

DECREASES IN PBDE AND PCB LEVELS IN BREAST MILK DURING LACTATION IN CALIFORNIA FIRST-TIME BREAST-FEEDING MOTHERS

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Introduction

High levels of polybrominated diphenyl ethers (PBDEs) in Californians^{1,2} have recently been confirmed by studies of PBDE body burdens of US residents from different regions³⁻¹¹. PBDEs are indoor contaminants, used as non-covalently-bound flame retardant additives to polyurethane foam, synthetic fabrics, and thermoplastics found in a great variety of home/office furnishings and consumer products. Indoor dusts encountered in the home, auto, office may represent a significant continuous exposure¹². In contrast, the polychlorinated biphenyls (PCBs) are predominantly outdoor contaminants, arising from point sources or broadcast applications outdoors. Diet is the major and intermittent exposure. We compared depuration rates of PBDEs and PCBs during breastfeeding in studies initiated in July, 2004. Depuration studies have been reviewed¹³, and a pilot depuration study for PBDEs and a variety of POPs has been previously reported¹⁴.

Materials and Methods

Overall Study Design. As part of a larger breast milk exposure assessment study of 82 healthy, first-time (primiparous) breastfeeding mothers with healthy singleton infants 1-8 weeks of age, a subset of 9 mothers who had abundant milk supplies and hand-expressed easily were recruited by the author's laboratory and the Women's Health and Birth Center in Santa Rosa California to examine the depuration rates of PBDEs and PCBs. These time-series studies received human subjects approval, and all participants signed an Informed Consent form. Breast milk samples were hand-expressed (~100 mL each) into chemically clean, 120 mL amber glass jars at approximately 4, 6, 8, 12, 16, 20, and 24 weeks after infant birth, with several collection sessions required to fill a jar at each time point. Jars were refrigerated between collections, and frozen when filled. Participants were instructed on methods to minimize contamination by skin, hair, or dust. Frozen samples were collected by study personnel and stored at -20° C until analysis. We measured 12 PBDE and 80 PCB congeners in batches of 12 samples: 9 experimental samples with one duplicate, a method blank, and a quality-control (QC) sample from pooled breast milk. To minimize effects of day-to-day variability in lab conditions, all time-series samples from one participant were prepared concurrently and analyzed as one batch.

To assess how much imprecision was introduced during the batch-analysis of one participant's samples, we ran a batch of method blanks and a batch of QC breast milk samples. To examine the sensitivity of our methods to measure changes in PBDE or PCB congener levels over time (in samples collected at 7 points over a 24-week time-series), we constructed a mock time-series by spiking a set of 5 QC milk samples with known amounts of PBDEs and PCBs to give successive, decreased (15%), stepwise concentrations, and analyzing the mock time-series as one batch.

Sample Preparation and Analysis. Sample preparation (lyophilization, extraction and fat determination, mixed silica gel column cleanup, and GPC column cleanup) and analysis are described elsewhere¹⁰.

Results and Discussion

Mock Time-Series. Results from the mock time-series using five QC breast milk samples spiked with PBDE and PCB congeners at successively lower concentrations indicate that our methods are precise enough to detect a 15% decrease in concentrations at each of the 5 successive samples for both PCBs ($R^2 = 0.9285$) and PBDEs ($R^2 = 0.9869$), with the exception of BDE-209.

Depuration of PBDEs and PCBs. Depuration rates of 12 major PBDEs are presented in Figures 1A-B for two California primiparae with 25-fold differences in their Σ PBDE levels.

Fig. 1A - PBDE Levels in Breast Milk 4-24 Weeks After Birth:
CA-SON-006-04

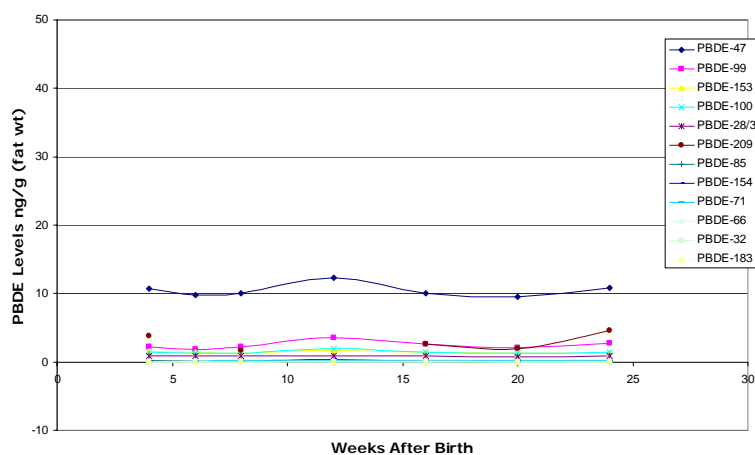
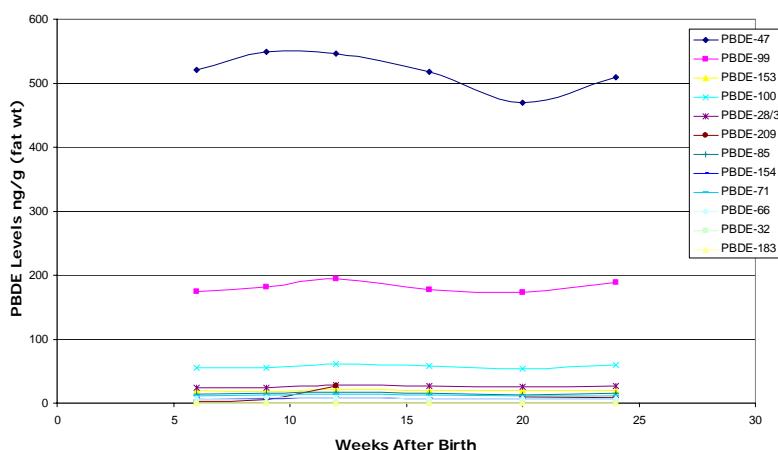
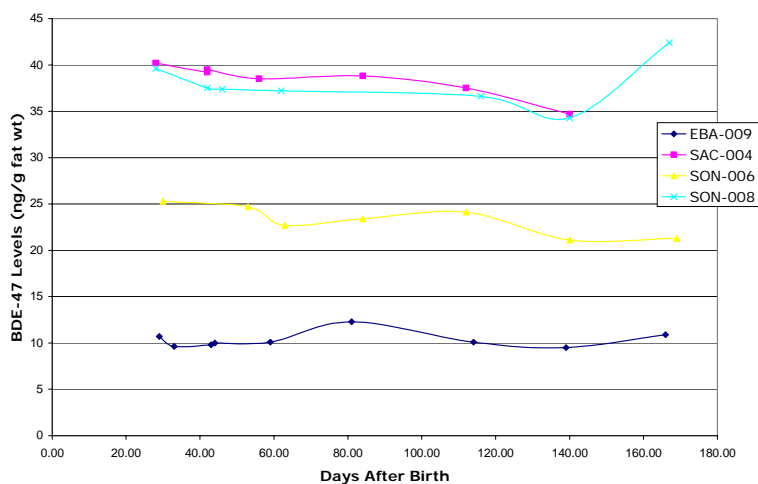


Fig. 1B - PBDE Levels in Breast Milk 4-24 Weeks After Birth:
CA-SON-010-04



Body burdens: pattern, levels and trends

Figure 2: BDE-47 Levels in Breast Milk 4-24 Weeks After Birth



Data from seven California primiparae suggest that depuration rates of BDE-47 do not appear to depend upon BDE-47 body burdens (Figs 1A-B). Using natural log transformed data, BDE-47 levels decreased significantly (regression $p < 0.05$) in 3 of 7 mothers over the 24-week time-series, with levels in a fourth at borderline significance (regression $p < 0.1$). The Spearman Rank Correlation examined relationship between the variables BDE-47 levels and days after birth, and found significant decreases in BDE-47 levels over the 18-week period in 4 of 7 mothers. For the aggregate of 7 mothers, the decrease in BDE-47 was significant, averaging about 3% per month (regression $p < 0.01$) (Table 1).

Table 1: BDE-47 Depuration (n=7) - Spearman Rank Correlation/Regression

		Spearman	Regression	
Woman	#	p-value	p-value	% Decrease/mo
SON-010*	7	0.01	0.09	5.3
SON-008	7	0.29	0.55	1.8
SAC-004	6	0.001	0.01	3.7
SON-014	6	0.01	0.001	5.5
SON-006	7	0.02	0.02	3.5
SON-012	7	0.7	0.98	0.1
EBA-009	7	0.94	0.92	0.2

*outlier

Levels of most PBDE and PCB congeners trended downward over the 18-week study period. As levels of all PBDEs, save BDE-153 and -209, are correlated in breast milk samples, there was little variation in the levels or proportions of each PBDE congener over the time-series. Results from these time-series suggest that monthly

Body burdens: pattern, levels and trends

decreases of PBDE and PCB levels in breast milk are small but measurable, and that PCBs do not appear to decrease more rapidly than PBDEs over this period.

Time-series study participants. The time-series participants were similar in demographic characteristics to participants from California (n=82) and the Pacific Northwest (n=40) enrolled in breast milk studies carried out by this laboratory. Most participants were 26-36 years of age (median 31.5 years), most were born in the US or Canada (95%), were Caucasian (90%), and many had a college education (61%). Also similar were distributions of % lipid and levels or patterns of PCBs and PBDEs in breast milk. With the small sample size (n=7), no attempt was made to ensure that participants were statistically representative of regional populations, of population sub-groups, or of the larger California or Pacific Northwest study populations. However, the similarities (demographic and breast milk contaminant characteristics) seen between the time-series population and the larger California and Pacific Northwest study populations suggest that these depuration patterns may have broader applicability.

*The opinions given by the authors are not necessarily those of the DTSC or the California Environmental Protection Agency (Cal-EPA). Mention of any product or organization does not constitute an endorsement by DTSC or Cal-EPA.

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