Dioksinler Nedir?

Türkiye'de İnsandaki Dioksin Düzeyleri

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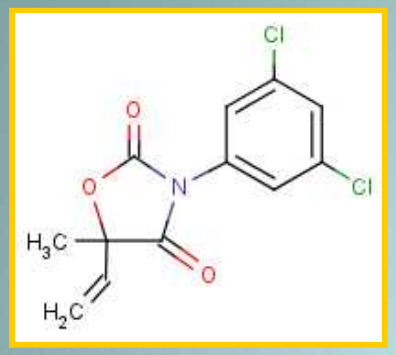
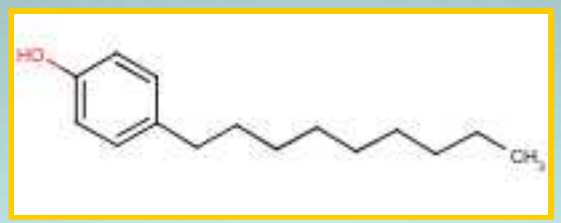
Hg(CH3)

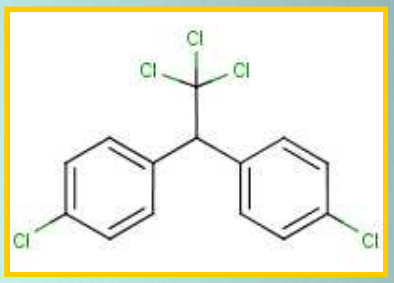


Vinclozolin
(fungicide)

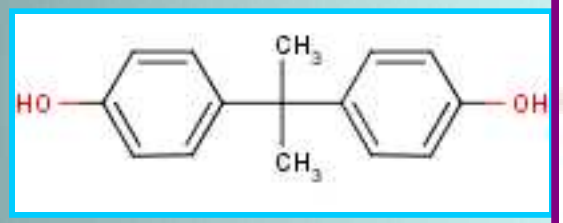


Nonylphenol
(from detergents and agrichemical polymers)

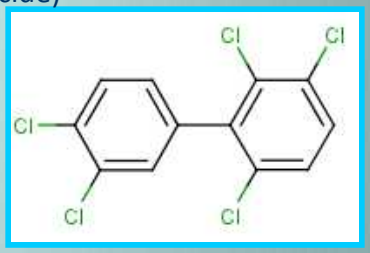
Polybrominated diiphenylethers
(e.g. PBDE-85, flame retardants)



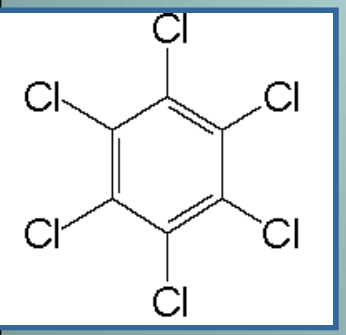
DDT
(pesticide)



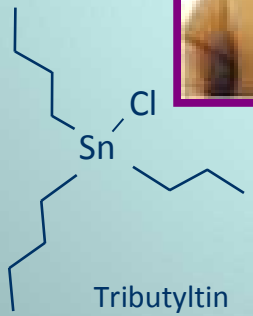
Bisphenol A
(polycarbonate plastics)



Polychlorinated biphenyls
(e.g. PCB-110, industrial chemical)

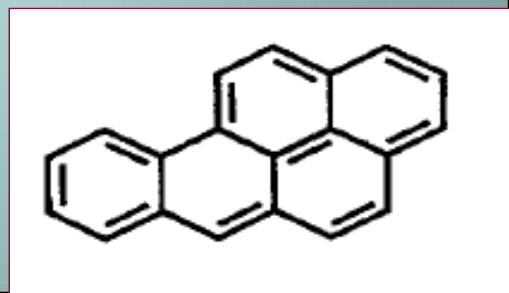


Hexachlorobenzene
(industrial chemical))



Tributyltin
(ship paints,
fungicide, PVC)

Diethylhexylphthalate
(plasticiser)



Birleşmiş Milletler Çevre Programı'na (UNEP) Göre DÜNYA KİMYASAL MADDE TÜKETİMİNDE YILLARA GÖRE ARTIŞ

1930	1 Milyon ton
1950	7 milyon ton
1970	63 milyon ton
1985	250 milyon ton
Günümüzde	>400 milyon ton

- **Stockholm Sözleşmesi, 2001**

"Yeni,toksik,kalıcı, doğada biriken kimyasalların önlenmesi,mevcut Kalıcı Organik Kirleticilerin (KOK) azaltılması,daha tehlikesiz maddelerle ikame edilmesi ve tüm kimyasal maddeler konusunda daha dikkatli olunması"

- UNEP Çevre birimi tarafından hazırlanan ve kalıcı özellik göstermeleri nedeniyle çevre ve insan sağlığını olumsuz olarak etkileyen 12 kimyasal maddenin (kirli düzine) kullanılmasına yasaklama ve sınırlama getiren uluslar arası sözleşmedir.

"Kirli Düzine" -Kalıcı Organik Kirleticiler-

KİMYASAL	PESTİSİT	ENDÜSTRİYEL KİMYASAL	YAN ÜRÜN
ALDRİN	+		
KLORDAN	+		
DDT	+		
DİELDRİN	+		
ENDRİN	+		
HEPTAKLOR	+		
MİREKS	+		
TOKSAFEN	+		
HEKSAKLOROBENZEN	+	+	+
POLİKLORLANMIŞ BİFENİLLER (PCB)		+	+
POLİKLORLANMIŞ DİOKSİNLER (PCDD)			+
POLİKLORLANMIŞ FURANLAR (PCDF)			+

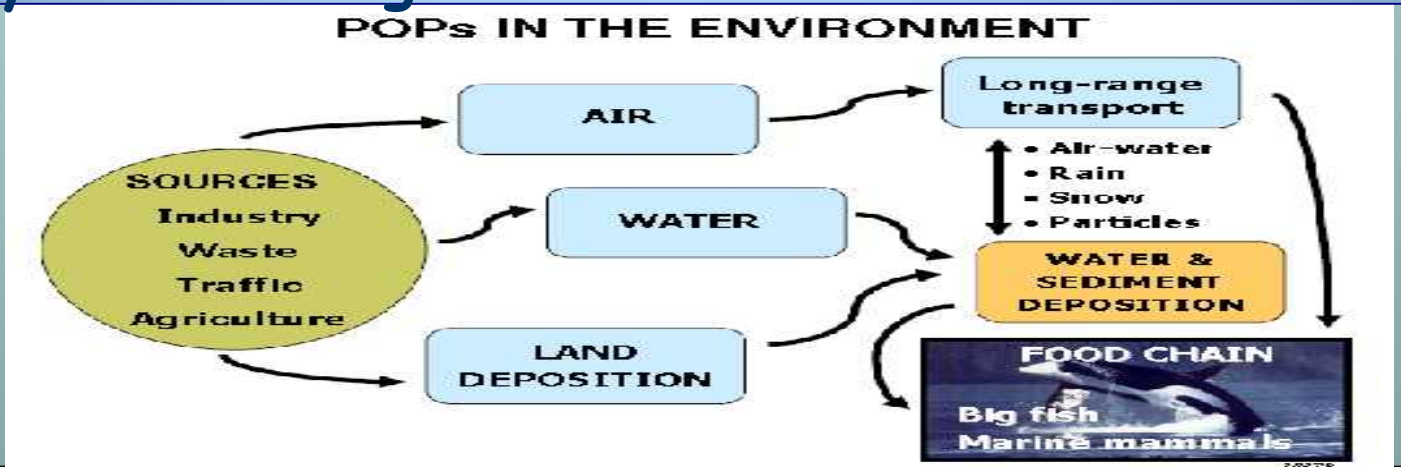
KOK'lar

- İnsan ve Hayvanlar için Toksik Olmaları

- Çevrede Uzun Süreler Parçalanmadan Kalıcılığa Sahip Olmaları -Kimyasal olarak stabildirler, Mikrobiyolojik bozulmaya karşı dirençliler

- Su , Hava, Göç Eden Türler Yoluyla Uygulama Alanlarından Çok Uzak Mesafelere Taşınabilmeleri

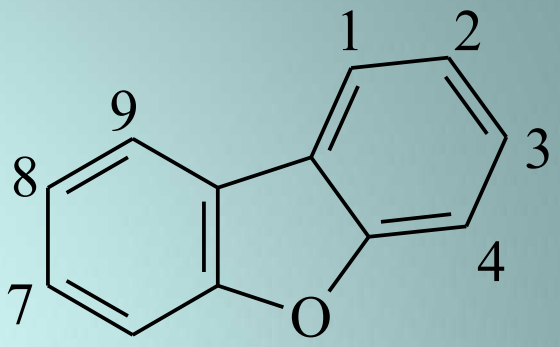
- Besin Zinciri Boyunca Canlıların Yağ Dokularında Biyobirikime Uğramaları



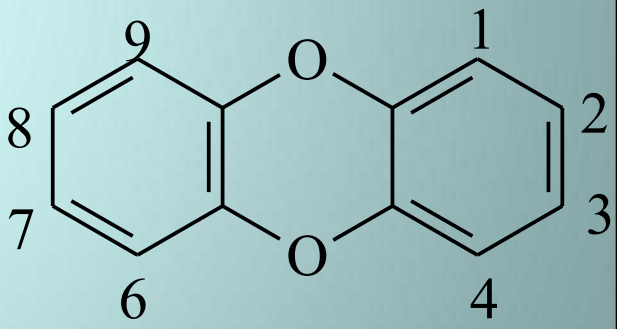
KİMYASAL	Kullanıma Başlama Yılı	Σ Dünya Üretimi (ton)	Kullanım
Aldrin	1949	240,000	İnsektisit
Klordan	1945	70,000	İnsektisit
DDT	1942	3 milyon	İnsektisit
Dieldrin	1948	240,000	İnsektisit
Endrin	1951	240,000	Rodentisit/İnsektisit
Heptaklor	1948	~1,000	İnsektisit
Heksaklorobenzen	1945	1-2 milyon	Fungusit
Mireks	1959	Bilgi Yok	İnsektisit
Toksafen	1948	1.3 milyon	İnsektisit
PCBs	1929	1-2 milyon	Endüstriyel Kimyasal
Dioksinler	?	?	Kullanım Amacıyla Üretimler Olmadı
Furanlar	?	?	Kullanım Amacıyla

Poliklorlu dioksinler(PCDDs) ve Poliklorlu furanlar (PCDFs)

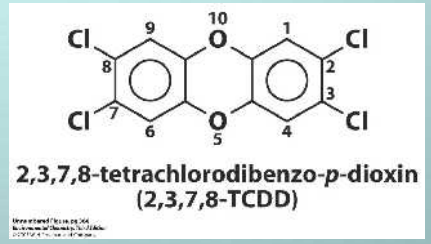
- KOKların en toksik özelliğe sahip üyeleridir.
- Dioksinler ve furanlar ticari olarak üretilmezler
- Dioksinler için 75 mümkün konjener söz konusudur.
- Furanlar için 135 mümkün konjener söz konusudur.
- İnsan vücudunda 2,3,7 ve 8 pozisyonlarında lateral klorları taşıyan 17 PCDD/F konjeneri (7 PCDDs ve 10 PCDFs) mevcuttur



dibenzofuran



dibenzo-p-dioxin



2,3,7,8-Tetrachlorodibenzo-p-dioxin “TCDD”

KONJENERLER	Sinonim	TEF (WHO 2005)
Dioksin Konjenerleri		
2,3,7,8-Tetrachlorobenzo-p-dioxin	2,3,7,8-TCDD	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1,2,3,7,8-PCDD	1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,4,7,8-HCDD	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,6,7,8-HCDD	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1,2,3,7,8,9-HCDD	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1,2,3,4,6,7,8-HCDD	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	1,2,3,4,6,7,8,9-OCDD	0.0003
Furan Konjenerleri		
2,3,7,8-Tetrachlorodibenzofuran	2,3,7,8-TCDF	0.1
1,2,3,7,8-Pentachlorodibenzofuran	1,2,3,7,8-PCDF	0.03
2,3,4,7,8-Pentachlorodibenzofuran	2,3,4,7,8-PCDF	0.3
1,2,3,4,7,8-Hexachlorodibenzofuran	1,2,3,4,7,8-HCDF	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	1,2,3,6,7,8-HCDF	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	1,2,3,7,8,9-HCDF	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	2,3,4,6,7,8-HCDF	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	1,2,3,4,6,7,8-HCDF	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1,2,3,4,7,8,9-HCDF	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	1,2,3,4,6,7,8,9-OCDF	0.0003

DOĞAL ORMAN YANGINLARI

BAHÇE ARTIKLARININ YAKIMI

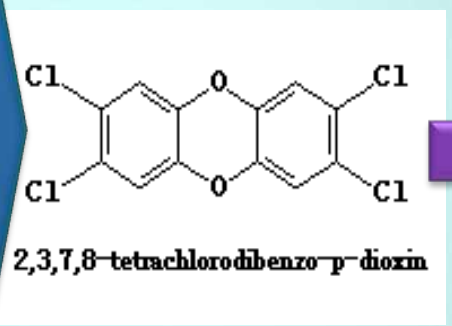
TEHLİKELİ ATIK YAKIM MERKEZLERİ

OTOMOBİL EKSOZLARI

PVC ÜRETİMİ & DISPOSAL

PESTİSİTLER

KAĞIT ENDÜSTRİSİ



2,3,7,8–tetrachlorodibenzo–p–dioxin

PLANKTON

BALIK

İNEK

BİTKİLER

TOPRAK

SU

HAVA

İNSAN

KAYNAKLAR

- **Yanma ve Yakma işletmeleri (Incineration)**

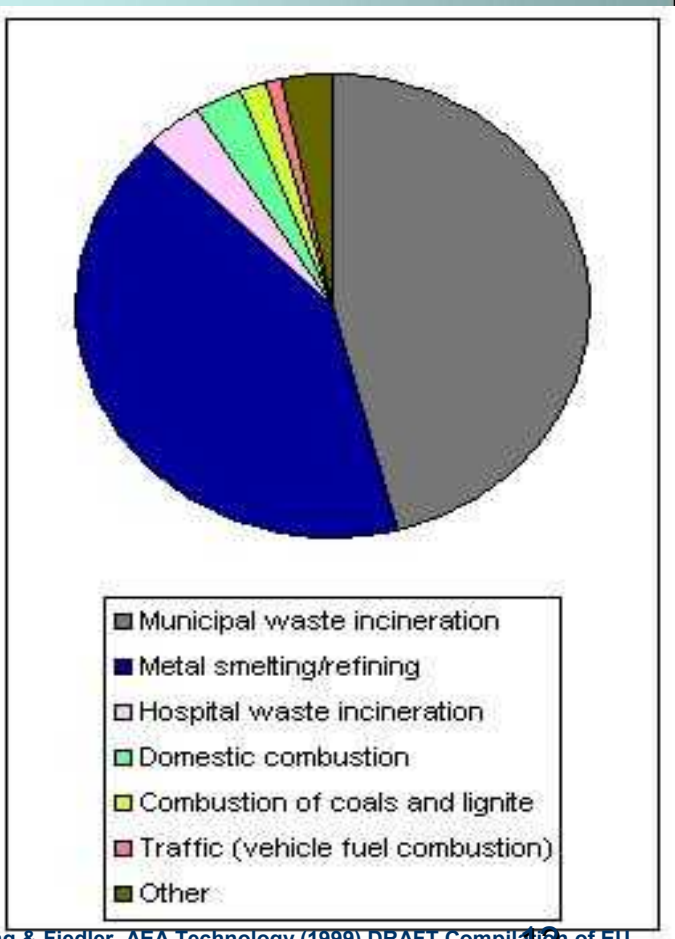
-Belediye katı atıklarının yakılması
-Hastane atıklarının yakılması
-Tehlikeli atıkların yakılması
-Çeşitli ısıtma ürünlerinin yanması Örn., kömür, odun,petrol ürünleri örn:benzin, dizel)
-Açık yanmalar
- Çimentodan tuğla yapımı sırasında fırında yakma

Metal İşleme ve Eritme işlemleri

-Demir eritme
-Çelik üretimi
-Pb, Zn, Cu, Mg, Ti eritme işlemleri
-Metal parçalama

Kimyasal Üretim/İşlem

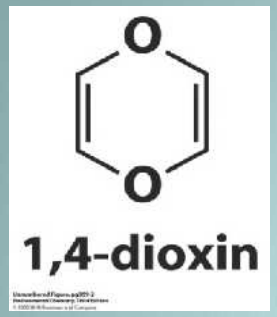
-Kağıt hamuru beyazlatma işlemleri
-Klorofenoller, örn., PCP
-Klorobenzenler
-Klorlanmış alifatik bileşikler (EDC, PVC)
-Halojenlenmiş difenil eterler
-Pestisitler,örn: 2,4-D
-Klor üretimi
-Boyalar, pigmentler



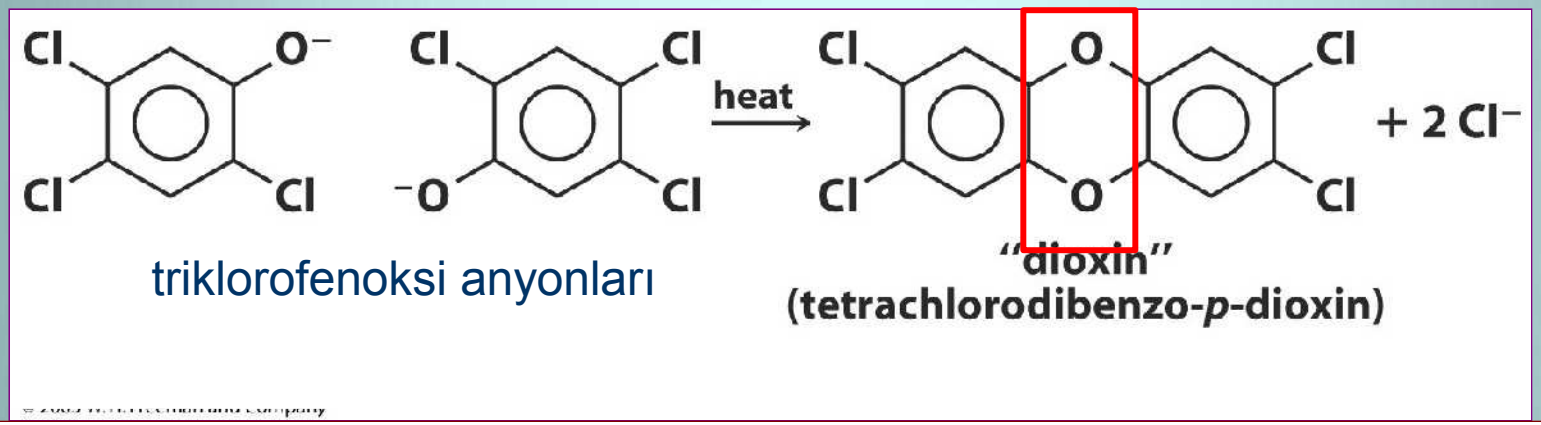
King & Fiedler, AEA Technology (1999) DRAFT Compilation of EU Dioxin Exposure and Health Data, Section 4 Human Exposure.

Dioksinler

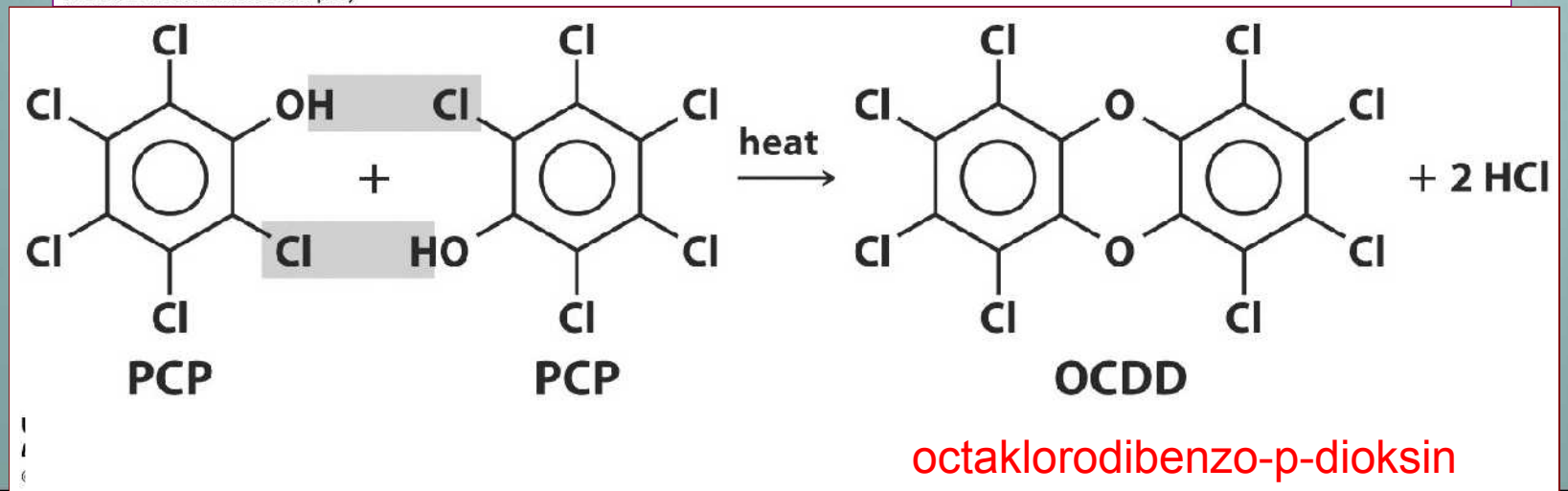
P-dioxin
(Basit dioksin)



- Herbisit 2,4,5 Triklorofenoksi asetik asit üretiminde 2,4,5-triklorofenol başlangıç materyali olarak kullanılır



triklorofenoksi anyonları



octaklorodibenzo-p-dioksin

1970 lerde TCDD kontamine olmuş herbisit kullanımı (Agent Orange)

Agent Orange – 2,4-D ve 2,4,5-T karışımı
Herbisit (defoliant)
~ 10 ppm TCDD dioksin

ABD askerlerince Vietnam savası boyunca kullanıldı.

Önce……

Agent Orange uygulamasından sonra……

'Yusho, Japonya (1968): Pirinç yağının PCB,PCDF ve az miktar PCDD kontaminasyonu ile gerçekleşen zehirlenme. 1862 kişi etkilendi, 149 kişi öldü (1990 yılına kadar).

NYT, 2 Ağustos 1988

'Yu-Cheng, Tayvan (1978/1979): Pirinç yağının PCB kontaminasyonu ile gerçekleşen zehirlenme .
2061 kişi etkilendi, ölüm: ?

PCB Exposure Linked to Birth Defects in Taiwan

-By GINA KOLATA

An industrial accident in Taiwan nine years ago that spilled high levels of toxic PCB's into cooking oil has caused an epidemic of birth defects, a new study has found.

Researchers said this was the first well-documented demonstration that PCB's can cause birth defects in humans, and it is one of the few instances of any environmental pollutant causing such defects. But they said there was no evidence that the minute amounts of PCB's in many residents of industrialized countries are causing birth defects.

The investigators found that women who used the contaminated oil were subjected to very high doses of poly... PCB's, their bo... with spe... discolor... develop... ers repo... issue of ...

PCB's are colorless and odorless oily substances. They have long been known to be toxic, and they resist normal degradation. Until the mid-1970's they were widely used as insulators because they do not explode or burn when subjected to high temperatures, and they do not conduct electricity.

But PCB's were subject to increasing concern when animal studies in the 1960's and 70's indicted that they can cause birth defects and liver cancer in high doses. It also was recognized that when people are exposed to high concentrations of PCB's, they can develop a severe form of acne, called chloracne.

In the mid-1970's the Environmental Protection Agency blocked most uses of PCB's, but the compounds persist at low levels in the environ..., contaminating many fresh ...er fish and occurring in minute ...centrations in human fat and ...ast milk.

...PCB's are part of the 'waste ...eam and will be part of it into the ...t century," said Dr. Walter Rogan ...he National Institute of Environmental Health Sciences and an author of the new report.

"Periodically, due to accidents and public concern, the issue arises, Was this person made ill by exposure to these chemicals? The only way to really answer that is to see what happens when someone is exposed to the chemicals," Dr. Rogan said, explaining why Taiwan's data are of interest.

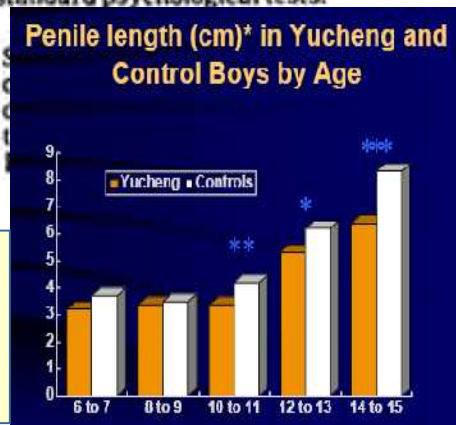
In May 1979, children at a school for the blind near Taipei, Taiwan, began breaking out with chloracne. Not long after that, some industrial workers visiting Taipei for training also developed this skin disease.

PCB's Persist in Body Fat

Taiwan traced the outbreaks to a brand of rice oil that they suspected had been contaminated with PCB's when it was processed. In October, the oil was recalled, but by then more than 2,000 people had been exposed to high concentrations of PCB's and polychlorinated dibenzofurans, even more potent derivatives of the chemicals that were also in the oil.

Dr. Rogan and his colleagues, including Dr. Kun-Long Hung of Cathay General Hospital in Taipei, identified 117 children born between 1979 and 1985 whose mothers consumed the contaminated rice oil. PCB's persist in fat tissue for years, so women who consumed the oil in 1979 would expose fetuses to high levels of the chemicals even years later.

The children had a variety of birth defects, including dark colored heads, faces and genitals and abnormal nails that were dark and often ridged, split or folded. They also tended to have swollen gums and teeth that chipped readily. They were shorter and lighter on average than children who were not exposed and had developmental delays as measured by standard psychological tests.



Yusho maruziyet (yaklaşık 1µg PCDF, 150/150 µg PCB/PCQ /kg bw/d) ve Yu-Cheng benzer değerler

Dioxin Kazası

Seveso, Italya

Endüstriyel kaza Seveso,İtalya
Temmuz 10, 1976

TCP (2,4,5-triklorofenol)

20 More Evacuated From Area in Italy Hit by Poison

SEVESO, Italy, July 28 (AP)—Authorities evacuated 20 more persons today and extended by several miles the zone regarded as dangerously polluted by a cloud of chemicals from a Swiss-owned plant.

Since the cloud of poisonous trichlorophenol gas escaped from the Icmesa chemical plant near here 18 days ago, one cow and hundreds of rab-

The gas, which escaped after an explosion, is allegedly used for making defoliants, such as those sprayed by the United States in Vietnam. The authorities have appealed to Italy's NATO allies for help in counteracting the gas and said they were waiting for United States and British reclamation units to arrive.

Some American chemical ex-

NATO bas

ed the area yes-

have forbidden

vegetables and

e infested area.

Italian doctor,

has advised

area against

y for at least three

d the long-term effects

s on the health of peo-

he area could not be

ed now.

oxin Peril Cited

most significant sub-

hat escaped from the

plant was said by an

n expert to be dioxin,

he deadliest chemicals

A dose of less than a

of a gram is fatal to

igs.

nount believed to have

from the Italian

a subsidiary of Hoff-

oche, the Swiss phar-

al and chemical con-

said to be about four

alf pounds. No one

hat the lethal dose is

for human beings but no one doubts that four and a half pounds would kill many thousands of people.

The American expert is Dr. John Moore, an authority on dioxin with the National Institute of Environmental Health Services. He has been consulted about the Italian situation by the State Department.

Dr. Moore said the Italian Government had asked for help that a decontamination specialist fro Agriculture was being sent to Italy.

Dioxin, which is also known as TCDD, was the contaminant

of Vietnam during the war. It was removed.

was implicated in numerous birth defects among Vietnamese children.

In 1974 scientists found that waste oil sprayed on the earthen floor of a Missouri stable and roads to keep dust down was contaminated with dioxin at a concentration of 60 parts per million. This was not discovered until, over a period of years, the deaths of 48 horses, 70 chickens, several dogs, a reds of wild birds was traced to the rea. The animals had merely walked over the oil-soaked earth. A number of people also became ill, but there were no reported deaths.

deaths continued rs after the soil

man was executed by guillotine today for the kidnapping and

- **1999, Belçika da besinlerin PCB ile kontaminasyonu. 40-50 kg PCBs ve 1 g dioksinlerin 500 ton hayvan yemine karışması sözkonusu**

-Tavuklar üzerine etkisi:

- Azalmış yumurta üretimi ve kuluçka

- Tavuk oedema hastalığı

- 2 milyon tavuk yok edildi

-İnsan maruziyetinin tahmini etkileri:

- Yetişkinlerde tahmini 40 ila 8.000 kanser olayının gelişmesi

- Yeni doğan bebeklerde norotoksik ve davranışsal etkilerin görülmesi

- Çalışmalar sürüyor

Viktor Yushchenko

SAĞLIK ETKİLERİ

Dioksinler/Furanlar

- Toksikolojik ve epidemiyolojik çalışmalar (kaza ile maruziyetler)

YÜKSEK DOZ

Klorakne
Karaciğer hasarı
Immunosupresyon
Davranış değişiklikleri
Üreme problemleri
Doğum defektleri
Deney hayvanlarında kanser

DÜŞÜK DOZ

Gelişimsel problemler
(motor hareketler/hafıza)
Immunosupresyon
Endokrin sistem bozulmaları
-Azalmış erkek/kadın doğum oranı
-Azalmış testesteron ve tiroid düzeyleri

NYT 101891

GERMAN STUDY TIES DIOXIN TO CANCER

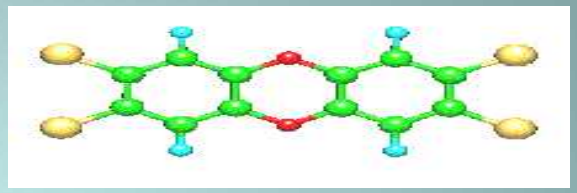
Death Rate Is Found Higher Among Those Exposed to High Level of Chemical

Exposure to high levels of dioxin-laced herbicides substantially increased the rate of cancer deaths among workers at a German chemical plant, a new study has found.

The study, being published in tomorrow's issue of The Lancet, a British medical journal, is the latest round in a continuing debate about the relative toxicity of dioxin, an environmental contaminant. Research has indicated that even small doses cause cancer in laboratory animals. The issue of dioxin toxicity for humans, however, has been hotly contested amid ambiguous or conflicting research results.

International Agency for Research on Cancer

World Health Organization



- **Group 1: *Carcinogenic to humans* :** *(There is sufficient evidence of carcinogenicity in humans. In addition, an agent may be placed in this category if the carcinogenicity data for humans is less than sufficient but there is sufficient evidence of carcinogenicity in experimental animals and strong evidence in exposed humans with an identified mechanism of carcinogenicity)*

  2,3,7,8-Tetrachlorodibenzo-*para*-dioxin

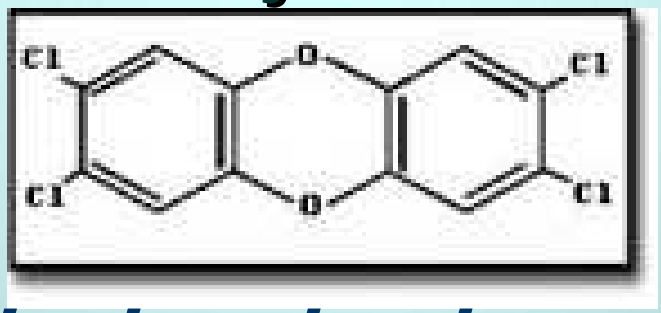
- **Group 3: *Not classifiable as to its carcinogenicity to humans* :** *(The evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals)*

  Polychlorinated dibenzo-*para*-dioxins (other than 2,3,7,8-tetrachlorodibenzo-*para*-dioxin)

  Polychlorinated dibenzofurans

2,3,7,8-Tetraklorodibenzo-p-dioksin ,TCDD,

- En toksik dioksin konjeneri
- Toksisiteyi belirlemekde kullanılan *"toxicity equivalence factors* -Toksik Eşdeğerlik Faktörü (TEFs)" için referans bileşik



-TCDD hayvanlarda pek çok organ için karsinojen. Hedef organlar karaciğer, tiroid, akciğer, deri ve yumuşak dokular.

Toksisitenin Tanımlanması

- 'Toxic Equivalency Factor-Toksik Eşdeğerlik Faktörü" (TEF)
  2,3,7,8-tetraklorodibenzo-p-dioksin (TCDD) ile karşılaştırmalı olarak belirlenmekte

  1 ila 0.00003 arasında değerlendirilmekte
- Çeşitli WHO-TEF, Nordic TEF and international TEF (I-TEF)
- WHO-TEF değerleri bilimsel olarak kabul edilen son değerlerdir (1998,2005)
- Dioxin-benzeri PCBler içinde TEF değerleri belirlenmiştir
- Bireysel Konjenerlerin toksisiteleri additif

Bileşik	WHO 1998 TEF	WHO 2005 TEF
Klorlu dibenzo dioksinler		
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	1	1
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01
OCDD	0.0001	0.0003
Klorlu Dibenzofuranlar		
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	0.03
2,3,4,7,8-PeCDF	0.5	0.3
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.0001	0.0003

Total Toksisite

Toxic Equivalent Quantity -Toksik eşdeğerlik miktarı (**TEQ**)

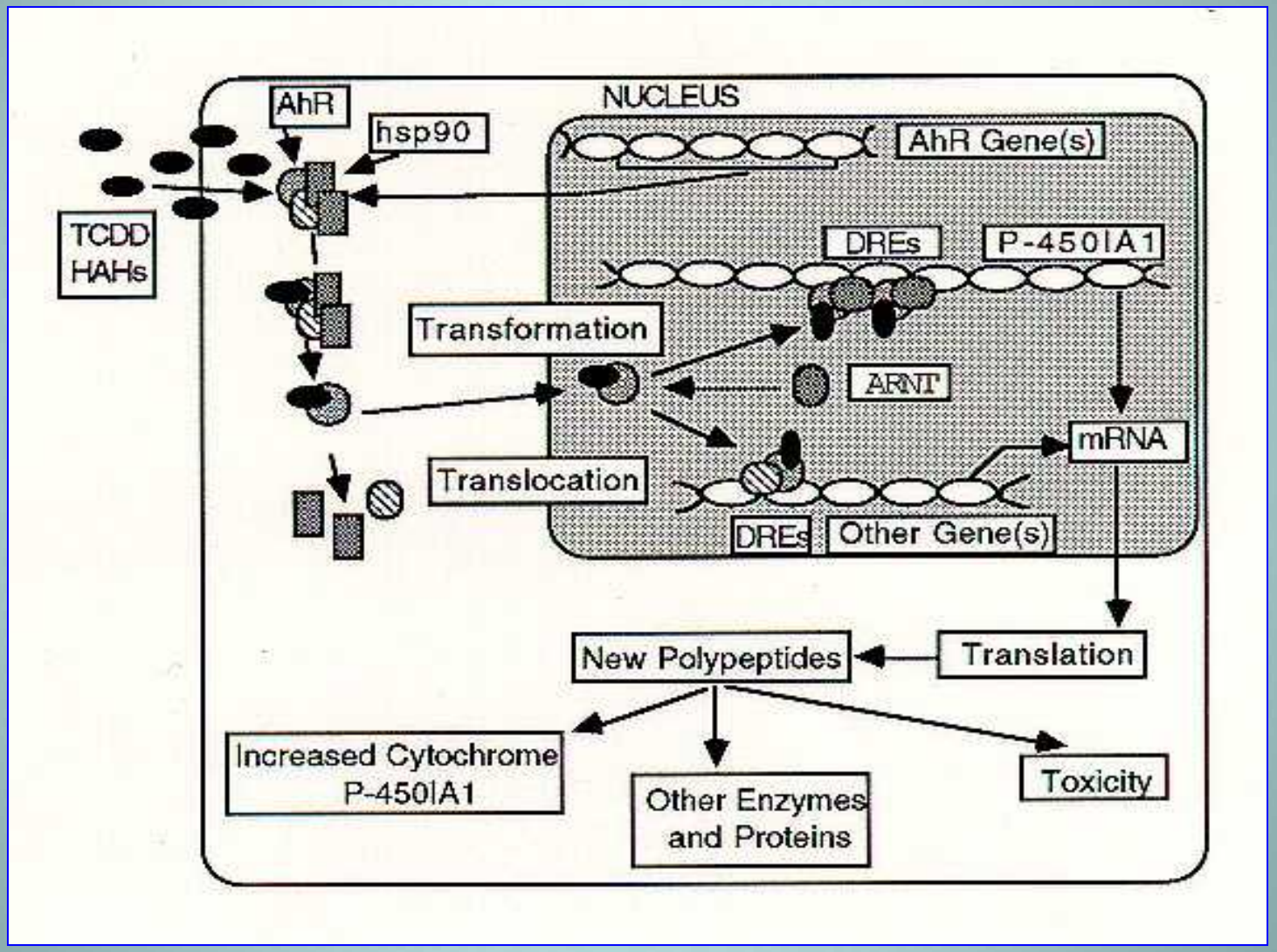
$$TEQ = \sum TEFi * ci$$

$$\mathrm{TEQ} = \sum(\mathrm{PCDD}_i \times \mathrm{TEF}_i) + \sum(\mathrm{PCDF}_i \times \mathrm{TEF}_i) + \sum(\mathrm{PCB}_i \times \mathrm{TEF}_i).$$

ci konjenerin konsantrasyonu

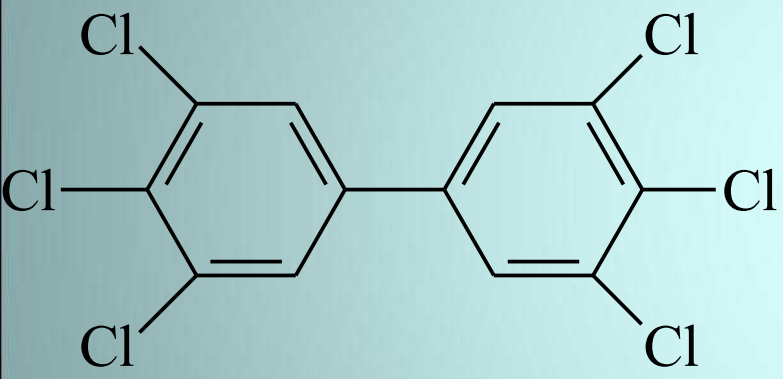
TEF toxic equivalent faktor (WHO)

Biokimyasal etkiler

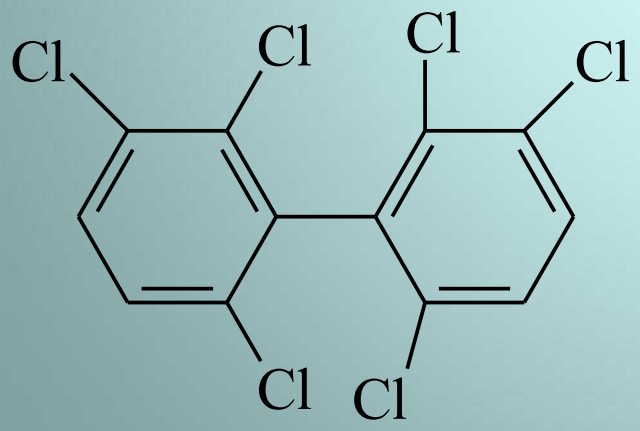


Dioksin-benzeri PCBler

- 1970 lerde toksisite açısından PCBs ile PCDDs ve PCDFs arasında pek çok benzerlikler saptandı.
- "Coplanar" PCBs, veya non-ortho or mono-ortho konjenerler



3,3'4,4',5,5'-hexachlorobiphenyl PCB-169; non-ortho PCB ortho pozisyonunda Cl olmayışı iki halkanın rotasyonu sağlar. Genellikle fazla biyoaktif.



2,2',3,3',6,6'-hexachlorobiphenyl PCB-136; Bütün ortho pozisyonları doldurulmuş. Yapı olarak rigid. Genellikle düşük biyoaktif.

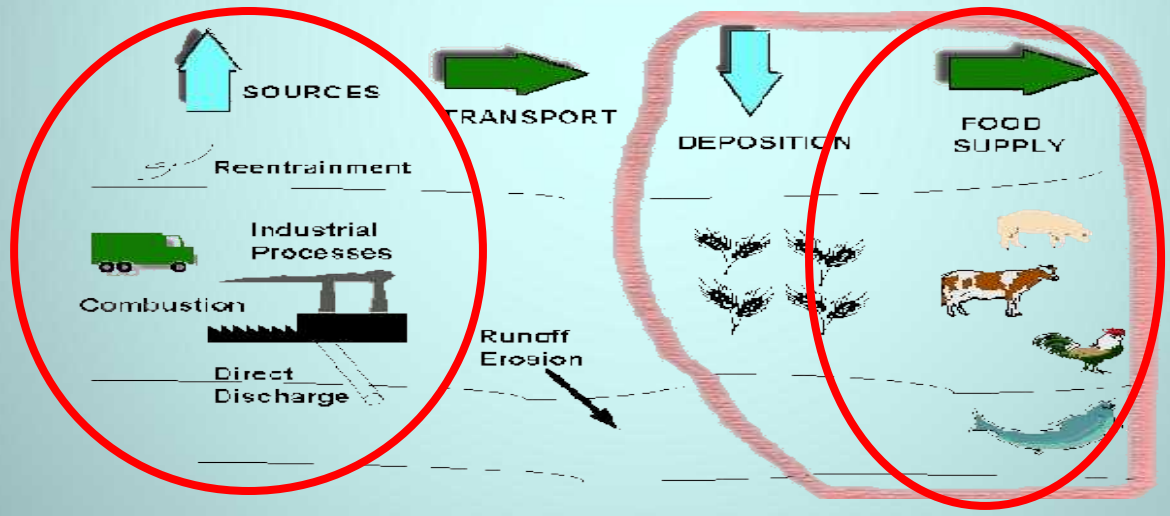
Dioksin-benzeri PCBler

Non-ortho PCBler:	TEF
3,3',4,4'-Tetrachlorobiphenyl (PCB #77)	0.0001
3,4,4',5-Tetrachlorobiphenyl (PCB #81)	0.0003
3,3',4,4',5-Pentachlorobiphenyl (PCB #126)	0.1
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB #169)	0.03
Mono-ortho PCBler:	
2,3,3',4,4'-Pentachlorobiphenyl (PCB #105)	0.00003
2,3,4,4',5-Pentachlorobiphenyl (PCB #114)	0.00003
2,3',4,4',5-Pentachlorobiphenyl (PCB #118)	0.00003
2',3,4,4',5-Pentachlorobiphenyl (PCB #123)	0.00003
2,3,3',4,4',5-Hexachlorobiphenyl (PCB #156)	0.00003
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB #157)	0.00003
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB #167)	0.00003
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB #189)	0.00003

Source:TOXICOLOGICAL SCIENCES 93(2), 223–241 (2006)

PCDDs,PCDFs, PCBs bileşiklerine insan maruziyeti:

- Besinler
- Dermal kontakt
- İçme suyu
- Soluma havası



PCDDs,PCDFs, PCBlere ANA MARUZİYET YOLU : DIYET

PCDD/F, PCBlere ANA MARUZİYET YOLU : DİYET

Et ve et ürünleri, süt ve süt ürünleri,

alık ve diğer deniz ürünleri PCDD/Fs,

CBlere toplam maruziyetin %90 dan

azlasını olustururlar

Table 1
Mean (standard deviation) PCDD/F and dl-PCB concentration for each food group

Food group	Expressed in	N	PCDD/Fs	N	dl-PCBs
Meat and meat products					
Chicken	pg CALUX-TEQ/g fat	76	1.2 (1.18)	53	0.9 (0.69)
Turkey	pg CALUX-TEQ/g fat	11	0.6 (0.30)	8	0.6 (0.21)
Pork	pg CALUX-TEQ/g fat	45	0.7 (2.01)	36	0.6 (0.23)
Beef	pg CALUX-TEQ/g fat	134	1.3 (0.69)	133	1.5 (1.50)
Sheep	pg CALUX-TEQ/g fat	11	3.4 (5.58)	11	1.1 (0.83)
Horse	pg CALUX-TEQ/g fat	13	5.6 (4.10)	8	4.9 (3.26)
Fish and seafood					
Shrimps	pg CALUX-TEQ/g product	16	2.0 (0.67)	15	2.2 (1.35)
Mussels	pg CALUX-TEQ/g product	4	1.7 (0.96)	2	2.2 (0.92)
Lean fish[a]	pg CALUX-TEQ/g product	97	0.8 (0.68)	95	0.9 (0.85)
Herring	pg CALUX-TEQ/g product	15	1.4 (0.39)	15	2.1 (1.56)
Mackerel	pg CALUX-TEQ/g product	2	1.0 (0.64)	2	1.0 (0.75)
Salmon	pg CALUX-TEQ/g product	73	1.0 (0.62)	61	1.2 (0.80)
Eel	pg CALUX-TEQ/g product	12	1.2 (0.61)	10	0.8 (0.58)
Smoked fish	pg CALUX-TEQ/g product	30	0.8 (0.38)	30	1.2 (0.83)
Canned fish	pg CALUX-TEQ/g product	27	0.5 (0.22)	38	0.8 (0.64)
Dairy products					
Cheese	pg CALUX-TEQ/g fat	47	1.4 (0.78)	36	1.1 (0.55)
Milk	pg CALUX-TEQ/g fat	274	1.5 (0.71)	237	1.4 (0.78)
Yoghurt	pg CALUX-TEQ/g fat	6	1.1 (0.50)	6	0.9 (0.43)
Other food groups					
Cereals	pg CALUX-TEQ/g product	4	0.3 (0.17)	2	0.6 (0.02)
Egg	pg CALUX-TEQ/g fat	286	1.0 (0.98)	283	1.0 (1.27)
Added fats[b]	pg CALUX-TEQ/g fat	77	0.8 (0.51)	36	1.2 (0.74)

[a] Lean fish: cod, plaice, ray, sole, Nile perch, whiting, anglerfish and turbot.
[b] Added fats: spreads, baking and frying fat.

U.S. Urged to Educate Women About Foods Linked to Dioxin

By ELIZABETH OLSON

WASHINGTON, July 1 — The government should encourage women and girls to reduce the amount of meat, whole milk and other fatty foods they eat as a way of protecting themselves and their offspring from dioxins, harmful residues of natural and industrial combustion, an expert panel said today.

A report by the Institute of Medicine, a nonprofit health policy advisory body, recommended that the government do more to educate women and girls about how to limit consumption of dioxins, which can be passed through the placenta to a fetus or through breast milk to an infant.

Dioxin has been linked to cancer and other health problems. Since its health dangers were recognized in the 1970's, levels of dioxins and related chemical compounds have dropped, according to a report this week by the Environmental Protection Agency. But the pollutants linger in the environment and lodge in the fatty tissue of farm animals which eat grass or contaminated feed.

The most direct way to reduce intake of these chemicals, the expert panel said, is to reduce "consumption of dietary fat, especially from animal sources that are known to contain higher levels of these compounds." This includes meat and whole milk, products that Department of Agriculture dietary guidelines include as saturated fats. Current guidelines recommend they be restricted to no more than 10 percent of a person's daily diet.

Dioxin is particularly worrisome for women, who can accumulate it in their bodies for years and then pass it on to their unborn children or nursing infants.

The panel said the government ought to try to "reduce girls' and women's exposure to dioxins in foods during the years well before childbearing, so that less of these compounds accumulate in their bodies." The panel suggested that "government-sponsored food programs such as the National School Lunch Program should increase the availability of foods low in animal fat." That would include low-fat and skim milk, instead of the whole milk now provided to millions of children. This is also recommended for participants in the Special Supplement Food Program for Women, Infants and Children, except for children younger than 2 years.

The 16-member panel held off setting any level for dioxin intake. The panel's chairman, Dr. Robert S. Lawrence, associate dean of the Bloomberg School of Public Health at Johns Hopkins University in Baltimore, said that current test costs made it too expensive to measure the levels in food. Instead, the panel urged healthier eating while data is collected to clarify the health risks.

NYT July 2nd 2003

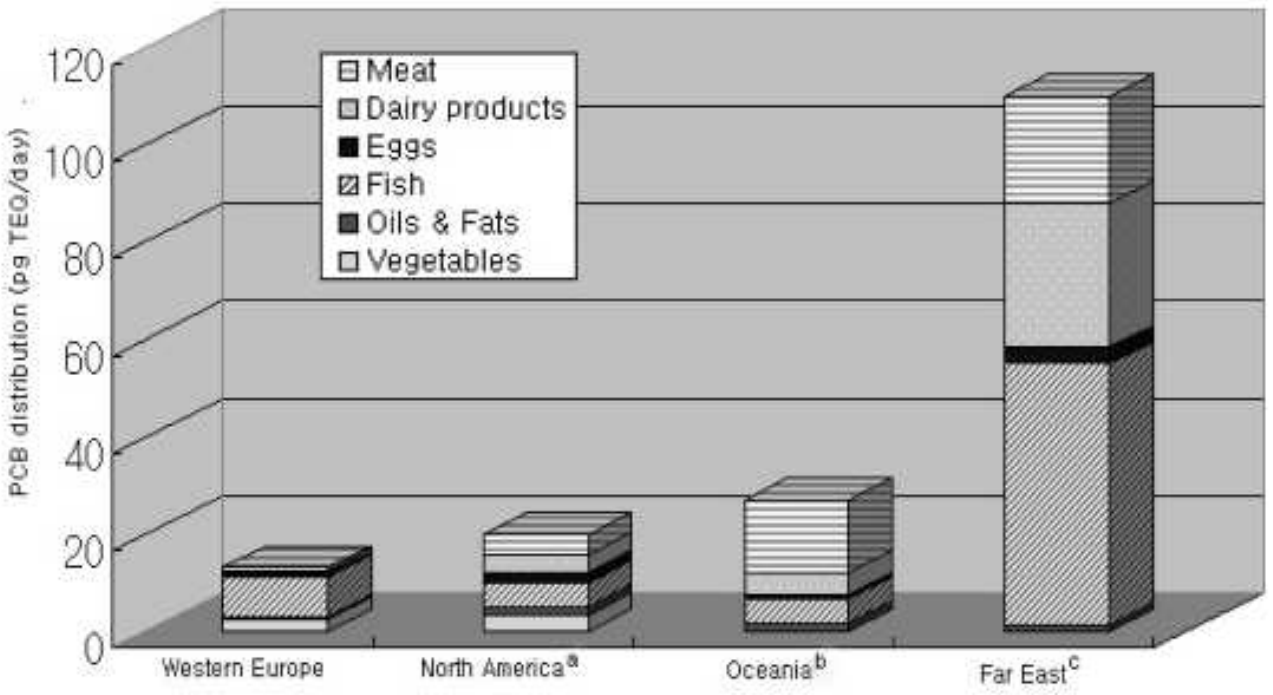


Figure 2: Estimated intake of PCBs in regional diets (pg TEQ/day) (14); [a]North America, data from USA & Canada; [b]Oceania, data from New Zealand; [c]Far east, data from Japan.

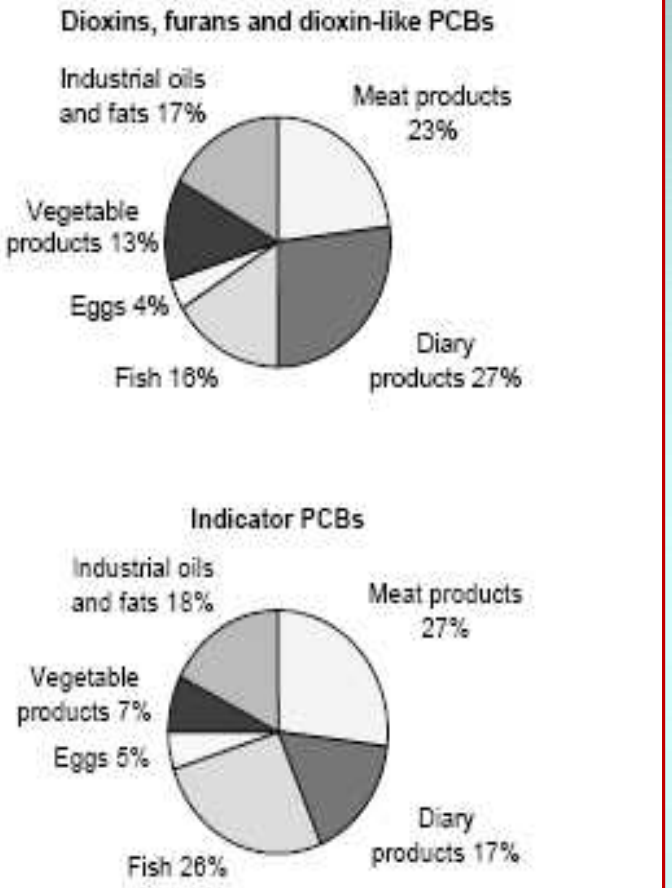
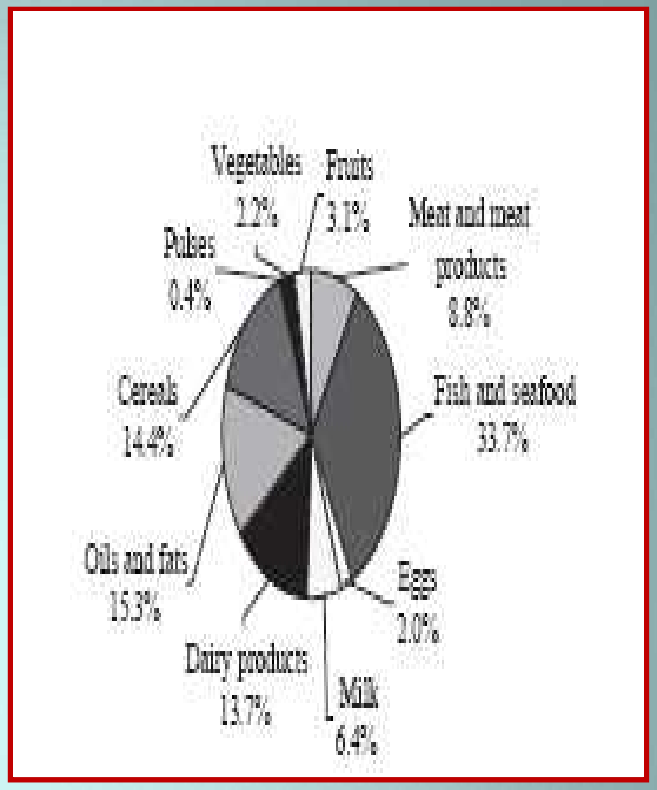


Fig. 2. Estimated average contribution of food groups (%) to the intake of dioxins, furans and dioxin-like PCBs (upper panel), and indicator PCBs (lower panel) in the Dutch population.

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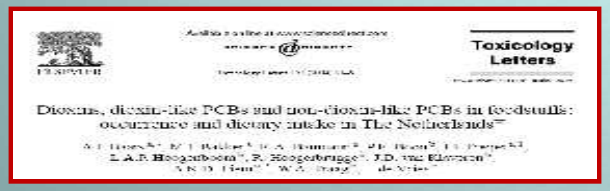
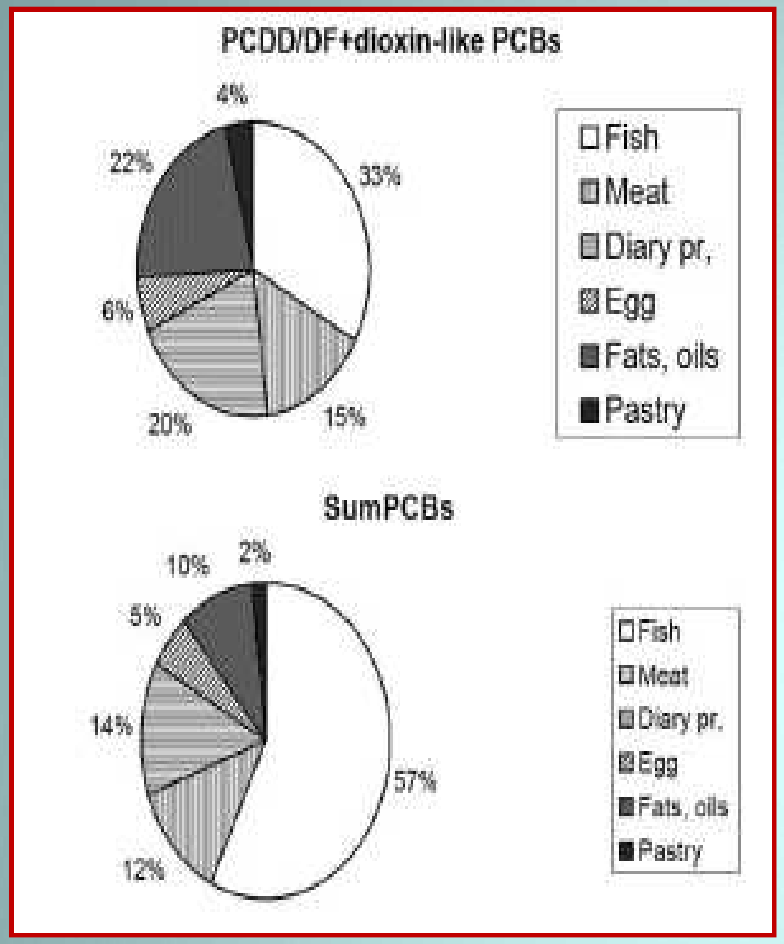
Daily intake of polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (PCDD/PCDFs) in foodstuffs consumed in Tarragona, Spain: a review of recent studies (2001–2003) on human PCDD/PCDF exposure through the diet

Ana Bocio and Jose L. Domingo*


Toxicology Letters

Dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs: occurrence and dietary intake in The Netherlands



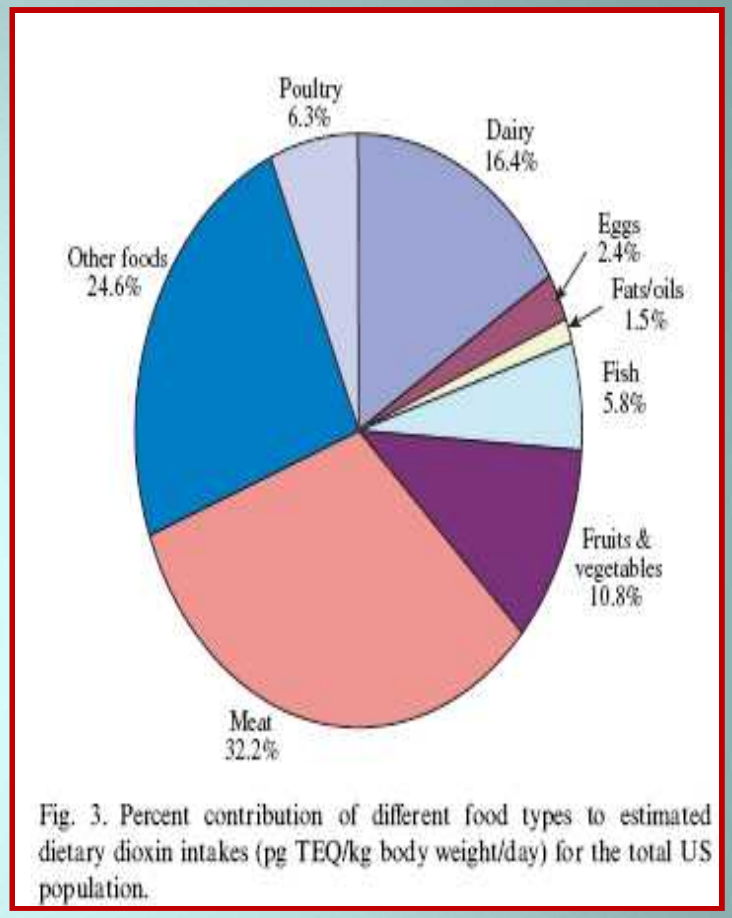
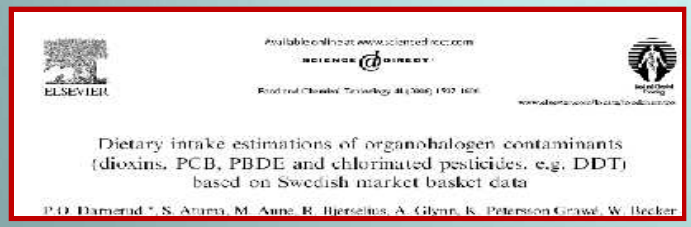
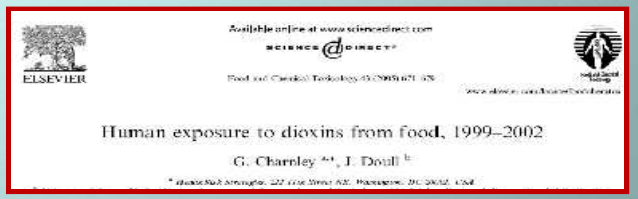


Fig. 3. Percent contribution of different food types to estimated dietary dioxin intakes (pg TEQ/kg body weight/day) for the total US population.





Anne Sütü

- PCBs ve PCDD/Fların konsantrasyonu annenin yağ dokusu,serum lipitleri ve anne sütündeki yağda yaklaşık aynı düzeydedir
- Anne sütü ile vucuttaki PCBs ve PCDD/Fların %25'i atılmaktadır
- Fakat çok daha kücük bir vücutta konsantre olmaktadır
- Anne sütü ile alım minimize edilmelidir
- 6 ay boyunca anne sütü alımı 25 yaşına kadar alınacak kümülatif dioksinlerin %12-14 ünü sağlamaktadır.

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Chemosphere 66 (2007) 1955–1961

CHEMOSPHERE

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Concentration of polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans and dioxin-like PCBs in human adipose tissue from Turkish men

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Received 14 December 2005; received in revised form 28 June 2006; accepted 26 July 2006
Available online 8 September 2006

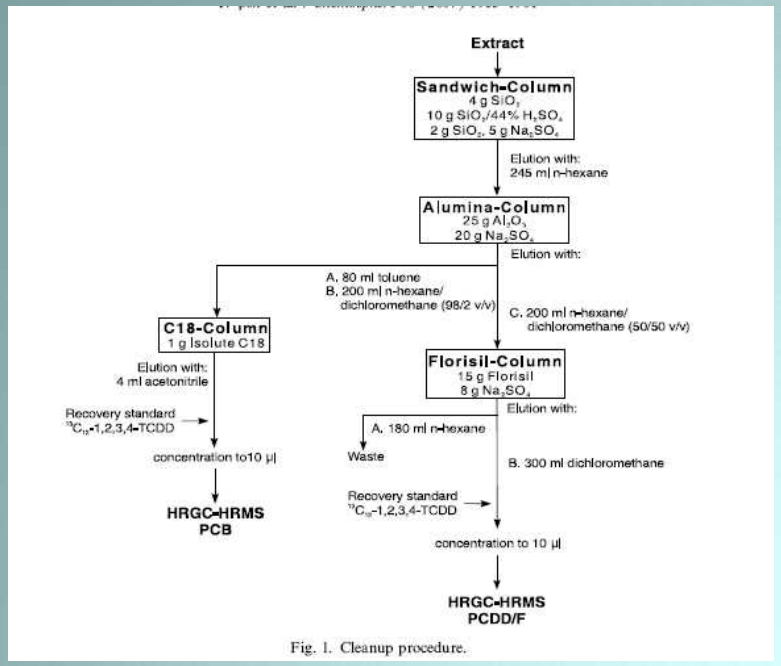

Fig. 1. Cleanup procedure.

Table 1
Individual PCDD/F and dioxin-like PCB concentrations (pg/g lipid) in adipose tissue from subjects living in Ankara (Turkey)

Sample	Sex	Age	$WHO_{PCDD/F}$-TEQ	WHO_{total}-TEQ
1	M	32	10.2	13.2
2	M	29	4.0	6.8
3	M	22	7.6	11.4
4	M	42	5.2	8.4
5	M	31	9.4	16.3
6	M	40	12.1	19.7
7	M	34	3.2	5.4
8	M	40	7.3	15.8
9	M	34	3.9	6.1
10	M	45	5.8	13.0
11	M	21	4.3	10.2
12	M	32	11.3	22.3
13	M	39	19.7	28.6
14	M	32	10.0	12.8
15	M	39	11.9	23.2
16	M	40	18.2	42.7
17	M	35	11.4	34.1
18	M	25	6.3	10.4
19	M	36	11.6	16.0
20	M	38	3.7	5.3
21	M	44	16.3	23.6
22	M	39	17.4	26.1
23	M	39	4.7	7.5

Isomers	*n*	Concentration (pg/g) lipid mean	Minimum	Maximum	SD	Frequency of determination (%)	TEFs
Dioxin congeners							
2,3,7,8-Tetrachlorobenzo-*p*-dioxin	23	1.2	n.d	3.0	0.7	87	1
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin	23	2.73	0.9	6.1	1.43	100	1
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin	23	1.4	n.d	5.3	1.0	87	0.1
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin	23	3.2	1.5	5.7	1.1	100	0.1
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin	23	0.4	n.d	0.9	0.21	82.61	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin	23	4.6	2.6	9.9	2.0	100	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin	23	33.4	11.7	64.8	11.4	100	0.0001
Furan congeners							
2,3,7,8-Tetrachlorodibenzofuran	23	0.6	n.d	2.4	0.5	78.26	0.1
1,2,3,7,8-Pentachlorodibenzofuran	23	0.5	n.d	0.9	0.24	91.3	0.05
2,3,4,7,8-Pentachlorodibenzofuran	23	8.0	2.4	19.0	4.9	100	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	23	2.7	0.7	7.3	1.7	100	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	23	2.7	0.3	6.8	1.7	100	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	23	0.3	n.d	0.7	0.18	34.78	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	23	3.1	1.2	8.6	1.6	100	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	23	5.7	1.2	47.9	9.8	100	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	23	0.7	n.d	0.9	0.2	13.04	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	23	2.1	0.5	6.0	1.3	100	0.0001
Non-ortho PCB:							
3,3′,4,4′-Tetrachlorobiphenyl (PCB #77)	23	33.2	10.5	72.5	19.2	100	0.0001
3,4,4′,5-Tetrachlorobiphenyl (PCB #81)	23	7.9	n.d	39.4	9.6	91.3	0.0001
3,3′,4,4′,5-Pentachlorobiphenyl (PCB #126)	23	32.3	8.6	39.4	24.4	100	0.1
3,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB #169)	23	36.0	9.2	91.8	21.5	100	0.01
Mono-ortho PCB:							
2,3,3′,4,4′-Pentachlorobiphenyl (PCB #105)	23	1605	334	7270	1497	100	0.0001
2,3,4,4′,5-Pentachlorobiphenyl (PCB #114)	23	372	76	1360	296	100	0.0005
2,3′,4,4′,5-Pentachlorobiphenyl (PCB #118)	23	6359	1223	28182	5745	100	0.0001
2′,3,4,4′,5-Pentachlorobiphenyl (PCB #123)	23	66.7	n.d	381	77	91.3	0.0001
2,3,3′,4,4′,5-Hexachlorobiphenyl (PCB #156)	23	3423	691	12095	2697	100	0.0005
2,3,3′,4,4′,5′-Hexachlorobiphenyl (PCB #157)	23	623	123	2446	534	100	0.0005
2,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB #167)	23	924	160	4303	901	100	0.00001
2,3,3′,4,4′,5,5′-Heptachlorobiphenyl (PCB #189)		477	97	1618	396	100	0.0001
$WHO_{PCDD/F}$-TEQ		9.2			4.9		
ΣTEQ (WHO, 1998, Humans)		16.14			7.2		

Country	n	Year of Sampling	Mean age of Subjects	WHO $_{PCDD/F}$-TEQ (mean,pg/g fat)	WHO $_{PCB}$-TEQ (mean,pg/g fat)	References
France	**16**	**1999**	**53**	**35.63***	**--**	**Arfi et al, 2001**
Spain	**15**	**2002**	**58**	**11.03**	**10.8 *(PCB 77,126,169)***	**Schuhmacher et al., 2004**
Finland	**420**	**1997-98**	**44**	**29**	**20.7 *(PCB 77,126,169)***	**Kiviranta et al., 2005**
Sweden	**28**	**Not reported**	**68**	**32.8**	**--**	**Wingfors et al., 2000**
Korea	**32**	**1994-95**	**53**	**18***	**--**	**Kang et al.,1997**
Germany	**139**	**1996**	**37**	**16.1**	**--**	**Papke, 1998**
Japan	**10**	**2000**	**Not reported**	**11.9**	**15.3 *(PCB 77, 81, 126, 169, 105, 114, 118,123, 156, 157,167, 189)***	**Choi et al.,2002**
USA	**28**	**1984-86**	**Not reported**	**9.5***	**14.19 *(PCB 77, 81, 126, 169)***	**Paterson et al,1994**
India	**21**	**2000**	**20-69**	**14-56**	**14.4 *(PCB 77, 81, 126, 169, 105, 114, 118, 123, 156, 157,167, 189)***	**Kumar et al.,2001**
Italy	**9**	**Not reported**	**Not reported**	**2.81-13.2****	**--**	**Baldassarri et al., 2002**
Turkey	**23**	**2004**	**36**	**9.2**	**6.6 *(PCB 77, 81, 126, 169, 105, 114, 118,123, 156, 157,167, 189)***	**Çok et., 2007**

Arch Environ Contam Toxicol (2008) 55:143–152
DOI 10.1007/s00244-007-9094-1

Concentrations of Polychlorinated Dibenzo-*p*-Dioxins (PCDDs), Polychlorinated Dibenzofurans (PCDFs), and Dioxin-Like PCBs in Adipose Tissue of Infertile Men

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Haziran 2003-Eylül 2005, adipoz doku
23 fertil 22 infertil erkek, Ankara

Table 1 WHO_{total}-TEQ concentrations in adipose tissue of fertile and infertile men in pg/g fat

Sample	Fertile				Infertile			
	Sex	Age	$WHO_{PCDD/F}$-TEQ (WHO 2005)	WHO_{total}-TEQ (WHO 2005)	Sex	Age	$WHO_{PCDD/F}$-TEQ (WHO 2005)	WHO_{total}-TEQ (WHO 2005)
1	M	32	8.6	10.9	M	33	8.7	10.6
2	M	29	3.5	5.7	M	35	8.4	10.3
3	M	22	6.5	9.1	M	25	9.6	12.7
4	M	42	4.6	8.4	M	40	7.3	11.4
5	M	31	7.5	11.9	M	33	10.2	14.7
6	M	40	9.4	15.1	M	42	5.3	6.8
7	M	34	3.0	4.8	M	31	6.6	9.6
8	M	40	6.0	12.2	M	28	2.8	4.7
9	M	34	3.4	5.2	M	50	8.8	11.1
10	M	45	4.7	9.8	M	38	9.1	12.7
11	M	21	3.5	7.0	M	43	8.3	10.9
12	M	32	9.5	17.0	M	27	5.3	7.8
13	M	39	15.8	22.5	M	36	17.2	22.3
14	M	32	8.0	10.5	M	38	8.7	11.6
15	M	39	9.6	17.5	M	33	6.0	8.2
16	M	40	15.1	31.5	M	27	5.7	7.9
17	M	35	9.2	18.2	M	34	4.1	5.2
18	M	25	5.3	8.6	M	25	5.5	7.8
19	M	36	9.4	12.8	M	40	4.9	6.4
20	M	38	3.2	4.4	M	26	3.2	4.2
21	M	44	13.2	18.3	M	27	4.4	5.5
22	M	39	14.4	20.7	M	32	3.9	5.0
23	M	39	4.0	6.2				
		35.1 ± 6.5	7.2 ± 3.9	12.5 ± 6.6		33.8 ± 6.5	7.0 ± 3.1	9.4 ± 4.0

WHO, World Health Organization; TEQ, toxicity equivalency

Isomers	TEFs	Fertile					Infertile					*p* value*
		n	Conc.(pg/g) lipid mean ± SD	Min	Max	% > DL	*n*	Conc.(pg/g) lipid mean ± SD	Min	Max	% > DL	
Dioxin congeners												
2,3,7,8-Tetrachlorobenzo-*p*-dioxin	1	23	1.2 ± 0.7	n.d	3.0	82.6	22	1.4 ± 1.3	n.d	5.2	100	0.52
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin	1	23	2.73 ± 1.43	0.9	6.1	100	22	2.1 ± 1.4	n.d	5.2	86.4	0.14
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin	0.1	23	1.4 ± 1.0	n.d	5.3	87	22	1.1 ± 1.5	n.d	5.6	50	0.43
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin	0.1	23	3.2 ± 1.1	1.5	5.7	100	22	3.8 ± 2.0	n.d	8.7	95.5	0.22
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin	0.1	23	0.4 ± 0.21	n.d	0.9	78.3	22	0.6 ± 1.9	n.d	8.5	18.2	0.62
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	23	4.6 ± 2.0	2.6	9.9	100	22	6.5 ± 4.4	2.9	23.9	100	0.067
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin	0.0003	23	33.4 ± 11.4	11.7	64.8	100	22	41.77 ± 22.86	21.2	131.0	100	0.125
Furan congeners												
2,3,7,8-Tetrachlorodibenzofuran	0.1	23	0.6 ± 0.5	n.d	2.4	78.3	22	1.4 ± 1.1	n.d	3.0	72.7	0.0029
1,2,3,7,8-Pentachlorodibenzofuran	0.03	23	0.5 ± 0.24	n.d	0.9	91.3	22	0.42 ± 0.4	n.d	1.5	59	0.418
2,3,4,7,8-Pentachlorodibenzofuran	0.3	23	8.0 ± 4.9	2.4	19.0	100	22	6.2 ± 3.8	2.4	19.2	95.5	0.177
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	23	2.7 ± 1.7	0.7	7.3	100	22	2.4 ± 1.5	n.d	7.5	95.5	0.53
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	23	2.7 ± 1.7	0.3	6.8	100	22	2.1 ± 1.2	n.d	5.5	95.5	0.18
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	23	0.1 ± 0.18	n.d	0.7	34.8	22	0.0 ± 0.0	n.d	n.d	0.0	
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	23	3.1 ± 1.6	1.2	8.6	100	22	3.4 ± 2.1	1.0	8.2	100	0.59
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	23	5.7 ± 9.8	1.2	47.9	100	22	4.9 ± 3.2	1.6	13.3	100	0.717
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	23	0.7 ± 0.2	n.d	0.9	13.0	22	0.0 ± 0.1	n.d	0.27	4.5	0.0001
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0003	23	2.1 ± 1.3	0.5	6.0	100	20	4.3 ± 3.6	0.91	13.1	100	0.01
Non-ortho PCBs												
3,3',4,4'-Tetrachlorobiphenyl (PCB #77)	0.0001	23	33.2 ± 19.2	10.5	72.5	100	22	13.03 ± 10.3	4.5	43.6	100	0.0001
3,4,4',5-Tetrachlorobiphenyl (PCB #81)	0.0003	23	7.9 ± 9.6	n.d	39.4	91.3	22	2.61 ± 2.4	n.d	9.8	100	0.016
3,3',4,4',5-Pentachlorobiphenyl (PCB #126)	0.1	23	32.3 ± 24.4	8.6	39.4	100	22	17.1 ± 8.2	7.0	35.5	100	0.008
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB #169)	0.03	23	36.0 ± 21.5	9.2	91.8	100	22	18.50 ± 8.5	7.9	40.2	100	0.0009
Mono-ortho PCBs												
2,3,3',4,4'-Pentachlorobiphenyl (PCB #105)	0.00003	23	1605 ± 1497	334	7270	100	22	715.82 ± 405.6	294	1853	100	0.01
2,3,4,4',5-Pentachlorobiphenyl (PCB #114)	0.00003	23	372 ± 296	76	1360	100	22	133.0 ± 83.8	61.8	392	100	0.0007
2,3',4,4',5-Pentachlorobiphenyl (PCB #118)	0.00003	23	6359 ± 5745	1223	28182	100	22	2303.86 ± 1232.6	802	4987	100	0.0023
2',3,4,4',5-Pentachlorobiphenyl (PCB #123)	0.00003	23	66.7 ± 77	n.d	381	91.3	22	35.84 ± 19.07	13.9	80.5	100	0.075
2,3,3',4,4',5-Hexachlorobiphenyl (PCB #156)	0.00003	23	3423 ± 2697	691	12095	100	22	1119.27 ± 629.7	321	2173	100	0.0003
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB #157)	0.00003	23	623 ± 534	123	2446	100	22	222.77 ± 123.7	81	453	100	0.0014
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB #167)	0.00003	23	924 ± 901	160	4303	100	22	292.27 ± 155.44	99	633	100	0.0023
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB #189)	0.00003	23	477 ± 396	97	1618	100	22	142.63 ± 83.6	49.2	314	100	0.0004
WHO $_{PCDD/F}$-TEQ			7.2 ± 3.9					7.0 ± 3.1				0.85
ΣTEQ (WHO 2005, Humans)			12.5 ± 6.6					9.4 ± 4.0				0.065

PCDDs, polychlorinated dibenzo-*p*-dioxins; PCDFs, polychlorinated dibenzofurans; PCBs, polychlorinated biphenyls; DL, detection limit; TEFs, toxic equivalency factors; WHO, World Health Organization; TEQ, toxicity equivalency

Table 4
A summary of recent (current decade) investigations on PCDD/F levels in human adipose tissue from different countries.

Country (region)	Year of collection	Number of samples	PCDD/F (mean, pg WHO-TEQ/g fat)	Mean age (range)	Reference
Japan	1998, 1999	12 Women, 16 men	49.0 (TEF-1998)	63 (17–87)	Takenaka et al. (2002)
Spain (Tarragona County)	2002	4 Women, 11 men	9.9	58 (19–94)	Schuhmacher et al. (2004a)
Southern Finland	1997–1999	420 (51% Females)	29.0	44 (13–81)	Kiviranta et al. (2005)
Japan (Kansai area)	Not reported	20 (Nursing mothers)	16.0	(24–37)	Suzuki et al. (2005)
Turkey (Ankara)	2004	23 Fertile and 22 infertile men	7.2 (fertile) and 7.0 (infertile)	35 (21–45)	Cok et al. (2007, 2008)
Italy	Not reported	9 (Obese subjects)	9.5	n.a.	La Rocca et al. (2008)
Southern Spain (Granada)	2003	20 Women	19.6	60 (24–81)	López-Espinosa et al. (2008)
Spain (Tarragona County)	2007	4 Women, 11 men	14.6	53 (28–83)	This study

n.a.: non available data.

Chemosphere 76 (2009) 1563–1571

Contents lists available at ScienceDirect

Chemosphere

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Polychlorinated dibenzo-p-dioxins, dibenzofurans and polychlorinated biphenyls levels in human breast milk from different regions of Turkey

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Mart-Eylül 2007, 51 anne sütü örneği
Istanbul (n = 13),
Ankara(n = 4),
Afyon (n = 15),
Antalya (n = 9),
Kahramanmaras (n = 10)

Table 2
Concentrations of PCDD and PCDF congeners in human milk samples from five different cities of Turkey (pg g^{-1} lipid).

Congeners	Istanbul (n = 13)		Afyon (n = 15)		K.Maraş (n = 10)		Antalya (n = 9)		Ankara (n = 4)	
	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max
PCDD congeners										
2,3,7,8-Tetrachlorobenzo-p-dioxin	0.29 ± 0.50	0.0–0.9	0.41 ± 0.79	0.0–2.6	0.23 ± 0.73	0.0–2.3	1.1 ± 1.85	0.0–5.8	0.46 ± 0.48	0.0–1.1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.95 ± 1.98	0.0–6.8	0.69 ± 0.89	0.0–2.2	0.64 ± 1.35	0.0–3.4	0.93 ± 1.07	0.0–2.6	0.88 ± 0.91	0.0–2.1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.21 ± 2.96	0.0–8.2	1.10 ± 1.64	0.0–4.3	1.80 ± 2.72	0.0–7.0	5.8 ± 7.4	0.0–24.1	4.2 ± 4.7	0.0–12.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.2 ± 3.56	0.0–9.9	1.41 ± 1.72	0.0–5.0	1.67 ± 2.5	0.0–7.3	5.5 ± 5.8	0.0–18.7	4.2 ± 3.1	0.0–9.5
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.08 ± 1.85	0.0–6.2	0.54 ± 1.20	0.0–3.5	0.23 ± 0.73	0.0–2.3	0.82 ± 1.91	0.0–6.1	0.85 ± 0.92	0.0–2.2
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	22.8 ± 32.4	0.0–115	7.8 ± 11.4	0.0–31.4	107.8 ± 242.2	0.0–786	38.81 ± 49.7	0.00–132	12.15 ± 15.1	1.3–34
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	61.2 ± 70.0	7.8–255	21.9 ± 25.1	0.0–86.2	180.1 ± 388.6	2.5–1274	92.8 ± 102.7	7.4–295	45.3 ± 53.9	12.6–126
WHO-TEQ (PCDD)	2.11 ± 0.71		1.49 ± 0.66		2.34 ± 0.99		3.64 ± 1.37		2.34 ± 0.68	
PCDF congeners										
2,3,7,8-Tetrachlorodibenzofuran	0.32 ± 0.68	0.0–2.4	0.43 ± 0.84	0.0–2.8	0.34 ± 0.88	0.0–2.8	0.42 ± 0.63	0.0–1.8	0.30 ± 0.31	0.0–0.7
1,2,3,7,8-Pentachlorodibenzofuran	0.29 ± 0.65	0.0–2.3	0.25 ± 0.38	0.0–1.0	0.60 ± 0.86	0.0–2.2	0.72 ± 0.70	0.0–1.9	0.55 ± 0.44	0.0–1.2
2,3,4,7,8-Pentachlorodibenzofuran	4.9 ± 2.9	1.6–11.2	4.9 ± 2.3	1.3–9.8	5.9 ± 5.2	1.0–19.7	8.2 ± 4.4	4.8–18.8	6.0 ± 2.6	3.3–9.0
1,2,3,4,7,8-Hexachlorodibenzofuran	6.1 ± 8.0	0.8–29	2.9 ± 1.9	0.75–7.2	6.1 ± 5.2	0.0–16.3	12.1 ± 15.6	2.0–49	3.9 ± 2.7	1.6–7.6
1,2,3,6,7,8-Hexachlorodibenzofuran	4.7 ± 5.5	0.6–17.2	2.9 ± 1.8	0.8–6.3	4.4 ± 3.4	0.0–10.8	8.2 ± 8.0	1.3–25.7	4.0 ± 3.2	1.2–8.6
1,2,3,7,8,9-Hexachlorodibenzofuran	0.0 ± 0.0	0.0–0.0	0.0 ± 0.0	0.0–0.0	0.0 ± 0.0	0.0–0.0	0.0 ± 0.0	0.0–0.0	0.0 ± 0.0	0.0–0.0
2,3,4,6,7,8-Hexachlorodibenzofuran	6.1 ± 8.0	0.0–24.0	2.3 ± 3.0	0.0–9.6	5.3 ± 5.6	0.0–17.4	11.9 ± 15.0	1.3–42.6	4.6 ± 6.5	0.0–14.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	31.6 ± 45.6	0.4–155	10.9 ± 17.3	0.0–46.3	25.0 ± 25.7	0.0–80.3	57.1 ± 78.3	0.8–218	17.2 ± 22.6	1.7–50.0
1,2,3,4,7,8,9-Heptachlorodibenzofuran	5.10 ± 6.31	0.0–19.1	1.49 ± 3.47	0.0–10.8	6.3 ± 7.8	0.0–21.6	9.80 ± 12.7	0.0–37.1	3.3 ± 4.0	0.0–9.8
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	25.9 ± 38.4	0.0–126	7.5 ± 14.7	0.0–37.8	20.2 ± 21.1	0.0–67.0	47.8 ± 63.3	0.0–183	14.8 ± 19.2	0.0–42.7
WHO-TEQ (PCDF)	4.56 ± 1.71		3.44 ± 0.71		4.91 ± 1.85		8.07 ± 1.19		4.51 ± 0.97	
WHO-TEQ (PCDD/F)	6.67 ± 5.96		4.93 ± 2.42		7.24 ± 6.64		11.72 ± 8.56		6.85 ± 3.52	
WHO-TEQ (PCDD/F + PCB)	9.72 ± 1.81		6.81 ± 1.52		10.53 ± 1.98		15.63 ± 3.91		10.25 ± 1.73	

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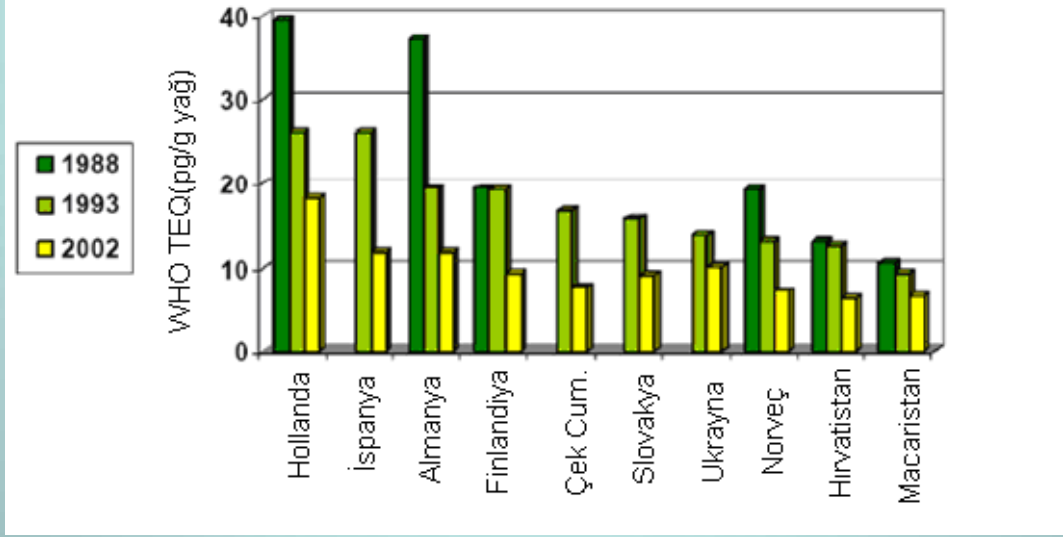
Table 3
Concentrations of indicator PCB and dioxin-like PCB in human milk samples from five different cities of Turkey (pg g^{-1} lipid).

Congeners	Istanbul (n = 13)		Afyon (n = 15)		K.Maraş (n = 10)		Antalya (n = 9)		Ankara (n = 4)	
	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max	Congeners (pg g^{-1}) lipid mean ± sd	Min–max
Indicator PCBs										
2,4,4′/2,5,4′-Trichlorobiphenyl (PCB #28)	1422 ± 1130	571–4631	1305 ± 607	489–2978	3025 ± 1913	147–7899	1503 ± 603	738–2288	1389 ± 549	618–1899
2,2′,5,5′-Tetrachlorobiphenyl (PCB #52)	294 ± 1004	89.7–1004	191 ± 90	90.2–371	301 ± 178	71.2–693	626 ± 679	110–2061	219 ± 141	79.8–383
2,2′,4,5,5′-Pentachlorobiphenyl (PCB #101)	428 ± 319	156–1262	277 ± 120	121–466	336 ± 228	67.2–847	786 ± 575	204–1562	362 ± 209	198–664
2,2′,3,4,4′,5′-Hexachlorobiphenyl (PCB #138)	4355 ± 3575	1325–14764	3192 ± 1412	1553–6478	1924 ± 1411	309–5336	5683 ± 4210	2361–12789	4575 ± 717	3722–5269
2,2′,4,4′,5,5′-Hexachlorobiphenyl (PCB #153)	8562 ± 6930	2371–28070	5630 ± 2431	2567–11052	3441 ± 2369	623–8831	11039 ± 9341	4093–30694	8293 ± 1617	6366–10225
2,2′,3,4,4′,5,5′-Heptachlorobiphenyl (PCB #180)	4401 ± 3565	846–14178	2352 ± 1054	995–4535	1671 ± 1151	277–4258	5401 ± 5681	2014–19444	3821 ± 1112	2390–5080
Sum of Indicator PCBs	19462 ± 2910		12947 ± 1884		10698 ± 1198		25038 ± 3699		18659 ± 2840	
Non-ortho PCBs										
3,3′,4,4′-Tetrachlorobiphenyl (PCB #77)	30.9 ± 23.1	8.2–76.1	21.3 ± 10.5	4.6–38.2	30.4 ± 40.9	2.7–138	43.3 ± 29.9	4.0–88.2	14.6 ± 0.5	10.5–20.0
3,4,4′,5-Tetrachlorobiphenyl (PCB #81)	3.78 ± 4.3	0.0–15.9	1.6 ± 1.4	0.0–4.2	5.5 ± 7.2	0.0–23.9	4.7 ± 3.6	0.0–12.3	3.7 ± 0.24	1.4–6.8
3,3′,4,4′,5-Pentachlorobiphenyl (PCB #126)	20.4 ± 19.9	8.8–85	12.1 ± 8.0	0.0–32.2	27.2 ± 14.7	8.4–52.2	25.0 ± 9.5	13.5–40.8	24.1 ± 4.9	15.1–31.1
3,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB #169)	11.4 ± 6.93	3.6–29.2	5.8 ± 3.3	0.0–11.3	12.4 ± 9.6	0.0–33.2	15.4 ± 13.1	5.5–46.9	11.4 ± 1.7	9.8–14.1
WHO-TEQ (non-ortho PCB)	2.16 ± 0.87		1.27 ± 0.52		2.85 ± 1.16		2.66 ± 1.06		2.53 ± 1.03	
Mono-ortho PCBs										
2,3,3′,4,4′-Pentachlorobiphenyl (PCB #105)	746.7 ± 615.8	308–2228	595.9 ± 268.8	286–1261	443.5 ± 201.6	132–875	974.9 ± 688.1	431–2630	883 ± 0.18	712–1163
2,3,4,4′,5-Pentachlorobiphenyl (PCB #114)	169.3 ± 143.5	51.7–485	116.7 ± 48.8	51.2–223	84.6 ± 44.1	15.9–178	221.2 ± 198.7	84.8–674	154.3 ± 1.6	138–189
2,3′,4,4′,5-Pentachlorobiphenyl (PCB #118)	2264 ± 1777	783–6554	1742 ± 783	833–3561	1220 ± 739	280–2937	3000 ± 2291	1192–8367	2600 ± 9.8	2004–3377
2′,3,4,4′,5-Pentachlorobiphenyl (PCB #123)	49.3 ± 37.8	19.4–134	46.8 ± 30.7	18.2–125	28.6 ± 21.9	0.0–60.9	61.1 ± 33.3	26–137	55.7 ± 0.2	39.4–76.9
2,3,3′,4,4′,5-Hexachlorobiphenyl (PCB #156)	810 ± 635	197–2462	499 ± 225	193–1020	355 ± 216	57.5–801	1185 ± 1240	347–3892	725 ± 1.3	529–917
2,3,3′,4,4′,5′-Hexachlorobiphenyl (PCB #157)	177.4 ± 143.2	35.4–558	110.6 ± 46.9	43.7–214	92.2 ± 50.3	12.2–181	251.2 ± 248.1	69.2–814	172.5 ± 9.8	144–202
2,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB #167)	253.3 ± 212.9	77.1–880	164.7 ± 85	68.8–368	122.8 ± 73.7	23.1–284	313.1 ± 239.6	124–764	269.3 ± 0.2	212–349
2,3,3′,4,4′,5,5′-Heptachlorobiphenyl (PCB #189)	83.2 ± 68.8	15.1–272	43.8 ± 18.8	17.1–84.9	43.6 ± 24.9	7.9–83.8	103.2 ± 98.7	41.4–308	68.5 ± 1.3	51.1–90.3
WHO-TEQ (mono-ortho PCB)	0.89 ± 0.13		0.61 ± 0.10		0.44 ± 0.06		1.25 ± 0.19		0.89 ± 0.12	
WHO –TEQ (PCB)	3.05 ± 2.63		1.88 ± 1.03		3.29 ± 1.69		3.91 ± 2.63		3.4 ± 0.95	

Table 6
Levels of PCDD/F and dioxin-like PCB in human milk from a number of countries.

Country	*n*	Year of sampling	$TEQ_{PCDD/F}$ (mean, pg g^{-1} fat)	∑TEQ (mean, pg g^{-1} fat)	References
Japan	30	2002–2004	7.4[a], 5.7[b]	12.3[a], 9.8[b]	Todaka et al. (2008)
Portugal	73	1999–2003		9,5	Reis et al. (2007)
Germany	169	2000–2003	13.3[c]	26.4[c]	Wittsiepe et al. (2007)
Italy	40	2000	13	29	Malisch et al. (2003)
Australia	157	2002–2003	5.8	9.0	Harden et al. (2007)
Greece	8	2002–2004	7.3	14.8	Costopoulou et al. (2006)
Belgium	20	2000–2001	29.4	40.8	Focant et al. (2002)
PR China	316	2001–2002	8.25	12.9	Hedley et al. (2006)
Spain	11	2004	7.77	10.9	Bordajandi et al. (2008)
Turkey	*51*	*2007*	*7.5*	*10.6*	Çok et al. (this study)

[a] Primiparous mother.
[b] Multiparous mother.
[c] Median.



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