UNKOWN LEVELS, UNCERTAIN SOURCES: OR ALL WE KNOW REGARDING HUMANS AND ORGANOTIN COMPOUNDS

Ana C. A. Sousa, M. Ramiro Pastorinho, António J. A. Nogueira, Luís Taborda-Barata, Shin Takahashi, Shinsuke Tanabe
Organotins belong to the most widely used organometallic compounds family;

More than 800 organotin compounds in use;

Estimated annual production: 60,000 tons.

- PVC Stabilizers
- Antifouling biocides
- Agricultural biocides
- Catalysts for the production of polyurethanes and silicones
ORGANOTIN COMPOUNDS

Butyltins
- MBT
- DBT
- TBT
- TeBT

Phenyltins
- MPT
- DPT
- TPT
- TePT

Octyltins
- MOT
- DOT
- TOT
- TeOT

PVC stabilizers
PVC stabilizers, silicones, Polyurethane foams, FRs
Biocides
Intermediates

Antifouling paints are used to prevent biofouling

Ship 6 months @ sea: 150 Kg m\(^{-2}\) of organisms; 40% increase in petrol consumption

**TRIBUTYL Tin (TBT)**

- Used as active compound in antifouling paints
- One of the most toxic xenobiotics ever produced and deliberately introduced into the environment (Goldberg 1986)
- Highly persistent
- Extremely toxic to nontarget organisms

**IMPOSEX** —> Superimposed sex

Imosex is the **best documented example of endocrine disruption** in wildlife.
Human health effects

- Obesogenicity
- Immunotoxicity
- Endocrine disruption
- Organotin compounds
  And many, many other nasty tees....
OBESOGENS:

- **First described in 2006 for OTs** (by Grün & Blumberg)
  TBT activates PPARγ, the master regulator of adipogenesis

- Refers to those xenobiotics that through an inappropriate activation of nuclear receptors induce adipocyte differentiation (TBT, BPA, PFOA, ...).

OBESOGEN HYPOTHESIS:

perturbations in metabolic signaling, resulting from exposure to dietary and environmental chemicals, may further exacerbate the effects of imbalances in diet and exercise, resulting in an increased susceptibility to obesity and obesity-related disorders.
Limited information on OTs levels in humans
Human liver samples
(post-mortem)

Sum BTs
(ng.g$^{-1}$ ww)

<table>
<thead>
<tr>
<th>Country</th>
<th>N</th>
<th>OTs levels</th>
</tr>
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<tbody>
<tr>
<td>Poland, 1999</td>
<td>9</td>
<td>20</td>
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<td>Japan, 1999</td>
<td>4</td>
<td>180</td>
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<tr>
<td>Denmark, 2002</td>
<td>18</td>
<td>100</td>
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</tbody>
</table>
OTs levels - Blood

**[BTs] blood**

- MBT
- DBT
- TBT

**[OTs] blood**

- MBT
- DBT
- TBT
- MPT
- DPT
- TPT
- MOT
- DOT

Values <DL= half DL

- Germany, N=30
- Germany, N=8
- Netherlands, N=91
- Finland, N=300
- Portugal, N=10

- USA, N=32
- USA, N=6
- 2001
- 2003 ***
- 2004
- 2008
- Sousa et al, unpub.

Kannan et al, 1999
Whalen et al, 1999
Rüdel & Steinhanses, 2001
Lo et al, 2003 ***
Peters, 2004
Rantakokko et al, 2008
Sousa et al, unpub.
Urine samples  (Zachariadis & Rosenberg 2009, N= 4)

Breast milk samples  (Mino et al, 2002; Japan, N=67)
Placenta (Rantakokko et al, 2013, Denmark & Finland, N=280)

**Denmark** (2.5 - 97.5 percentiles)

- MBT: 10%
- DBT: 37%
- TBT: 37%
- TPT: 31%

**Finland** (2.5 - 97.5 percentiles)

- MBT: 11%
- DBT: 66%
- TBT: 99%
- TPT: 43%

Different exposure sources?

% > LOQ
People spend 90% of their time indoors

2/3 of this time is spent at home

House dust behaves as a repository and a concentrator of many persistent and toxic chemicals (Mercier et al., 2011).

![Graph showing concentrations of OTs in different locations with data from various studies.](chart.png)
27 house dust samples from Aveiro and Coimbra, Portugal (2011-12)

Quantification of: MBT, DBT, TBT
DPT, TPT
MOT, DOT
Total OTs levels highly variable between samples:

570 - 6100 ng Sn.g⁻¹ dw

Relative contribution of individual organotins to total OTs

Monosubstituted compounds are more abundant

Profile of OTs usage in household items
Extremely high levels of TBT (870 ng Sn.g⁻¹) in one house: this concentration is the highest reported so far for house dust.

Risk associated with dust ingestion?

**Adults:** ingest 50 mg dust per day  
**Children:** ingest 100 mg dust per day

**daily intake via dust**

- Adults: 36 ng.day⁻¹  
- Children: 72 ng.day⁻¹

Tolerable Daily Intake (TDI)  

100 ng.Kg⁻¹ bw.day⁻¹
It is generally assumed that seafood is the main source of organotins, especially TBT and TPT (Rantakokko et al, 2006; EC, 2003).

Most reports on dietary OTs refer to the pre-ban period,

TBT levels derived from AF paints were very high....
March–May 2013

For one week (7 consecutive days) volunteers from Aveiro University kept a duplicate of their diet
Duplicate Diet Study - Portugal

N = 18 duplicate diet samples

EFSA Recommendation (TBT+DBT+TPT+DOT)

2.0 - 20 ng Sn.g⁻¹ dw
Organotin compounds are ubiquitous;

TBT is one of the most toxic xenobiotics ever produced and deliberately introduced into the environment (Goldberg 1986);

Imposex: the best example of endocrine disruption in wildlife

Innumerable reports on OTs levels and effects in the marine environment

In humans, TBT is “the OBESOGEN”

Limited information on the levels of OTs burdens in humans

Further research is mandatory....
Acknowledgements

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Thank you for your attention!