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STUDY OF RISK EXPOSURE ASSESSMENT FOR EGYPTIAN INFANTS EXPOSED TO DIOXIN INTAKE IN COMMERCIAL BABY MILK

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ABSTRACT

Dioxin is ubiquitous highly toxic environmental pollutants, which exhibit a potential risk for human health. Baby milk with high amount of fat content, which includes infant formula and follow-on formula, is the major food sources for babies. Therefore, it was a source for dioxin (polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDFs)) accumulated in baby body. A total thirty-three baby milk samples collected from imported and domestic market with 22 different brands from 8 different countries to determine the levels of 17 PCDD/PCDFs in baby milk with a mean total value 0.199 pg WHO-TEQ/g fresh weight, and ranged from 0.039 to 0.691 pg WHO-TEQ/g fresh weight. The Dioxin profile analysis was useful as a fingerprint to suggest the source of dioxin contamination. The congener profiles of 17 PCDD/PCDFs in infant-formula milk, hence the 75.5% of PCDF levels contributed in total TEQ account of the toxicity in infant-formula milk while 24.5% for PCDD levels. Moreover, the 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD congeners were the most abundant congeners of total PCDD congeners while the 2,3,4,7,8-PeCDF and 1,2,3,4,7,8-HxCDF congeners were the most abundant congeners of total PCDF. Estimate dietary exposures to dioxins for various age groups: newborn aged 0-6 months; infant aged 6-12 months and toddlers aged 12-24 months. Dioxin Tolerable Daily Intake (TDI) was estimated to be within the value is consistent with tolerable intakes derived using WHO: 1-4pg WHO TEQ /kg bw/day. Furthermore, dietary exposure to dioxin of exclusively formula-fed infants assessed at each month from 0 to 24 months. The percentage of formula-fed infants with an exposure exceeding the TDI of 6.56 pg WHO-TEQ/kg bw.d^{-1} was 163.9% at 0 months, 43.8% at 6 months, 14.5% at >6 months, 12.4% at ≤12 months, 20.7% at >12 months and 16.7% at <24 months. However, estimated dietary exposure more than 6 months of age was always below the lowest range of the TDI of 1 pg WHO-TEQ kg^{-1}.bw.d^{-1}. This study gives useful data for TDI data on the daily intake permitted to Egyptian children to assess the risks and benefits of infant formula in Egypt for ages from newborns to age two years.

Keywords: Formula, milk, Dioxin, Infant, Baby milk, Profile, Egypt and Daily intake.

INTRODUCTION

The exposure levels of dioxins such as polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs), and coplanar PCBs (Co-PCBs), in infants are exceed the Tolerable daily intake (TDI) set by the World Health Organization (WHO), because of their small bodies. Actually, it is unusual that the dioxin level in an infant who was breastfed for a short term exceeds TDI (Schecter *et al*. 1996). As TDI is the total amount of dioxins that taken by a human over an entire lifetime without posing any appreciable health risk, WHO has opined that breastfeeding presents much more advantages,

including proper nourishment, immunity, and physical contact with mother, than commercial infant formula. However, in general, infants start taking baby food around the sixth month after birth. Therefore, it feared that the dioxin level in infants who receive relatively large amounts of dioxins originating in baby food during the weaning period, in addition to the dioxins from breastfeeding, might exceed TDI even after lactation.

There are few reports on the residual dioxin levels in baby food (Frommberger 1993; Schecter *et al*. 2002; Amakura *et al*. 2005; Sasamoto *et al*. 2006). One reason why studies that assess dioxin intake from baby food are limited could be that no model food groups are available for the assessment of dioxin contamination in baby food. On the other hand, Tsutsumi *et al*. (2001) conducted a total diet study that assessed dioxin intake from various kinds of food in adults. Because human infants are born with an immature immune system, they are at increased risk of infections. Human milk contains antibodies and other factors that assist the infant in warding off infections and parasites until such time as the immune system are fully functioning (LaKind *et al*., 2002).

Human health risk assessments for dioxins and dioxin-like PCBs have been performed and WHO established health based exposure limits within the range of 1–4 pg WHO-TEQ kg^{-1} bw d^{-1} (WHO, 2000). Infants tend to have a relative higher dietary exposure to food chemicals because of their higher food consumption per kilogram body weight. In infant period, human milk and formula milk are obviously the major sources of food chemicals. In general, the highest dietary exposure to dioxins observed in breast-fed infants, however, a considerable amount of data exits for concentrations of dioxins in human milk that reveals a decrease in levels over the last years (Loran *et al*., 2007). Although WHO recommends breast-feeding as the best feeding choice (WHO, 2008), infant formula are an alternative to breast milk that often play an important role in the infant's diet, therefore their potential contamination with PCDD/F and PCB should be considered. Only few studies investigated the PCDD/F and PCB level in infant formula (Schecter *et al*., 1989; Ramos *et al*., 1998; Chovancova *et al*., 2005; Hsu *et al*., 2007; Kerger *et al*., 2007), with most of the studies focused on dioxins in human milk. In a study carried out in the metropolitan Tokyo area, the main source of dioxins appeared to be infant formula in the early stage of the weaning period whereas in the subsequent weaning stage, the main source was protein-based food (Sasamoto *et al*., 2006). The aim of this study is to promote the health of non-breastfed children's and assess the dietary exposure to PCDDs/PCDFs of newborns; infants and toddler for fed with most frequently use infant formula on the Egyptian market.

MATERIALS AND METHODS

1.0 Sampling:

Thirty-three commercial baby milk samples (infant formula and follow-on formula) roughly classified into three age groups collected from domestic and international baby milk producers for twenty-two different brands from 8

different countries. Dioxin levels in baby milk were determined, and dioxin intake in babies assessed based on the proposed model milk aged groups. The average fat content in baby milk samples was 19.1% with possess ranges between 2 - 31.4% resulted in table (i).

Table I. Fat percent contents in baby milk samples for all ages period

	N	Min	Max	Average fat %
Fat%(All groups)	**33**	2.00%	31.4%	19.1 %

N: No. of baby milk sample analyzed

The mean daily dietary exposure to PCDD/F (pg WHO-TEQ kg^{-1} bw d^{-1}) was calculated based on the estimated average amount of baby milk (mL d^{-1}) consumed by an ‘‘average Egypt baby”. The standard values of weight for age and sex proposed by WHO (2006) for formula-fed infants for babies in 0 to 24 months of life. The identified amounts of liquid infant formula (mL.d^{-1}) was translated in g d^{-1}, according to the label of the sampled products, that suggests using on average 30 mL of water to dilute 4.6 g of powder of infant formula and based on an estimated volumetric density of infant formula of 1.03 g mL (Kardos, 2003). These values additionally related to g $body^{-1}$ $weight^{-1}$(Pandelova 2010).

The daily dioxin intakes calculated for each period age at 0, 6, 12 and 24 months to identify the risk for babies aged from 0 to 24 month according the table(ii).

Table II. Calculated daily liquid and dry Infant formula consumption of total PCDD/Fs (pg. WHO-TEQ/Person /day) and calculated daily gram infant formula per kg body weight for infant aged 0–24 month.

Infant age (month)	Average body weight (b.w.)a (kg)	Calculated daily liquid Infant formula consumptionb (mL d-1)	Calculated daily dry Infant formula consumption (g d-1)	Calculated daily gram infant formula per kg body weight (g bw-1)
0	3.25	644	96	29.54
6	7.6	400	60	7.89
>6 -≤12	7.95 - 9.25	240	36	4.53 - 3.89
>12-≤24	9.55 - 11.85	240	36	3.77 - 3.04

[a] Body weight values (WHO, 2006) at the 50th percentage were obtained: Calculating, for babies with age between month x and month x + 1, the mean of values of 50th percentile in month x and at month x + 1, both for females and males. Calculating the mean between the values in females and males.

[b] According to the recommendations of the report of Scientific Committee on Food (SCF, 2003).

2.0 Chemicals and Reagents:

All solvents (toluene, cyclohexane, n-Hexane, methanol, methylene chloride, nonane and diethyl ether) used were from pesticide grade and purity not less than 99%, Silica gel and basic Alumina were from Aldrich (Brockmann I, standard grade, Milwaukee, USA), anhydrous sodium sulphate and conc.H2SO4 (96%) from Riedel-deHaen, carbopack C- 80/100 (Supelco) and celite 545- (BDH or Aldrich)

Calibration standard solutions, labeled standard and injection solutions specified in EPA Method-1613B obtained from Cambridge Isotopes Laboratories (Andover, USA).

3.0 Instruments:

3.1 HRGC/HRMS Instrument

Analyses were conducted using HP 6890 plus gas chromatograph coupled with Micromass /Autospec Ultima mass spectrometer operating in EI mode at 35 eV and with a resolution of 10.000 (5% valley). Sample injections performed in the splitless mode on DB5 MS column (60m, 0.25 mm id, 0.1µm film thickness). The oven program was started from 90ºC then takes 15min. to reach 220ºC then held for 15 min, then from 220-290 in 8min then held for 17min. Helium (Ultra high purity) at a flow rate 0.8 ml/min. was used as a carrier gas. Injector temperature was 225 C; 1µl of the sample injected using splitless mode.

3.2 Accelerated Solvent Extractor (ASE):

Dionex 350 model; condition of ASE: Oven temp.: 125 C˚, Static cycle time: 5 minute, Cycles: 4, Rinse volume: 80%, Purge time: 70 Sec, Cell pressure: 1500 psi (nitrogen gas) and Total extraction time: 30 min per sample.

4.0 Procedure:

Extraction of fat from dried baby milk sample (25 ±0.1g) by Soxhlet or with Accelerated Solvent Extractor (ASE-Dionex 350) using a solvent mixture of n-Hexane: Dichloromethane: Methanol (5:2:1). The lipid was extract from the samples by using either soxhlet or ASE and then transfer to cleanup steps. Cleanup steps conducted according to EPA Method (U.S EPA 1613(B), 1994), using acidified silica gel, anthropogenic, multilayer silica gel, alumina and active carbon column. Finally determine of PCDD/F by using HRGC/HRMS.

4.1 Quality Assurance/Quality control(QA/QC):

The QCAP lab operate and follows the quality assurance system as shown in table (iii) and method of analysis of PCDD/F in baby milk was accredited since 2003 by Finnish Accreditation Service body (FINAS) according to the requirements of the International Standard ISO/IEC 17025.

Method blank, ongoing precision and recovery (OPR), certified reference material (CRM) and quality control samples were included with each batch of 12 samples were measured to confirm the laboratory performance and the method validation.

Table (iii). LOD and average recoveries of labeled PCDD/Fs with all baby milk samples analyzed

Labeled PCDD/Fs	LOD (ng/ml)	Expected Conc. (ng/ml)	Average Recovery %	Acceptance Av. Rec. Range %
2,3,7,8-TCDD	0.01	100	79	25-164
1,2,3,7,8-PeCDD	0.01	100	82.9	25-181
1,2,3,4,7,8-HxCDD	0.05	100	85.5	32-141
1,2,3,6,7,8-HxCDD	0.05	100	81.9	28-130
1,2,3,4,6,7,8-HpCDD	0.05	100	88.9	23-140
1,2,3,4,6,7,8,9-OCDD	0.1	200	52	17-157
2,3,7,8-TCDF	0.01	100	89.9	24-169
1,2,3,7,8-PeCDF	0.01	100	91.4	24-185
2,3,4,7,8-PeCDF	0.01	100	93.6	21-178
1,2,3,4,7,8-HxCDF	0.05	100	90	26-152
1,2,3,6,7,8-HxCDF	0.05	100	88.6	26-123
2,3,4,6,7,8-HxCDF	0.05	100	89.2	28-136
1,2,3,7,8,9-HxCDF	0.05	100	93	29-147
1,2,3,4,6,7,8-HpCDF	0.05	100	84.7	28-143
1,2,3,4,7,8,9-HpCDF	0.05	100	84.2	26-138
1,2,3,4,6,7,8,9-OCDF	0.1	200	52	17-157

4.2 Determination of PCDDs/PCDFs amounts in baby milk samples:

Determinations of PCDD/Fs performed by an isotope dilution method using relative response factors previously obtained from five standard solutions. The TEQ concentrations were calculated guided to World health Organization-toxic equivalent factor (WHO-TEFs, 1998), The tetra through octa PCDD/F results for infant formula sample were identified and quantified and presented in pg WHO-TEQ/g fresh weight (fw) multiplied by the associated WHO-TEF (Van den Berg*et al*., 1998). It assumed that non-detected isomer concentrations were equal to the limits of determination. As recommended by the European Regulation (Council Regulation EC No. 199/2006), detection and quantification limits, as well as recoveries, for all PCDD/Fs congeners were in good agreement with requirements laying down the sampling methods and the methods of the analysis for the official control of PCDD/Fs. For each run, the samples were prepared including a method blank and quality control samples. All steps of analysis conducted according to (U.S adverse consequences of the observed effects adverse consequences of the observed effects EPA 1613(B), 1994).

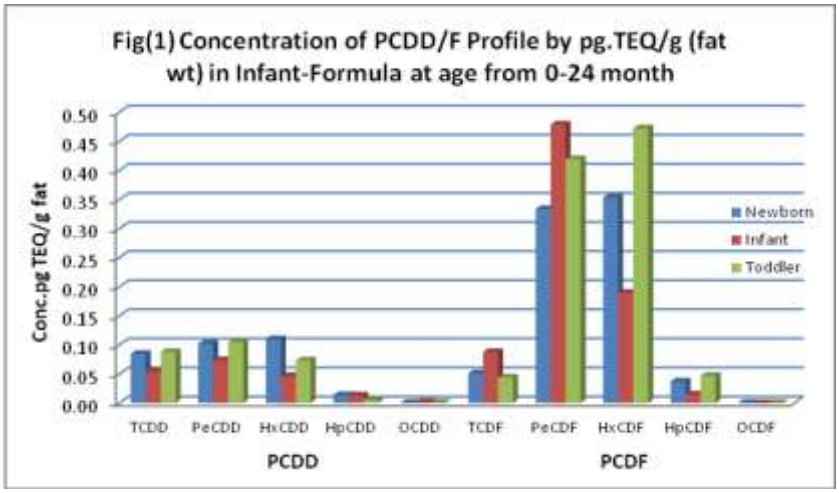
RESULTS AND DISCUSSION

1.0 Dioxin profile in baby milk

For total PCDDs/PCDFs TEQ levels, 2,3,4,7,8-PeCDF and 1,2,3,4,7,8-HxCDF were the predominant congeners contributions to total toxicity-adjusted baby milk exposure of 33.2 and 11.9%, respectively and shows these two congeners in almost samples with high frequency detection percent by 96.9%. Although 1,2,3,7,8-PeCDD and 2,3,7,8-TCDD was the high contributions total toxicity-adjusted baby milk exposure by 8.7 and 7.1% however slightly high in frequency of detection by 59.4 and 65.6% respectively.

Moreover, most five highest compounds contributors to the toxicity are 2,3,4,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 2,3,4,6,7,8-HxCDF, 1,2,3,7,8-PeCDD and 2,3,7,8-TCDD; they account for more than 68.3% of the total TEQ.

In fig(1) demonstrated the congener profiles of 17 PCDD/PCDFs in infant-formula milk, hence the 75.5% of PCDF levels contributed in total TEQ account of the toxicity infant-formula milk while 24.5% for PCDD levels. Moreover, the 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD congeners were the most abundant congeners of total PCDD congeners while the 2,3,4,7,8-PeCDF and 1,2,3,4,7,8-HxCDF congeners were the most abundant congeners of total PCDF. These profile results were very close to the result by Hsu *et al*., 2007.



Also, the highest frequency of detection corresponds to 2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 1,2,3,4,6,7,8-HpCDF and 1,2,3,4,6,7,8-HpCDD in all samples by 100, 100, 100 and 96.9%, respectively (see table 2).

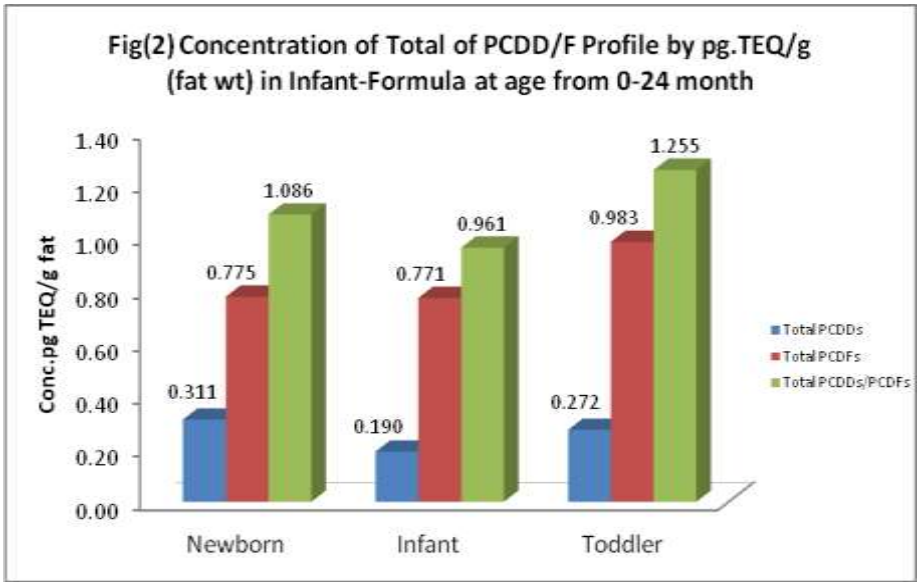
All results were confirmed that the total PCDD/Fs in baby milk were higher contamination in newborn (1.086 pg/TEQ/g fat wt.) than in infant 0.961 pg/TEQ/g (fat wt.), but less than in toddlers 1.255 pg/TEQ/g (fat wt.) as shown in fig.(2).

In contrast, as shown in table (1) the mean total concentration of PCDDs/ PCDFs in infant formula was 1.104 pg TEQ/g fat of at 2011. These results were higher than compare with the mean in samples of infant milk formula imported from EU countries was 0.64 pg TEQ/g fat (Chovancova *et al*., 2005) and also lower than presented mean value of 0.7± 0.2 pg WHO-TEQ g^{-1} lipid in formula milk purchased from stores in southern Taiwan (Hsu *et al*., 2007).

Table 1. Age groups; minimum, maximum, mean, concentration of PCDD/PCDF sum pg/g ITEQ (WHO) fat weight, 90th percentile and median in baby milk.

			Sum pg/g ITEQ(WHO) PCDDs/PCDFs(fat)				
Age Groups	**Age (Months)**	**N (no. of brand origin)**	**Min**	**Max**	**Mean ± SD**	**90%**	**50%**
Newborn	0-6	15(7)[a]	0.27	2.4	1.09 ± 0.769	2.27	0.73
Infant	≥6-≤12	8(1)[b]	0.34	2.09	0.96 ± 0.792	1.978	0.42
Toddler	>12 - ≤24	9(5)[c]	0.5	2.25	1.257 ± 0.651	2.133	1.06
Total		32	0.27	2.4	1.104±0.7281	2.216	0.883

N: No. of baby milk samples
Brand origin: [a] Belgium, France, Boland, Ireland, Holland, Switzerland and Egypt; [b] Egypt, [c] France, Holland, Ireland, Spain and Egypt



2.0 Dioxin in infant formulas brands from different origin of production countries

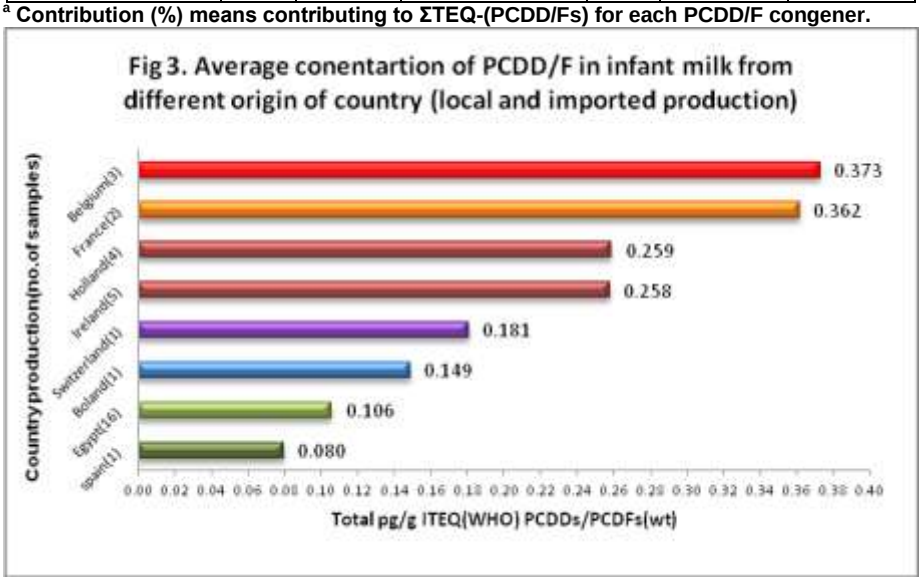
Contamination of infant formulas brands by PCDD/F are variables in different production countries. Egypt is lowest mean concentration of 0.106 pg/g ITEQ(WHO)PCDD/F(wt) compare to other brands from seven industrial countries such as Belgium (0.373), France (0.362), Holland (0.259), Ireland (0.258), Switzerland (0.181), Boland (0.149) and Spain (0.08) pg/g ITEQ(WHO) PCDDs/PCDFs(wt) as shown in fig.(3). Infant formula milk from industrial with higher contains amounts on a lipid basis of PCDD/Fs than low or non-industrial countries. There were several other findings in feed and food of non-compliance with the EU legislation on dioxins and dioxin-like PCBs which were notified to the RASFF (European Commission, 2010): high levels of dioxins and dioxin-like PCBs in cod liver from Poland (6 notifications); high level of dioxins and dioxin-like PCBs in sardines from France. Therefore, the French authorities have prohibited the catching of sardines in the Seine bay; Non-compliant level of dioxins and dioxin-like PCBs in organic eggs from

Germany. This non-compliance traced to a possible contamination of organic corn from Ukraine. Another finding of contamination in eggs from France related to a local contamination of the environment.

Table 2: Minimum, maximum, mean concentrations, frequency percent and contribution percent of PCDD/F congeners in baby milk samples (TEQ fat) for infant at age from 0 to 24 months.

PCDD/Fs congeners	Min	Max	Mean (pg TEQ/g milk fat)	SD	Frequency detected %	Contribution %[a]
2,3,7,8-TCDD	0.000	0.370	0.078	0.09	65.6	7.1
1,2,3,7,8-PeCDD	0.000	0.407	0.096	0.11	59.4	8.7
1,2,3,4,7,8-HxCDD	0.000	0.311	0.024	0.06	62.5	2.2
1,2,3,6,7,8-HxCDD	0.000	0.266	0.036	0.05	81.3	3.3
1,2,3,7,8,9-HxCDD	0.000	0.196	0.024	0.04	65.6	2.1
1,2,3,4,6,7,8-HpCDD	0.000	0.088	0.012	0.02	96.9	1.0
1,2,3,4,6,7,8,9-OCDD	0.000	0.009	0.001	0.00	15.6	0.1
2,3,7,8-TCDF	0.012	0.292	0.058	0.06	100.0	5.3
1,2,3,7,8-PeCDF	0.004	0.091	0.028	0.02	100.0	2.5
2,3,4,7,8-PeCDF	0.000	1.240	0.366	0.31	96.9	33.2
1,2,3,4,7,8-HxCDF	0.000	0.547	0.131	0.15	96.9	11.9
1,2,3,6,7,8-HxCDF	0.000	0.196	0.066	0.06	93.8	6.0
2,3,4,6,7,8-HxCDF	0.000	0.310	0.082	0.08	90.6	7.4
1,2,3,7,8,9-HxCDF	0.000	0.325	0.067	0.08	84.4	6.0
1,2,3,4,6,7,8-HpCDF	0.003	0.085	0.023	0.03	100.0	2.1
1,2,3,4,7,8,9-HpCDF	0.000	0.133	0.011	0.02	65.6	1.0
1,2,3,4,6,7,8,9-OCDF	0.000	0.003	0.000	-	3.1	-

[a] **Contribution (%) means contributing to ΣTEQ-(PCDD/Fs) for each PCDD/F congener.**



In general, the TEQs calculated for analyzed soybean infant formulas (in the 0.02–0.11 ng TEQ g of lipids range) were similar to those reported for human breast milk from industrialised countries. Similar results found when the daily intake by both lactation means was compared (Ramos *et al*., 1998).

3.0 Dioxin body burdens in infants by formula milk feeding

During 2011, baby milk samples analysis were conducted on 17 target dioxin compounds, including PCDD/Fs, comprising 33 collected individual baby milk samples from imported and monitor from domestic market.

We note that where concentrations of these compounds in food were below the limit of detection, the concentration has assumed to be at the limit of detection. This approach overestimates dietary exposures to dioxins. Dietary exposure of adults and schoolchildren has been estimated using food consumption data for these specific groups (Gregory, 1990).

Calculate of TDI, TWI and PMTI from mean concentration of sum PCDD/F for newborn, infant and toddler were 0.222, 0.128 and 0.22 pg/gITEQ(fresh weight) table (3)

Table 3. Age groups; minimum, maximum, mean, concentration of PCDD/PCDF, 90th percentile and median.

			Sum pg/g ITEQ(WHO) PCDDs/PCDFs fresh weight)				
Age Groups	**Age (Months)**	**N(no. of brand origin)**	**Min**	**Max**	**Mean ± SD**	**90%**	**median**
Newborn	0-6	16(7)[a]	0.079	0.691	0.222 ± 0.166	0.39	0.152
Infant	≥6 -≤12	8(1)[b]	0.039	0.465	0.128 ± 0.138	0.179	0.091
Toddler	>12 - ≤24	9(5)[c]	0.080	0.491	0.22 ± 0.153	0.466	0.189
Total		33	0.039	0.691	0.199 ± 0.1568	0.465	0.149

N: No. of baby milk samples
Brand origin: [a] Belgium, France, Boland, Ireland, Holland, Switzerland and Egypt; [b] Egypt, [c] France, Holland, Ireland, Spain and Egypt

3.1 Dioxin TDI in aged babies 0-24 month

Estimated daily intake range of PCDD/F would be 6.56 and 1.75 pg WHO-TEQ kg^{-1} $bw.d^{-1}$ for newborn of a 3.25 kg at aged 0 and a 7.6 kg at 6 months, respectively was calculated infant formula to evaluate the body burden in infants via formula feeding. It appears that dietary exposure decreases from month to month within this period, due to the decreased level of consumption per kg body weight (Pandelova 2010). Overall high estimated dietary exposure values more than 1 pg WHO-TEQ $kg^{-1}.bw.d^{-1}$ were found in case of PCDD/F for newborn consuming infant formula and with an average body weight lower than 7.95 kg. These values not comply with the recommended range of Tolerable Daily Intake (TDI) of 1–4 pg WHO-TEQ $kg^{-1}.bw.d^{-1}$ (WHO, 2000) as shown fig. (5).

The estimated daily intakes of baby milk for infants and toddlers age is 0.58, 0.498, 0.829 and 0.668 pg WHO-TEQ $kg^{-1}.bw.d^{-1}$ are below range of TDI recommended by the WHO (1– 4 pg WHO-TEQ $kg^{-1}.bw.d^{-1}$). Hence, relative to body weight, daily TEQ intake for a newborn is 6.56 pg/kg body weights, several times higher than for infant and toddler.

We believe that the proposed classification and calculation is suitable for the evaluation of total dioxin intake from commercial baby milk by estimate dietary exposures to dioxins for various age groups: newborn aged 0-6 months; infant aged 6-12 months and toddlers aged 12-24 months.

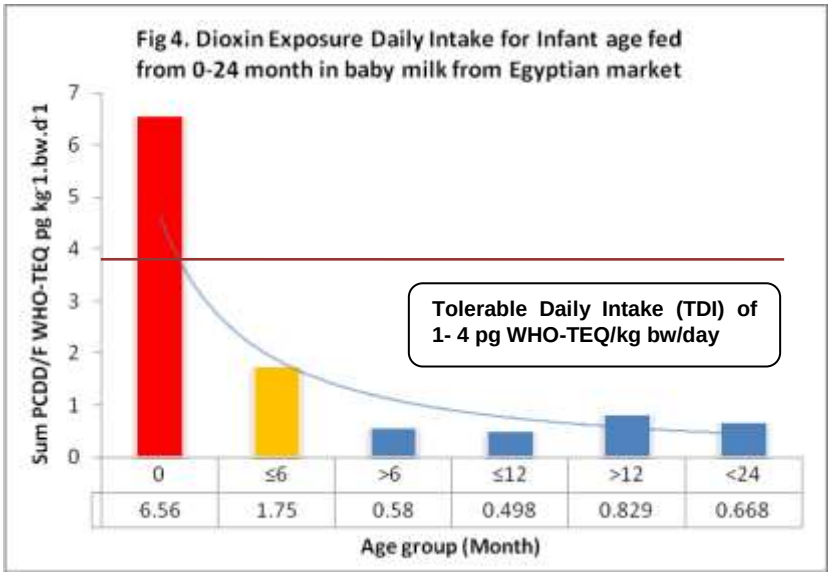
Furthermore, in table (4) dietary exposure to dioxin of exclusively formula-fed infants assessed at each month from zero to 24 months.

The average contributions to total cumulative intake of PCDD/F up to 24 months of life were 163.9%, 43.8%, 14.49%, 12.45%, 20.73% and 16.71% in the age periods of 0, ≤6, >6, ≤12, >12 and ≤24 months, respectively. Consequently, the highest estimated cumulative dietary exposure to PCDD/F obtained considering newborn of 0–1 months fed with infant formula 6.56 pgWHO-TEQkg^{-1}.bw.d^{-1}. A major reason for the markedly higher TEQ intake by infants in the first year of life is their high average daily milk consumption of 100 g/kg body weight (Patandin *et al*., 1997).

This ADI data may provide useful information for risk-benefit evaluation of baby milk in Egyptian babies.

Table (4). Estimated dietary exposure to PCDD/F for Egyptian babies of age fed with infant formula and percent of intake for each age group

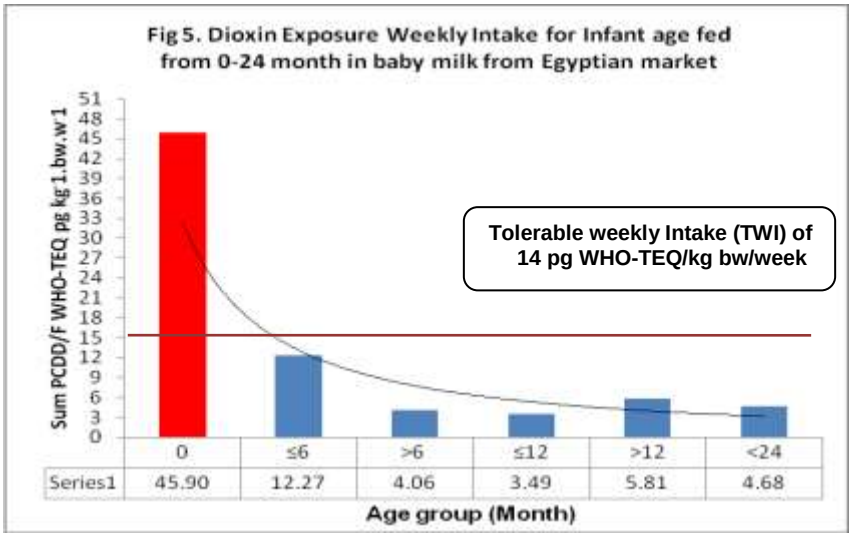
Age (Months)	Average body weight (b.w.) (kg)	Estimated Daily Intake (EDI) of PCDD/Fs (pgWHO-TEQ/kg b.w/day)	Intake, %
0-6	3.25 - 7.6	6.558 - 1.75	163.9 - 43.8
>6 -≤12	7.95 - 9.25	0.58 - 0.498	14.49 - 12.45
>12 - ≤24	9.55 - 11.85	0.829 - 0.668	20.73 - 16.71

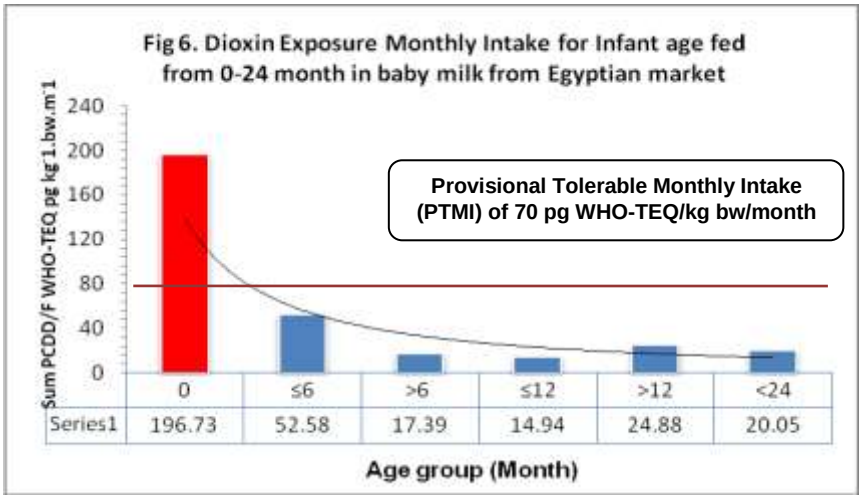


3.2 Dioxin TWI and PMTI in aged babies 0-24 month

To know the affect on the long half-lives of PCDD/F, their hazard to health can estimate after consideration of intake over a period of weeks and months. The intake was also expressed as a week and a monthly value and compared with Tolerable Weekly Intake (TWI) adopted by SCF: 14pg WHO TEQ /kg bw/week (SCF 2001) and a Provisional Tolerable Monthly Intake

(PMTI) of 70 pg WHO-TEQ kg^{-1} bw $month^{-1}$ established by the Joint FAO/WHO Expert Committee of Food Additives (JECFA, 2002), respectively. In figure (5 & 6) were observed the newborn fed by infant formula for 0 month given the PCDD/F estimated by TWI (45.92 pg WHO-TEQ $kg^{-1}.bw.w^{-1}$) and estimated by PMTI (196.8 pg WHO-TEQ kg^{-1} bw $month^{-1}$). So that concerning PCDD/F dietary exposure for newborn fed exclusively with consuming infant formula is the most important particular group of infants aged 0–6 months.





However, the newborn fed by infant formula for 6 month given the PCDD/F estimated by TWI (12.25 pg WHO-TEQ $kg^{-1}.bw.w^{-1}$) and estimated by PMTI (52.5 pg WHO-TEQ kg^{-1} bw $month^{-1}$) is slightly lower than the acceptance of TWI and PMTI. While as the estimated infants aged more than

6 months is below the acceptance of TWI and PTMI, However, estimated dietary exposure more than 6 months of age was always below the lowest range of the Tolerable Daily Intake (TDI) of 1 pg WHO-TEQ kg^{-1}.bw.d^{-1} and Provisional Tolerable Monthly Intake (PTMI) of 70 pg WHOTEQ kg^{-1} bw $month^{-1}$. That mean Newborn age have a far higher intake of dioxins relative to body weight than do all older age groups.

Relative to body weight, daily TEQ intake for an newborn is 6.56 pg/kg body weight, several times higher than for infant and toddler.

Conclusions

Although the infant formula and follow-on formula commercial brands produced by Egyptian companies were lowest contamination with PCDD/F than other industrial countries however, fed newborn consume not only from Egyptian production also from other six countries such as Belgium, France, Boland, Ireland, Holland and Switzerland. The dioxin intake in this study was considerably higher than the TDI of 4-pg TEQ/kg body weight/day at newborn aged below six month however, lower than acceptable TDI at infant and toddler aged up to six month to twenty-four month. Therefore, all possible actions should consider in order decreasing the high-risk exposure of PCDD/Fs in baby milk particularly newborn age by reducing the import of dioxin-contaminated baby milk. We conclude that the concentration of dioxin in commercial baby milk by artificial feeding are considered not being a serious risk to pose a risk to health at baby aged up to 6 month. In addition, continuous surveillance of PCDD/F and dl-PCBs in baby milk should be do in Egypt to clarify the possible adverse consequences of the observed effects on infant health for newborn, infant and toddler aged. Generally must be investigate the breast-fed infants to know the whole health risk for newborn, infant and toddler according previous studies by Abraham *et al*. (1994, 1996) and Dahl *et al*. (1995) reported almost complete absorption of lower chlorinated CDDs and CDFs in breast-fed infants during the first year of life. It was also noticed that intake of CDDs and CDFs was up to 50 times higher in breast-fed infants compared with a formula-fed infant (Abraham *et al*. 1996).

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دراسة تقييم المخاطر التى يتعرض لها الأطفال المصريين اثر تناول الديوكسين في ألبان الأطفال التجارية

ياسر محمد نبيل

المعمل المركزي لتحليل متبقيات المبيدات والعناصر الثقيلة في الأغذية, مركز البحوث الزراعية بوزارة الزراعة, الجيزة - مصر.

تتواجد مركبات الديوكسينات في كل مكان حولنا وهى ملوثات بيئية شديدة السمية، وتعتبر من المخاطر المحتملة على صحة الأطفال. ان ألبان الأطفال تحتوى على كمية عالية من الدهون، تشمل حليب الرضع والحليب المكمل, والذى يعتبر أحد المصادر الغذائية الرئيسية بالنسبة للأطفال لذلك هو أيضا مصدر لتواجد مركبات الديوكسينات ال (PCDDs) و(PCDFs) والتى تتراكم في جسم الأطفال. تم تجميع عدد ثلاثة وثلاثون عينة من حليب الأطفال لتحليلها من الأسواق المحلية ومن الشحنات المستوردة من دول الخارج لعدد اثنان وعشرون علامة تجارية مختلفة من ثمان دول مختلفة وذلك لتحديد مستويات ال 17 مركب ديوكسين (PCDDs) وفيوران (PCDFs) بها بقيمة تركيز اجمالية 0.199 بيكوجرام/جرام WHO-TEQ (الوزن الطازج)، حيث تراوح تركيز الديوكسينات بين 0.039-0.691 بيكوجرام/جرام WHO-TEQ (الوزن الطازج).

ويعتبر تحليل مكونات الديوكسينات بالأهمية كبصمة لتلك المركبات وذلك للتعرف على مصادر التلوث بها. حيث وجد أن نسبة تواجد أشكال متجانسات الديوكسينات السبعة عشر في حليب الأطفال كمايلى: نسبة مستويات الفيوران PCDF الى 75.5٪ من إجمالى سمية الدايوكسين في ألبان الأطفال بينما تصل نسبة مستويات PCDD الى 24.5٪ من إجمالى سمية الدايوكسين في ألبان الأطفال, علاوة على ذلك كانت متجانسات 2,3,7,8-TCDD و1,2,3,7,8-PeCDD الأكثر تواجد فى المجموع الكلى لمركبات الدايوكسين PCDD في حين أن متجانسات 2,3,4,7,8-PeCDF و 1,2,3,4,7,8-HxCDF الأكثر تواجد فى المجموع الكلى لمركبات الفيوران PCDF.

تم تقدير كمية التعرض الغذائي للديوكسين لثلاث فئات عمرية: حديثي الولادة الذين تتراوح أعمارهم بين 0-6 أشهر، الرضع الذين تتراوح أعمارهم بين 6-12 شهرا والأطفال الصغار الذين تتراوح أعمارهم بين 12-24 شهرا. وقدرت منظمة الصحة العالمية جرعة الديوكسين اليومية المسموح بها (TDI) في حدود 1-4 بيكوجرام WHO-TEQ/ كيلوغرام من وزن الجسم/ يوم لتنسجم مع المتناول اليومى المسموح به الذي يمكن يتحمله الأطفال من سن 0 الى 24 شهر.

تم تقييم التعرض الغذائي للديوكسين المتواجد فى حليب الرضع للأطفال من سن 0 الى 24 شهرا; فكانت النسبة المئوية من المتناول اليومى المسموح به لأطفال حديثى الولادة (6.56 بيكوجرام WHO-TEQ / كيلوغرام من وزن الجسم/ يوم) الذين يتعرضون للديوكسين تتجاوز المسموح به من منظمة الصحة العالمية بزيادة 163.9٪ عن المسموح به خلال الشهر الأول من الولادة وبنسبة 43.8٪ لسن 6 أشهر، 14.5٪ لسن أكبر من 6 أشهر، 12.4٪ لسن أقل ويساوى 12 شهرا، 20.7٪ لسن أكبر من 12 شهر و 16.7٪ لسن أقل من 24 شهر. وبناء على ذلك، حصل حديثي الولادة خلال الشهر الأول من الولادة على أعلى تقديرات للتعرض الغذائي التراكمي لمركبات الدايوكسين ومع ذلك، يقدر التعرض الغذائي للديوكسين لسن أكثر من 6 أشهر دائما أقل من المسموح به من منظمة الصحة العالمية 1 بيكوجرام WHO-TEQ/ كيلوغرام من وزن الجسم/ يوم. هذه الدراسة تعطى بيانات مهمة عن المتناول اليومى المسموح به لأطفال المصريين لتقييم المخاطر والمنافع من حليب الأطفال الرضع في مصر لأعمار من حديثى الولادة حتى عمر سنتين.

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