed)	P97.5	0.000-0.111	0.000-0.111	0.000-0.111	0.000-1.768	0.193-0.332
Total	P97.5	0.000-0.138	0.000-0.138	0.000-0.138	0.000-2.202	0.267-0.438

Food Group	Output	15 to 18 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	Mean	0	0	0	0	0

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First Milk: From Birth (Powder)	Mean	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	Mean	0	0	0	0.000-0.001	0.002
Growing Up Milk: 12 Months (Powder)	Mean	0	0	0	0	0.000-0.001
Goat Milk Formula	Mean	0	0	0	0	0
Hipp Organic	Mean	0	0	0	0	0
Soy	Mean	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	Mean	0.000-0.001	0.000-0.001	0.000-0.001	0.000-0.011	0.000-0.002
Follow on: 6 Months (Ready to Feed)	Mean	0.000-0.007	0.000-0.007	0.000-0.007	0.000-0.110	0.014-0.022
Growing up Milk: 12 Months (Ready to Feed)	Mean	0.000-0.009	0.000-0.009	0.000-0.009	0.000-0.143	0.016-0.027
Total	Mean	0.000-0.017	0.000-0.017	0.000-0.017	0.099-0.265	0.032-0.054
Food Group	Output	15 to 18 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Comfort	P97.5	0	0	0	0	0
First Milk: From Birth (Powder)	P97.5	0	0	0	0	0
Follow On Milk: 6 Months (Powder)	P97.5	0	0	0	0	0
Growing Up Milk: 12 Months (Powder)	P97.5	0	0	0	0	0
Goat Milk Formula	P97.5	0	0	0	0	0
Hipp Organic	P97.5	0	0	0	0	0
Soy	P97.5	0	0	0	0	0
First Milk: From Birth (Ready to Feed)	P97.5	0	0	0	0	0
Follow on: 6 Months (Ready to Feed)	P97.5	0.000-0.074	0.000-0.074	0.000-0.074	0.000-1.178	0.147-0.239
Growing up Milk: 12 Months (Ready to Feed)	P97.5	0.000-0.085	0.000-0.085	0.000-0.085	0.000-1.365	0.149-0.256
Total	P97.5	0.000-0.099	0.000-0.099	0.000-0.099	0.000-1.587	0.191-0.313

Commercial Infant foods

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Food Group	Output	4 to 5.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	Mean	0.006-0.014	0.003-0.010	0.000-0.003	0.010-0.068	0.049-0.065
Dairy Based Dishes	Mean	0.000-0.002	0.000-0.002	0.000-0.002	0.001-0.038	0.007-0.012
Fruit Based Dishes	Mean	0.000-0.004	0.000-0.004	0.000-0.004	0.000-0.056	0.005-0.012
Meat Based Dishes	Mean	0.003-0.008	0.000-0.005	0.000-0.005	0.008-0.092	0.143-0.151
Drinks	Mean	0.000-0.003	0.000-0.003	0.000-0.003	0.000-0.044	0.000-0.011
Other savoury based dishes	Mean	0.001-0.005	0.001-0.005	0.000-0.002	0.002-0.045	0.026-0.031
Snacks - sweet and savoury	Mean	0.001-0.003	0.001-0.002	0.000-0.001	0.002-0.013	0.009-0.014
Total	Mean	0.011-0.039	0.005-0.031	0.000-0.020	0.024-0.356	0.251-0.295
Food Group	Output	4 to 5.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	P97.5	0.028-0.070	0.014-0.049	0.000-0.014	0.049-0.327	0.236-0.313
Dairy Based Dishes	P97.5	0.000-0.023	0.000-0.023	0.000-0.023	0.012-0.374	0.071-0.117
Fruit Based Dishes	P97.5	0.000-0.027	0.000-0.027	0.000-0.027	0.000-0.433	0.041-0.095
Meat Based Dishes	P97.5	0.017-0.052	0.000-0.035	0.000-0.035	0.052-0.589	0.918-0.970
Drinks	P97.5	0.000-0.027	0.000-0.027	0.000-0.027	0.000-0.437	0.000-0.109
Other savoury based dishes	P97.5	0.008-0.032	0.008-0.032	0.000-0.016	0.016-0.298	0.169-0.201
Snacks - sweet and savoury	P97.5	0.007-0.017	0.005-0.012	0.000-0.003	0.012-0.080	0.058-0.085
Total	P97.5	0.047-0.168	0.019-0.136	0.000-0.092	0.110-1.592	1.203-1.372

Food Group	Output	6 to 8.00 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)
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		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	Mean	0.007-0.017	0.003-0.012	0.000-0.003	0.012-0.078	0.057-0.075
Dairy Based Dishes	Mean	0.000-0.002	0.000-0.002	0.000-0.002	0.001-0.038	0.007-0.012
Fruit Based Dishes	Mean	0.000-0.005	0.000-0.005	0.000-0.005	0.000-0.083	0.008-0.018
Meat Based Dishes	Mean	0.004-0.013	0.000-0.009	0.000-0.009	0.013-0.148	0.231-0.244
Drinks	Mean	0.000-0.004	0.000-0.004	0.000-0.004	0.000-0.058	0.000-0.014
Other savoury based dishes	Mean	0.002-0.007	0.002-0.007	0.000-0.004	0.004-0.066	0.037-0.044
Snacks - sweet and savoury	Mean	0.002-0.004	0.001-0.003	0.000-0.001	0.003-0.019	0.014-0.020
Total	Mean	0.014-0.052	0.006-0.042	0.000-0.028	0.032-0.491	0.366-0.429

Food Group	Output	6 to 8.00 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	P97.5	0.034-0.085	0.017-0.059	0.000-0.017	0.059-0.397	0.287-0.380
Dairy Based Dishes	P97.5	0.000-0.022	0.000-0.022	0.000-0.022	0.011-0.347	0.065-0.109
Fruit Based Dishes	P97.5	0.000-0.029	0.000-0.029	0.000-0.029	0.000-0.468	0.044-0.102
Meat Based Dishes	P97.5	0.022-0.066	0.000-0.044	0.000-0.044	0.066-0.751	1.171-1.237
Drinks	P97.5	0.000-0.036	0.000-0.036	0.000-0.036	0.000-0.581	0.000-0.145
Other savoury based dishes	P97.5	0.010-0.041	0.010-0.041	0.000-0.020	0.020-0.376	0.214-0.254
Snacks - sweet and savoury	P97.5	0.008-0.021	0.006-0.015	0.000-0.004	0.015-0.100	0.072-0.106
Total	P97.5	0.055-0.184	0.024-0.147	0.000-0.105	0.124-1.825	1.427-1.629

Food Group	Output	9 to 11.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209

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Cereal Based Dishes	Mean	0.005-0.012	0.002-0.008	0.000-0.002	0.008-0.056	0.040-0.053
Dairy Based Dishes	Mean	0.000-0.001	0.000-0.001	0.000-0.001	0.001-0.024	0.005-0.007
Fruit Based Dishes	Mean	0.000-0.005	0.000-0.005	0.000-0.005	0.000-0.079	0.007-0.017
Meat Based Dishes	Mean	0.004-0.012	0.000-0.008	0.000-0.008	0.012-0.140	0.219-0.231
Drinks	Mean	0.000-0.003	0.000-0.003	0.000-0.003	0.000-0.050	0.000-0.012
Other savoury based dishes	Mean	0.002-0.008	0.002-0.008	0.000-0.004	0.004-0.070	0.040-0.047
Snacks - sweet and savoury	Mean	0.002-0.004	0.001-0.003	0.000-0.001	0.003-0.019	0.014-0.020
Total	Mean	0.012-0.045	0.005-0.036	0.000-0.025	0.028-0.437	0.332-0.389

Food Group	Output	9 to 11.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	P97.5	0.030-0.076	0.015-0.053	0.000-0.015	0.053-0.357	0.258-0.342
Dairy Based Dishes	P97.5	0.000-0.016	0.000-0.016	0.000-0.016	0.008-0.248	0.047-0.078
Fruit Based Dishes	P97.5	0.000-0.027	0.000-0.027	0.000-0.027	0.000-0.425	0.040-0.093
Meat Based Dishes	P97.5	0.021-0.062	0.000-0.041	0.000-0.041	0.062-0.705	1.098-1.161
Drinks	P97.5	0.000-0.028	0.000-0.028	0.000-0.028	0.000-0.445	0.000-0.111
Other savoury based dishes	P97.5	0.013-0.053	0.013-0.053	0.000-0.026	0.026-0.487	0.277-0.329
Snacks - sweet and savoury	P97.5	0.009-0.021	0.006-0.015	0.000-0.004	0.015-0.100	0.073-0.107
Total	P97.5	0.057-0.192	0.026-0.163	0.000-0.102	0.115-1.745	1.529-1.700

Food Group	Output	12 to 14.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209

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Cereal Based Dishes	Mean	0.002-0.005	0.001-0.003	0.000-0.001	0.003-0.023	0.017-0.022
Dairy Based Dishes	Mean	0.000-0.001	0.000-0.001	0.000-0.001	0.000-0.012	0.002-0.004
Fruit Based Dishes	Mean	0.000-0.003	0.000-0.003	0.000-0.003	0.000-0.049	0.005-0.011
Meat Based Dishes	Mean	0.002-0.007	0.000-0.005	0.000-0.005	0.007-0.082	0.128-0.136
Drinks	Mean	0.000-0.002	0.000-0.002	0.000-0.002	0.000-0.025	0.000-0.006
Other savoury based dishes	Mean	0.001-0.003	0.001-0.003	0.000-0.001	0.001-0.028	0.016-0.019
Snacks - sweet and savoury	Mean	0.001-0.003	0.001-0.002	0.000-0.001	0.002-0.014	0.010-0.015
Total	Mean	0.006-0.024	0.003-0.019	0.000-0.013	0.015-0.234	0.182-0.212

Food Group	Output	12 to 14.99 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	P97.5	0.020-0.049	0.010-0.034	0.000-0.010	0.034-0.230	0.167-0.220
Dairy Based Dishes	P97.5	0.000-0.011	0.000-0.011	0.000-0.011	0.005-0.171	0.032-0.053
Fruit Based Dishes	P97.5	0.000-0.023	0.000-0.023	0.000-0.023	0.000-0.361	0.034-0.079
Meat Based Dishes	P97.5	0.017-0.050	0.000-0.034	0.000-0.034	0.050-0.570	0.888-0.938
Drinks	P97.5	0.000-0.023	0.000-0.023	0.000-0.023	0.000-0.372	0.000-0.093
Other savoury based dishes	P97.5	0.007-0.029	0.007-0.029	0.000-0.015	0.015-0.270	0.153-0.183
Snacks - sweet and savoury	P97.5	0.008-0.019	0.006-0.014	0.000-0.004	0.014-0.091	0.066-0.097
Total	P97.5	0.033-0.117	0.015-0.092	0.000-0.071	0.074-1.202	1.057-1.191

Food Group	Output	15 to 18 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)
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		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	Mean	0.001-0.002	0.000-0.001	0	0.001-0.009	0.007-0.009
Dairy Based Dishes	Mean	0	0	0	0.000-0.004	0.001-0.001
Fruit Based Dishes	Mean	0.000-0.002	0.000-0.002	0.000-0.002	0.000-0.030	0.003-0.007
Meat Based Dishes	Mean	0.001-0.004	0.000-0.002	0.000-0.002	0.004-0.042	0.066-0.069
Drinks	Mean	0.000-0.001	0.000-0.001	0.000-0.001	0.000-0.022	0.000-0.006
Other savoury based dishes	Mean	0.000-0.001	0.000-0.001	0.000-0.001	0.001-0.014	0.008-0.009
Snacks - sweet and savoury	Mean	0.001-0.002	0.001-0.001	0	0.001-0.008	0.006-0.009
Total	Mean	0.003-0.013	0.001-0.010	0.000-0.008	0.007-0.131	0.091-0.110

Food Group	Output	15 to 18 Months - PBDE Exposure (ng/kg bw/d) (LB-UB)				
		BDE 47	BDE 99	BDE 153	Sum excluding 209	BDE 209
Cereal Based Dishes	P97.5	0.009-0.022	0.004-0.015	0.000-0.004	0.015-0.104	0.075-0.099
Dairy Based Dishes	P97.5	0.000-0.004	0.000-0.004	0.000-0.004	0.002-0.068	0.013-0.021
Fruit Based Dishes	P97.5	0.000-0.016	0.000-0.016	0.000-0.016	0.000-0.262	0.025-0.057
Meat Based Dishes	P97.5	0.010-0.030	0.000-0.020	0.000-0.020	0.030-0.337	0.525-0.555
Drinks	P97.5	0.000-0.017	0.000-0.017	0.000-0.017	0.000-0.267	0.000-0.067
Other savoury based dishes	P97.5	0.006-0.022	0.006-0.022	0.000-0.011	0.011-0.206	0.117-0.139
Snacks - sweet and savoury	P97.5	0.005-0.011	0.003-0.008	0.000-0.002	0.008-0.053	0.039-0.057
Total	P97.5	0.020-0.066	0.009-0.051	0.000-0.044	0.046-0.716	0.644-0.724

TDS Exposure Food Groups

Food Group	12 to 14.99 Months – PBDE Exposure (ng/kg bw/d) (LB-UB)				
	BDE 47	BDE 99	BDE 153	Total Ex 209 (LB-UB)	BDE 209

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	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5
Bread	0.014	0.037	0.014	0.039	0.004	0.011	0.058-0.063	0.159-0.173	0.507	1.382
Canned veg	0.001	0.006	0.001	0.004	0.000	0.001	0.002-0.003	0.012-0.018	0.033	0.175
Carcase meat	0.017	0.088	0.022	0.111	0.007	0.035	0.059-0.060	0.303-0.307	0.125	0.642
Dairy products	0.232	1.226	0.256	1.349	0.059	0.310	0.652-0.673	3.442-3.553	0.211	1.115
Eggs	0.009	0.045	0.011	0.058	0.003	0.018	0.030-0.031	0.160-0.162	0.061	0.319
Fats and oils	0.010	0.039	0.009	0.037	0.002	0.009	0.026-0.027	0.104-0.110	0.104	0.417
Fish	0.125	0.578	0.021	0.098	0.007	0.030	0.282	1.308	0.158	0.732
Fresh fruit	0.007	0.024	0.005	0.018	0.001	0.005	0.018-0.021	0.062-0.071	0.804	2.761
Fruit products	0.002	0.017	0.002	0.013	0.001	0.005	0.005-0.008	0.038-0.059	0.056	0.401
Green veg	0.002	0.007	0.002	0.007	0.000	0.001	0.004	0.018-0.019	0.051	0.227
Meat products	0.017	0.089	0.018	0.097	0.004	0.020	0.050	0.262-0.266	0.134	0.706
Milk	0.047	0.134	0.051	0.146	0.013	0.037	0.139-1.437	0.397-4.100	3.146	8.979
Miscellaneous cereals	0.038	0.121	0.046	0.147	0.012	0.040	0.125-0.135	0.402-0.435	1.136	3.657
Nuts	0.000	0.002	0.000	0.002	0.000	0.000	0.001-0.002	0.004-0.007	0.008	0.033
Offal	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.000	0.000
Other veg	0.019	0.067	0.029	0.101	0.005	0.018	0.078-0.079	0.275-0.277	0.186	0.655
Potatoes	0.016	0.060	0.018	0.067	0.002	0.009	0.045-0.047	0.166-0.173	0.176	0.642
Poultry	0.006	0.024	0.006	0.027	0.001	0.006	0.019-0.020	0.082-0.086	0.228	0.998
Sugars	0.046	0.279	0.024	0.144	0.003	0.016	0.100	0.608	0.739	4.506
Total	0.607	1.525	0.534	1.569	0.125	0.359	1.694-3.042	4.241-6.005	7.862	15.200

Food Group	15 to 18 Months – PBDE Exposure (ng/kg bw/d) (LB-UB)									
	BDE 47		BDE 99		BDE 153		Total Ex 209 (LB-UB)		BDE 209	
	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5
Bread	0.015	0.041	0.016	0.044	0.005	0.013	0.065-0.071	0.041-0.044	0.569	1.528
Canned veg	0.001	0.005	0.001	0.004	0.000	0.001	0.002-0.003	0.004-0.005	0.033	0.156
Carcase meat	0.021	0.106	0.027	0.134	0.008	0.042	0.074	0.106-0.134	0.156	0.774
Dairy products	0.200	0.867	0.220	0.954	0.050	0.219	0.561-0.579	0.867-0.954	0.182	0.789

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Eggs	0.009	0.047	0.011	0.059	0.003	0.018	0.031-0.032	0.047-0.059	0.062	0.329
Fats and oils	0.012	0.043	0.011	0.040	0.003	0.009	0.031-0.032	0.040-0.043	0.123	0.455
Fish	0.117	0.592	0.020	0.100	0.006	0.031	0.264	0.100-0.592	0.148	0.749
Fresh fruit	0.009	0.024	0.006	0.018	0.002	0.005	0.022-0.026	0.024-0.018	0.990	2.841
Fruit products	0.003	0.017	0.002	0.014	0.001	0.006	0.006-0.009	0.017-0.014	0.064	0.423
Green veg	0.002	0.006	0.002	0.006	0.000	0.001	0.005	0.006	0.056	0.211
Meat products	0.021	0.096	0.023	0.104	0.005	0.022	0.061-0.062	0.096-0.104	0.165	0.758
Milk	0.047	0.114	0.051	0.124	0.013	0.031	0.139-1.441	0.114-0.124	3.156	7.645
Miscellaneous cereals	0.046	0.129	0.055	0.156	0.015	0.042	0.151-0.163	0.129-0.156	1.372	3.873
Nuts	0.000	0.002	0.000	0.001	0.000	0.000	0.000-0.001	0.002-0.001	0.003	0.032
Offal	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0	0.003	0.000
Other veg	0.020	0.066	0.030	0.099	0.005	0.018	0.081	0.066-0.099	0.193	0.644
Potatoes	0.015	0.050	0.017	0.055	0.002	0.007	0.043-0.044	0.050-0.055	0.165	0.530
Poultry	0.006	0.027	0.007	0.029	0.002	0.007	0.021-0.022	0.027-0.029	0.256	1.098
Sugars	0.069	0.345	0.036	0.177	0.004	0.020	0.151	0.177-0.345	1.118	5.559
Total	0.612	1.390	0.535	1.246	0.125	0.293	1.710-3.063	1.390-1.246	8.812	15.514

Food Group	18 to 23.99 Months – PBDE Exposure (ng/kg bw/d) (LB-UB)									
	BDE 47		BDE 99		BDE 153		Total Ex 209 (LB-UB)		BDE 209	
	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5
Bread	0.016	0.036	0.017	0.039	0.005	0.011	0.069-0.075	0.155-0.169	0.601	1.350
Canned veg	0.002	0.007	0.001	0.005	0.000	0.002	0.004-0.006	0.015-0.023	0.057	0.220
Carcase meat	0.024	0.121	0.030	0.153	0.009	0.048	0.081-0.082	0.417-0.422	0.172	0.883
Dairy products	0.219	1.019	0.242	1.122	0.055	0.257	0.616-0.636	2.861-2.954	0.200	0.927
Eggs	0.007	0.038	0.009	0.048	0.003	0.015	0.024	0.132-0.134	0.047	0.263

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Fats and oils	0.016	0.050	0.015	0.047	0.003	0.011	0.041-0.044	0.132-0.140	0.166	0.531
Fish	0.154	0.617	0.026	0.104	0.008	0.032	0.350	1.396	0.195	0.781
Fresh fruit	0.010	0.027	0.008	0.020	0.002	0.005	0.027-0.031	0.071-0.082	1.207	3.163
Fruit products	0.006	0.023	0.005	0.018	0.002	0.007	0.014-0.021	0.052-0.081	0.143	0.553
Green veg	0.001	0.009	0.001	0.008	0.000	0.001	0.004	0.023-0.024	0.048	0.287
Meat products	0.025	0.115	0.027	0.124	0.006	0.026	0.074-0.075	0.337-0.342	0.198	0.908
Milk	0.044	0.139	0.048	0.151	0.012	0.038	0.130-1.347	0.410-4.239	2.950	9.283
Miscellaneous cereals	0.049	0.096	0.059	0.116	0.016	0.032	0.163-0.176	0.318-0.344	1.481	2.891
Nuts	0.000	0.000	0.000	0.000	0.000	0.000	0	0.000-0.001	0.002	0.003
Offal	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.001	0.000
Other veg	0.012	0.036	0.018	0.054	0.003	0.009	0.050	0.147	0.119	0.349
Potatoes	0.016	0.033	0.018	0.036	0.002	0.005	0.044-0.046	0.091-0.094	0.171	0.350
Poultry	0.007	0.022	0.008	0.024	0.002	0.006	0.024-0.026	0.075-0.079	0.299	0.917
Sugars	0.081	0.386	0.042	0.198	0.005	0.023	0.177	0.839	1.313	6.216
Total	0.691	1.406	0.574	1.316	0.135	0.307	1.892-3.170	3.873-6.725	9.370	20.007

Food Group	24 to 60 Months – PBDE Exposure (ng/kg bw/d) (LB-UB)									
	BDE 47		BDE 99		BDE 153		Total Ex 209 (LB-UB)		BDE 209	
	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5	Mean	97.5
Bread	0.018	0.043	0.020	0.045	0.006	0.013	0.079-0.085	0.183-0.199	0.684	1.590
Canned veg	0.001	0.004	0.001	0.003	0.000	0.001	0.002-0.004	0.009-0.014	0.035	0.134
Carcase meat	0.014	0.076	0.018	0.096	0.006	0.030	0.049-0.050	0.262-0.265	0.104	0.556
Dairy products	0.130	0.469	0.143	0.516	0.033	0.118	0.366-0.377	1.317-1.359	0.118	0.427
Eggs	0.007	0.039	0.009	0.049	0.003	0.015	0.024-0.025	0.137-0.139	0.048	0.274

This is a background paper for discussion.
It does not reflect the views of the Committee and should not be cited.

Fats and oils	0.014	0.047	0.013	0.044	0.003	0.010	0.037-0.039	0.123-0.130	0.149	0.494
Fish	0.118	0.454	0.020	0.077	0.006	0.024	0.268	1.028	0.150	0.575
Fresh fruit	0.008	0.020	0.006	0.015	0.001	0.004	0.020-0.022	0.052-0.059	0.872	2.297
Fruit products	0.005	0.026	0.004	0.021	0.002	0.008	0.012-0.019	0.059-0.092	0.130	0.628
Green veg	0.002	0.006	0.001	0.006	0.000	0.001	0.004	0.016-0.017	0.049	0.201
Meat products	0.030	0.100	0.033	0.109	0.007	0.023	0.089-0.090	0.295-0.300	0.239	0.795
Milk	0.031	0.090	0.034	0.098	0.009	0.025	0.092	0.266-2.747	2.085	6.016
Miscellaneous cereals	0.040	0.095	0.048	0.115	0.013	0.031	0.131-0.142	0.314-0.339	1.194	2.852
Nuts	0.000	0.005	0.000	0.004	0.000	0.001	0.001	0.011-0.016	0.006	0.080
Offal	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.001	0.000
Other veg	0.014	0.044	0.021	0.067	0.004	0.012	0.056	0.183-0.184	0.134	0.435
Potatoes	0.015	0.042	0.017	0.047	0.002	0.006	0.042-0.043	0.116-0.120	0.161	0.447
Poultry	0.006	0.026	0.007	0.029	0.002	0.007	0.021-0.022	0.088-0.093	0.252	1.079
Sugars	0.117	0.493	0.060	0.254	0.007	0.029	0.256	1.074	1.893	7.952
Total	0.571	1.091	0.454	0.801	0.103	0.180	1.548-2.456	2.961-4.565	8.303	15.424