Endocrine active substances in toys

OFI - Austrian Research Inst. for Chem. and Tech.

Media Headlines

Scientists Fear Chemical in Plastic Could Be Harmful

ABC NEWS

By JAIME J. HENNESSEY
July 6, 2006

From food-storage containers to disposable silverware, plast
are such a part of our lives that it's
that could harm u

What's in YOUR blood?

First Run Features presents A DOCUMENTARY BY WERNER BOOTE

PLASTIC PLANET

BBC NEWS

Plastic chemicals 'feminise boys'

Chemicals in plastics alter the brains of baby boys, making them "more feminine", say US researchers.

Males exposed to high doses in the womb went on to be less likely to play with boys' toys like cars or to join in rough and tumble games, they found.

Male hormones drive boyish play

The University of Rochester team's latest work adds to concerns about the safety of phthalates, found in vinyl flooring and PVC sho

The findings are reported in the In

derStandard.at › Gesundheit › Leben › Umweltmedizin

Inland Wirtschaft Web Sport Panorama Etat

Weichmacher

Österreich verhält
Bisphenol A in Ba
stecken aber noc

Österreichische
Substanzen meh
2011 will Gesun
Massenchemik
in "kindernaher
verbieten. Zu f
Beschichtung
Trinkflaschen

foto: ernst rose/pixelio.de

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News > Science

Study shows dangers of BPA chemical used in plastic packaging

Bisphenol A is used to line drinks cans and in tests affected the way genes work in the brains of laboratory rats

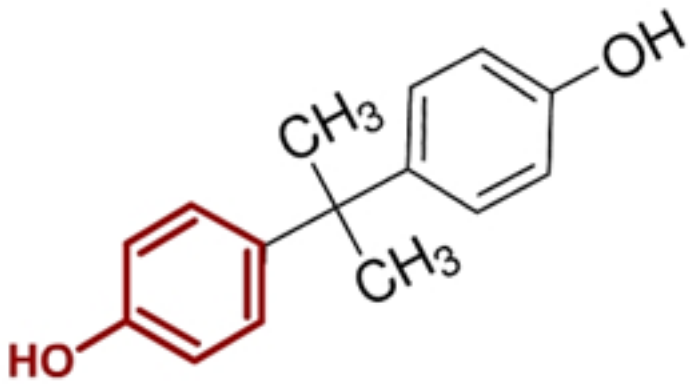
Are Plastic Baby Bottles Harmful?

By Laura Blue | Friday, Feb. 08, 2008

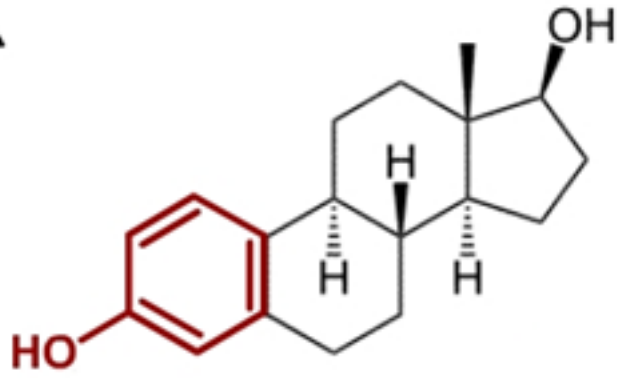
If a new report is to be believed, an entire generation of children has grown up drinking a toxic chemical from their earliest months: bisphenol A. A consortium of North American environmental and health groups released a paper Thursday showing that many major-brand baby bottles leach bisphenol A, and is now calling for a moratorium on the use of the compound — used to make polycarbonate plastic

Consumers are concerned…

Structural Similarities

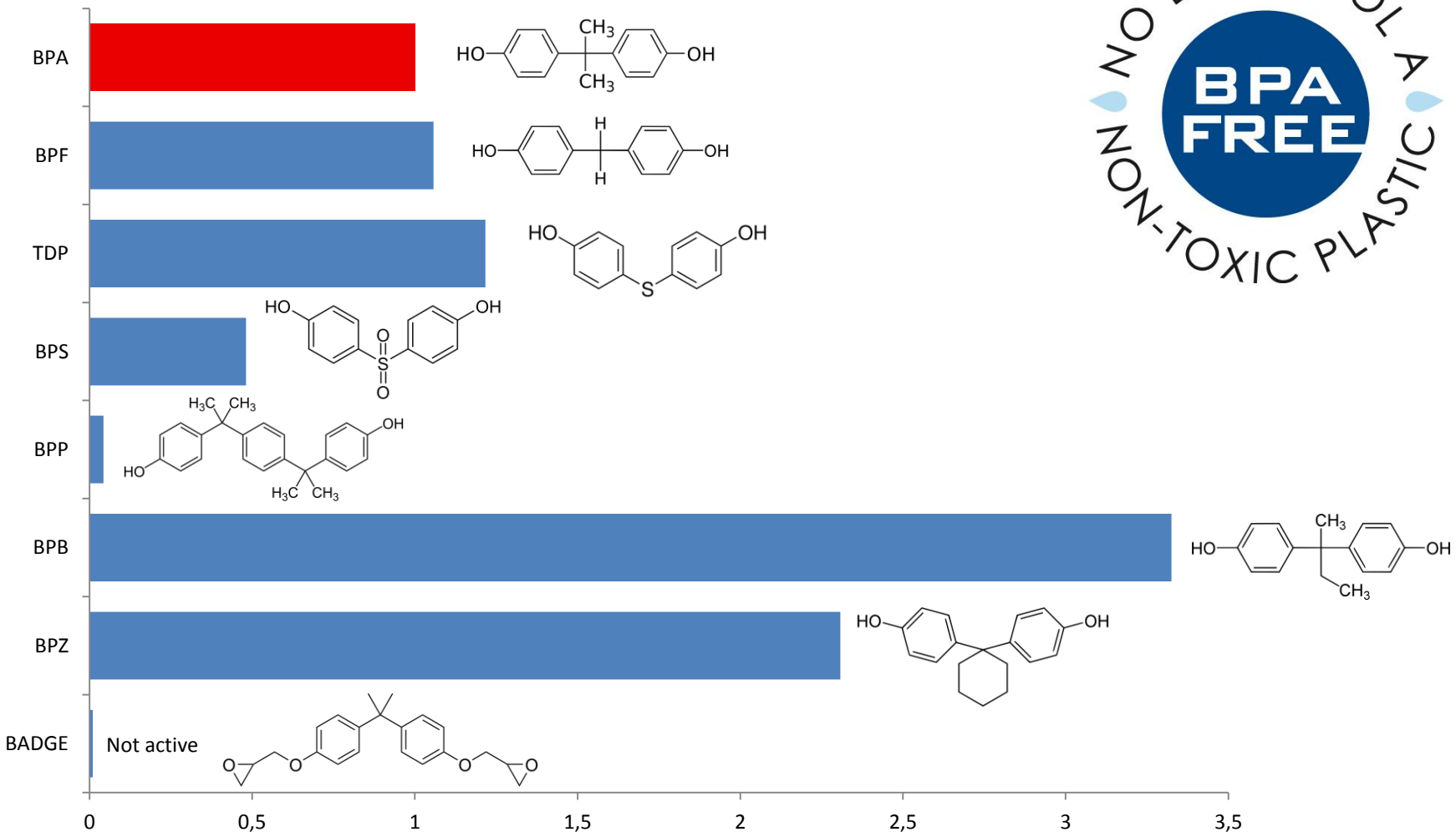


Bisphenol A
(Monomer of polycarbonate)

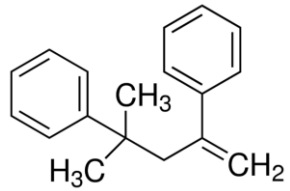


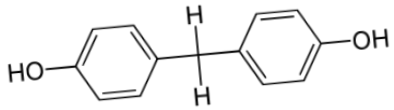
Estrogen (17β-Estradiol)
(Natural female sex hormone)

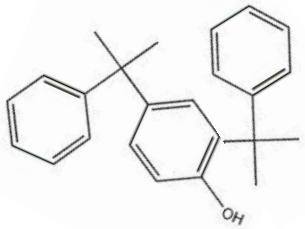
Bisphenol A replacement – estrogen activities in-vitro

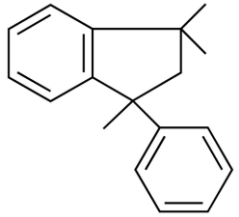


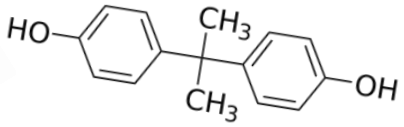
Hormone active substances in plastics





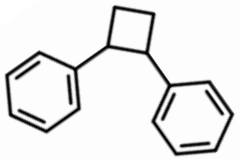


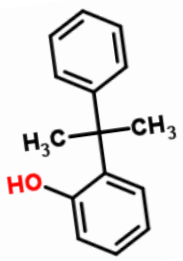


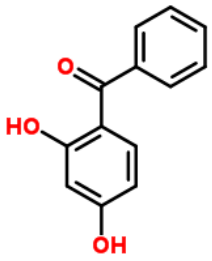


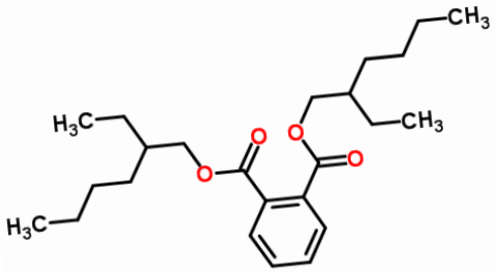
Other possible sources

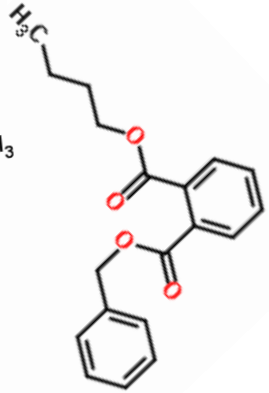
- Additives (e.g. plasticizers, UV-blockers)
- By-Products of the polymerization process (e.g. styrene dimers)
- Monomers (e.g. Bisphenol A, Bisphenol S,…)
- Printing color components (e.g. photo initiators)
- Contaminants
- ….

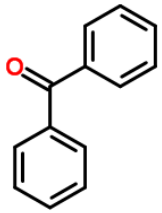


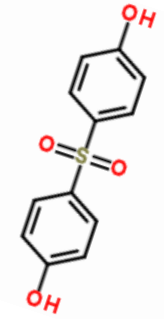




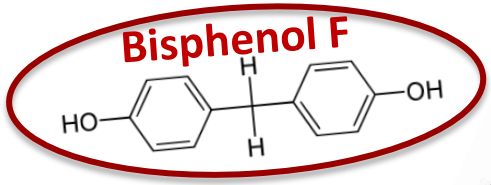


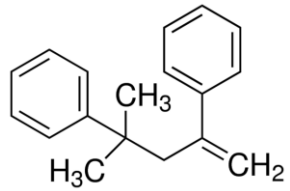


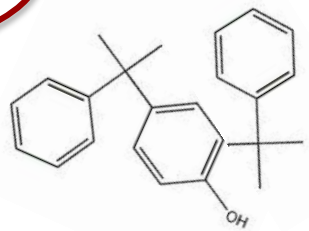


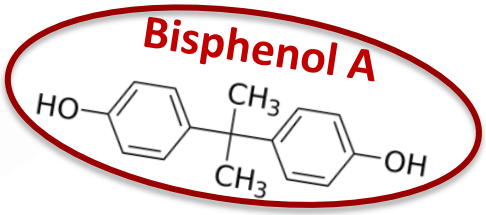


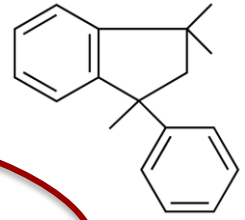
Hormone active substances in plastics











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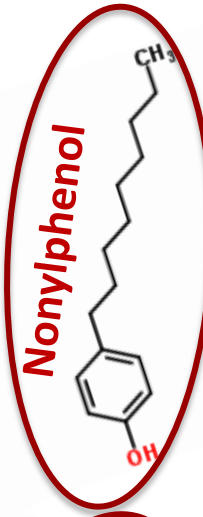

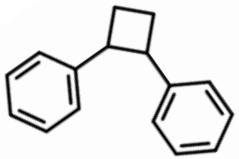

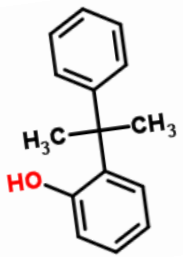

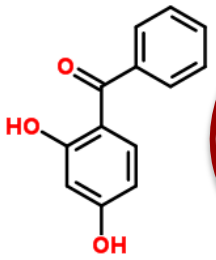

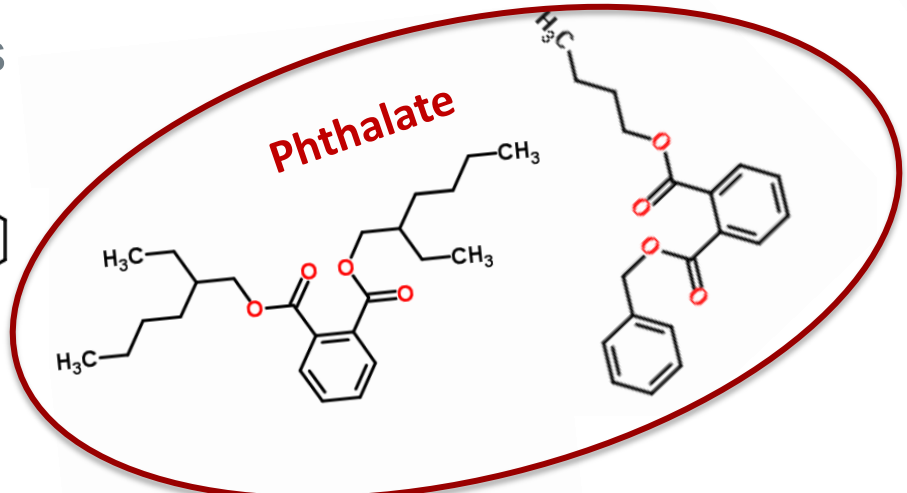

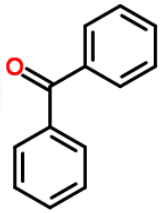

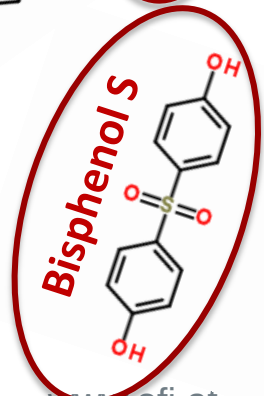

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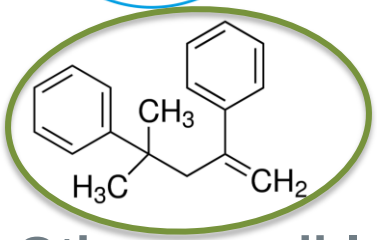
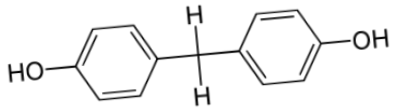
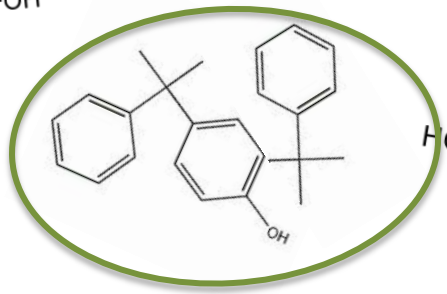
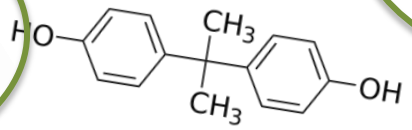
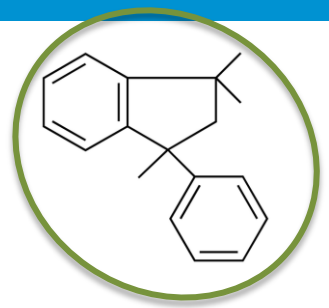








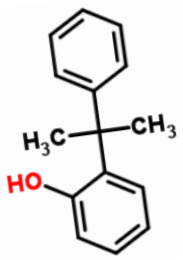


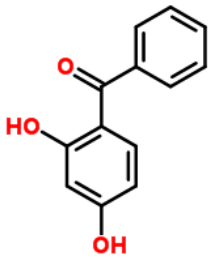
Other possible sources

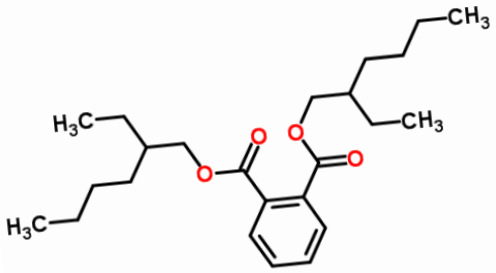
- Additives (e.g. plasticizers, UV-blockers)
- By-Products of the polymerization process (e.g. styrene dimers)
- Mo
- Pri
- Co
- ….

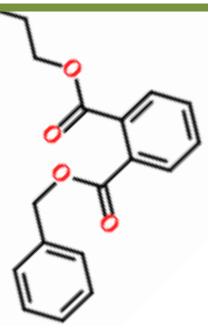
Some new estrogen active substances identified by OFI.

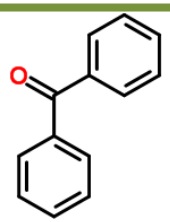
Probably many hormone active substances still unknown!

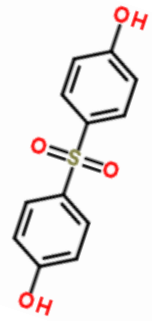












Established Bioassays

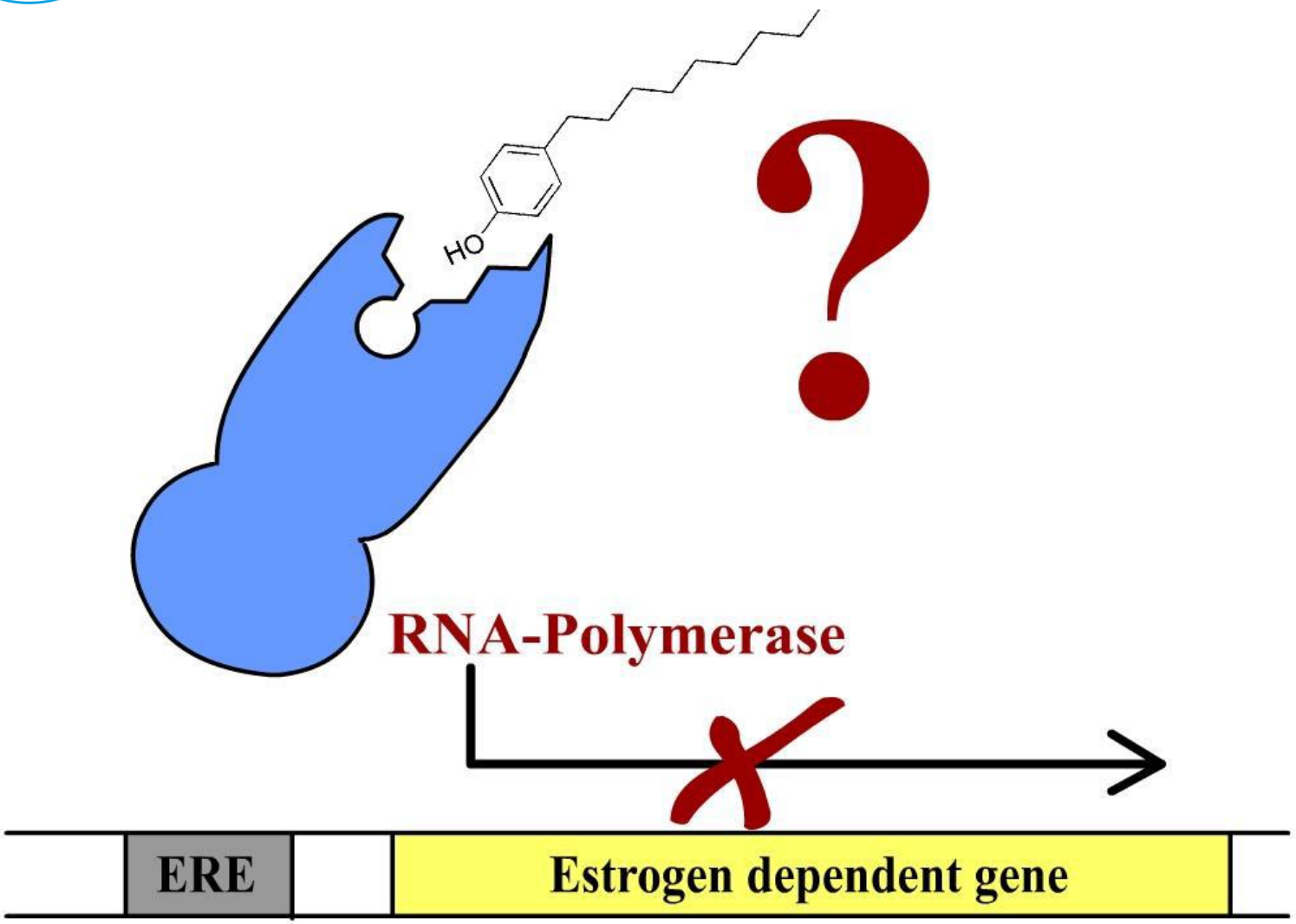
Yeast assays:

- Yeast Estrogen Screen
- Yeast Androgen Screen

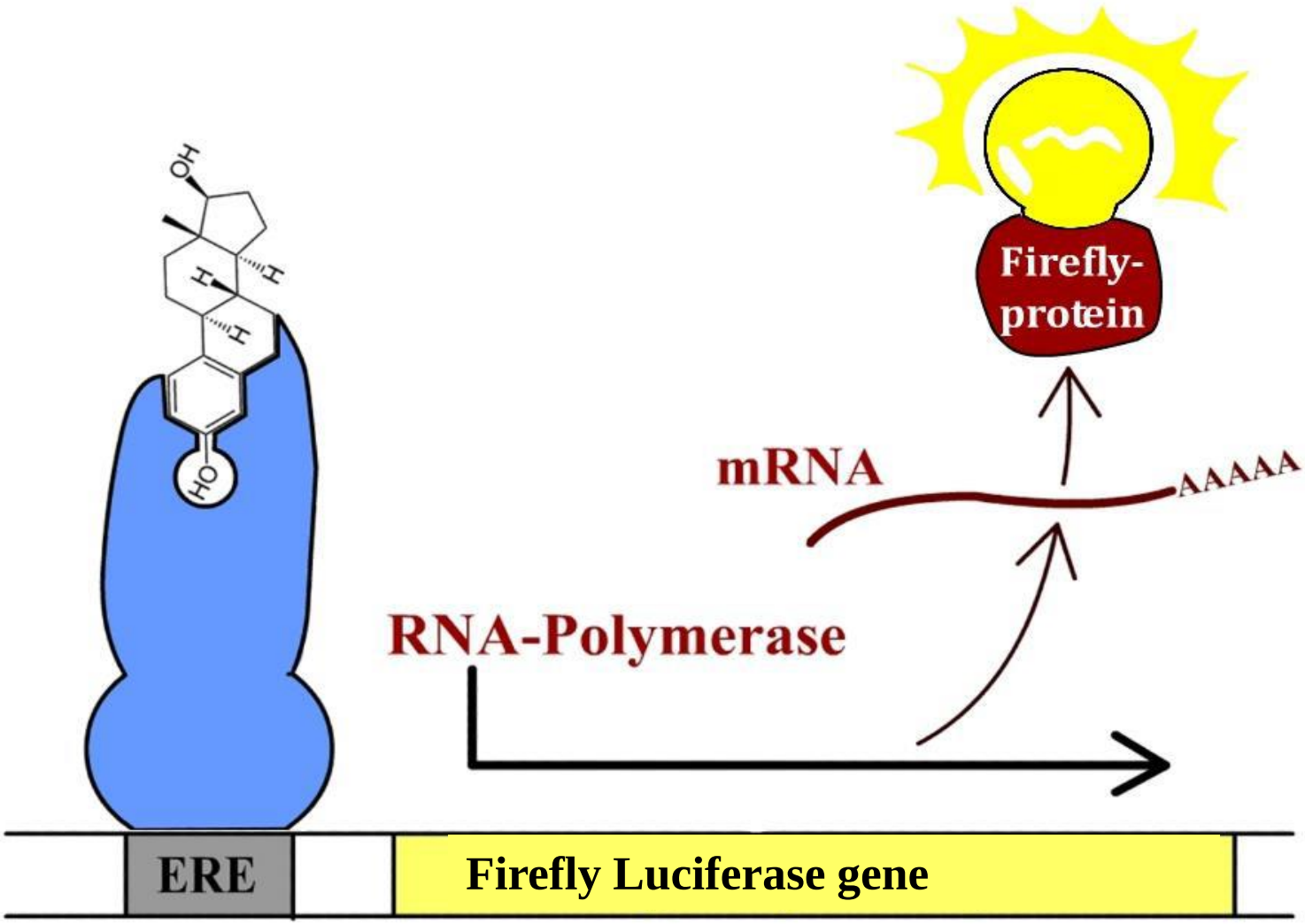
Human cell assays: (E-Screen and CALUX)

- Estrogens (female sex hormone)
- Androgens (male sex hormone)
- Thyroid hormones
- Substances interfering with PPAR-receptors

Binding of plastic additives ?



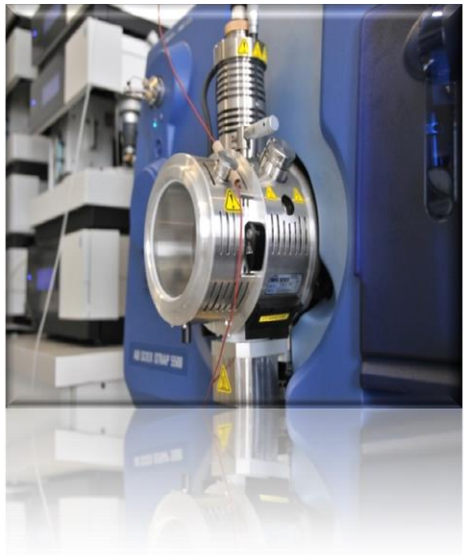
Light reaction



Chemical Analysis

HPLC-UV/VIS-MS/MS^n

Dionex U3000
Qtrap 5500, Triple-Quad with linear Ion trap
Source: ESI and APCI



GC-MS

- TDU-GC/MS: 7890A (GC) + 5975C inert (MS) + FID with multipurpose Sampler: TDU/HS/FI
- Screening of unknown substances

Limit of detection: < 10 ppb

Endocrine activity of toys:

So far only studies on canine toys…

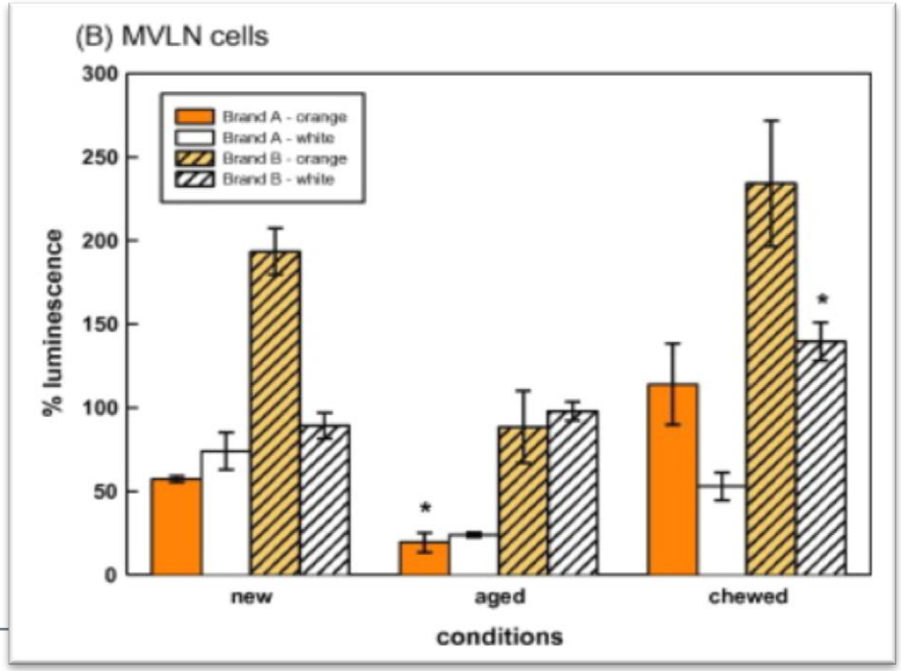
Contents lists available at ScienceDirect

Chemosphere

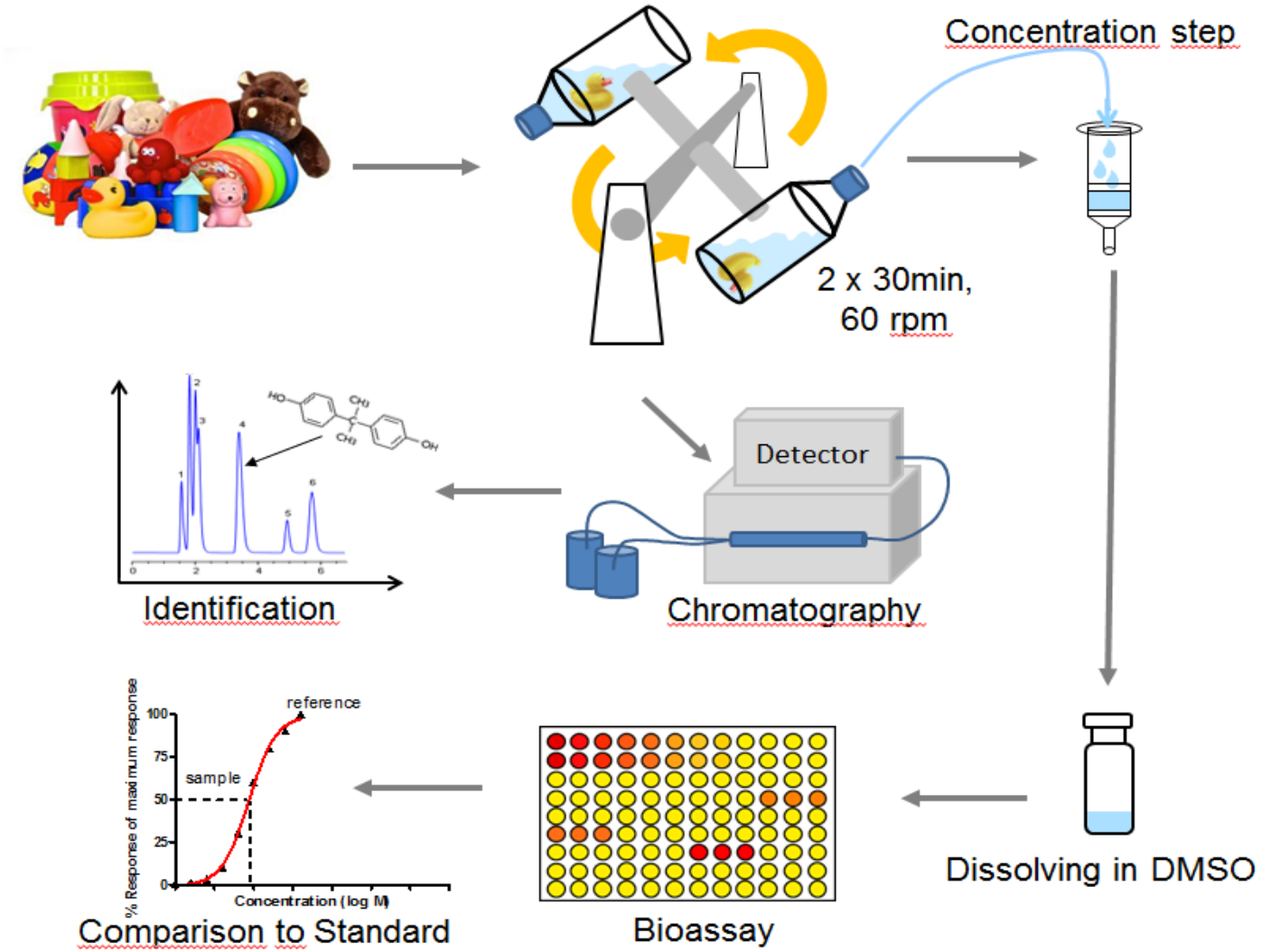
journal homepage: www.elsevier.com/locate/chemosphere

Canine toys and training devices as sources of exposure to phthalates and bisphenol A: Quantitation of chemicals in leachate and *in vitro* screening for endocrine activity

Kimberly J. Wooten *, Philip N. Smith



Scheme of analysis



Scheme of analysis

MIGRATION:

According to EN 71-10

Concentration step

2 x 30min,
60 rpm

Detector

Chromatography

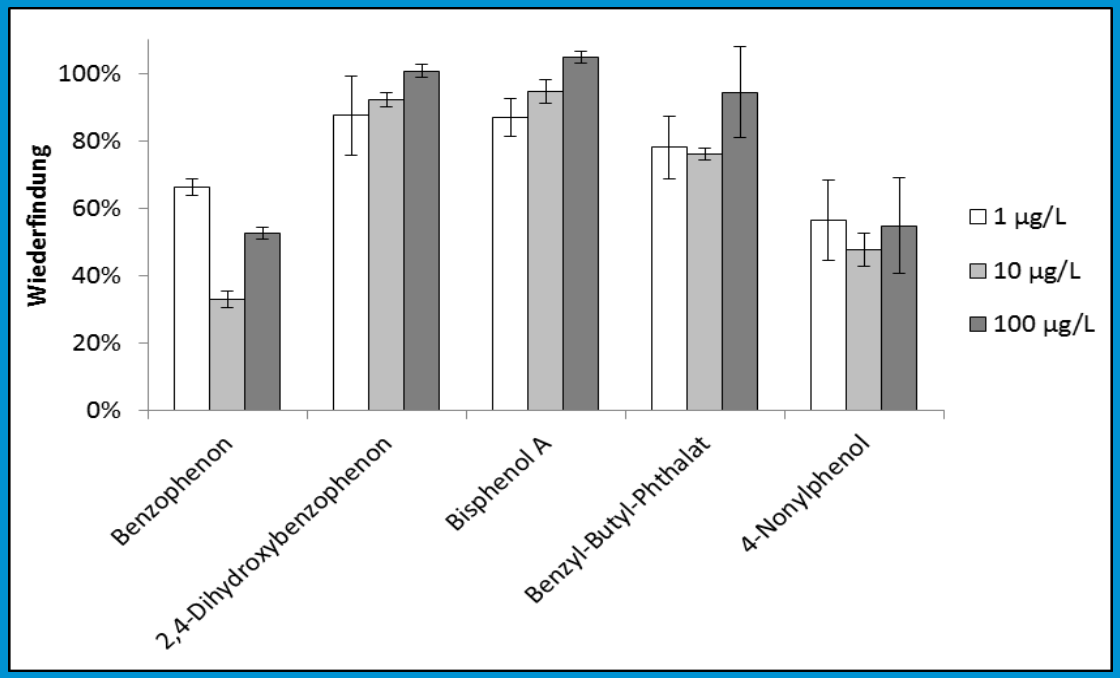
Dissolving in DMSO

Bioassay

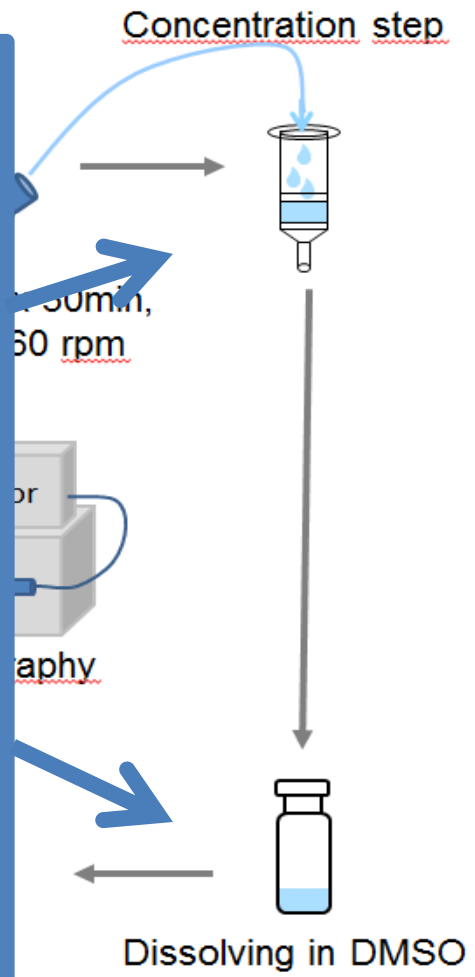
Validation

CONCENTRATION STEP AND TRANSFER TO DMSO

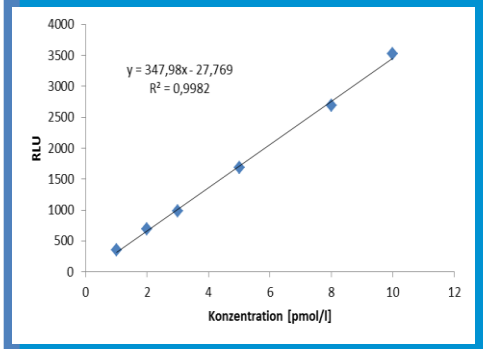
Validated with 5 model substances:



Critical factor: volatility of test compounds

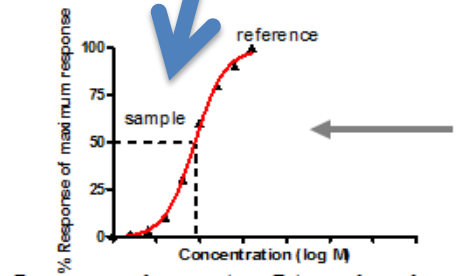


Validation

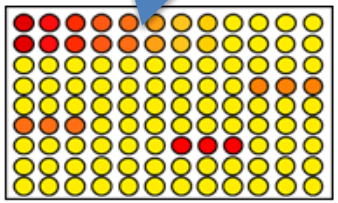


IN-VITRO-ASSAYS

	YES/YAS	CALUX	E-Screen
- reproducibility	✓	✓	≈
- limit of detection	✓	✓	✓
- Influence sample matrix	✗	✓	✗
- robustness	✓	✓	✗



Comparison to Standard



Bioassay

Dissolving in DMSO

Screening of toys for babies

8 out of 18 samples:
(low) Estrogen activity in at least one part!

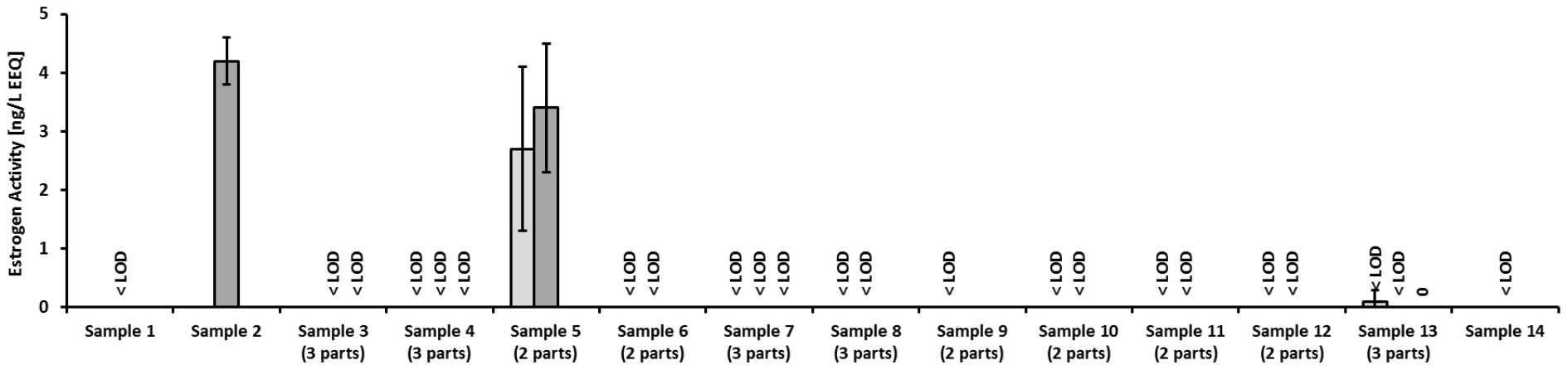
No Androgen, Thyroid or PPAR-γ activities

Results *in-vitro* Screening

Estrogen Activity in Plastic Samples:

- 3 out of 14 Samples: At least 1 part estrogen active
- 6 out of 32 sample parts: estrogen active

Androgen, Thyroid & PPARγ activity: no significant activity



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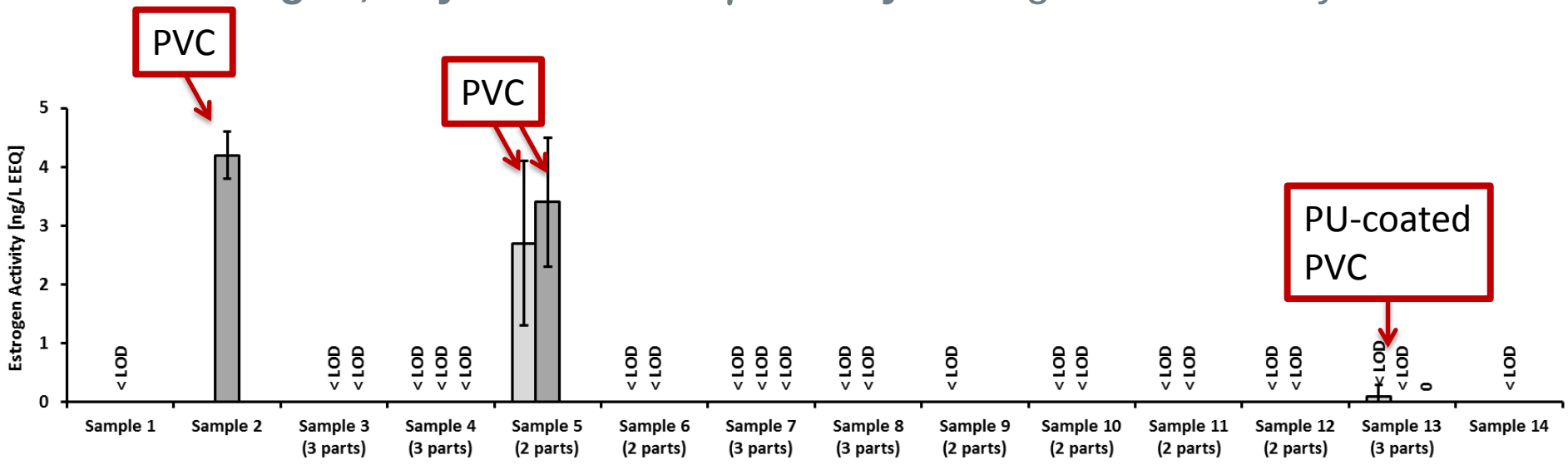

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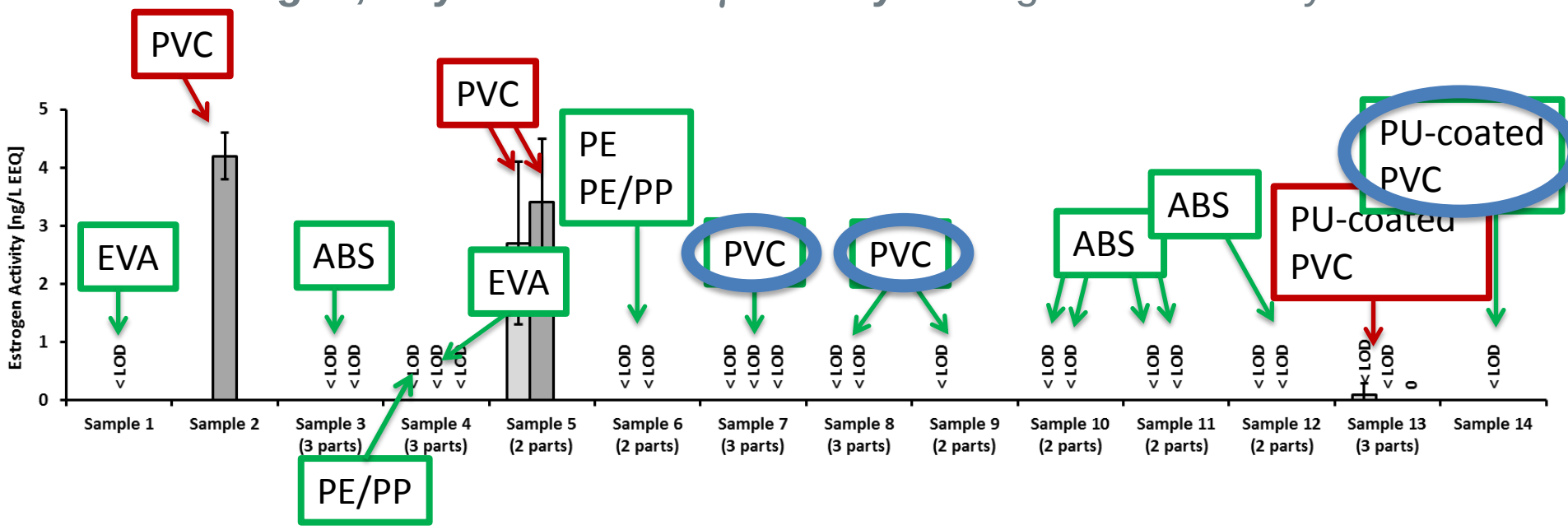
- 6 out of 32 sample parts: estrogen active

Androgen, Thyroid & PPARγ activity: no significant activity



Identification of hormone active substances

„Sample 4“ (A362)

Estrogen activity: 3.4 ± 1.1 ng EEQ/l in saliva solvent

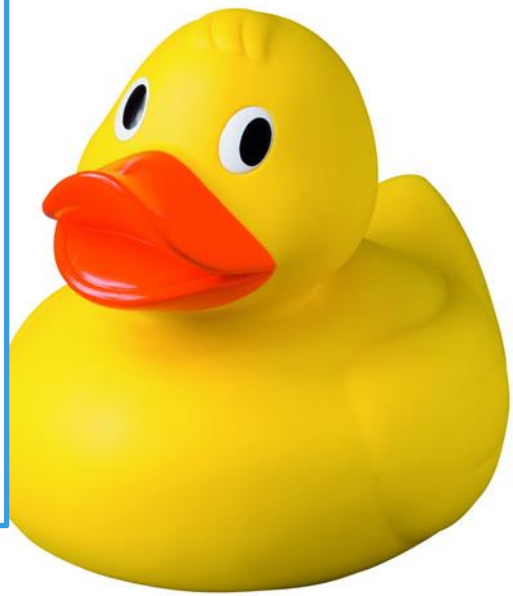
<u>3.4 ng Estradiol Equivalents per liter:</u>

Same Estrogen Activity as a solution of:

3.4 ng/l natural estrogen 17-β-Estradiol

30.000 times less active

Approx. 0.1 mg/l Bisphenol A



(Symbolic photo)

Health Risk??

Exposure estimation according to RIVM

(Dutch National Institute for Public Health)

Migration test: 83 pg EEQ/cm² in 60 min

→ 2.5 ng EEQ in **10 cm² in 180 min** ← **Worst case Assumption by RIVM**

→ 2.5 ng EEQ maximum daily uptake

Comparison: Exposure by food:

Maximum daily updake: 10.000 ng EEQ ← **Worst case Assumption: Milk on soy bean basis (Phytoestrogens)**

Comparison: Limits for Ethinylestradiol

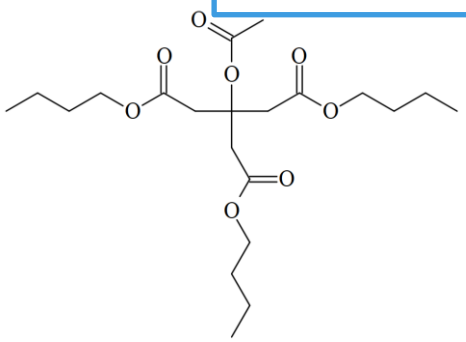
ADI (for 8 kg bodyweight): 0.9 ng EEQ

Identification of hormone active substances

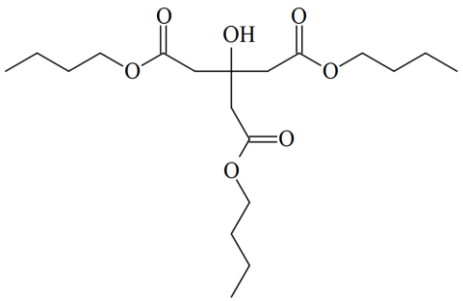
„Sample 4“ (A362)

Substances identified by GC-MS & HPLC-MS:

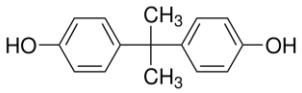
- **Acetyl tributyl citrate (ATBC) ≈ 3.000 µg/l**
- **Tributyl citrate (TBC) ≈ 200 µg/l**
- **Bisphenol A (BPA) ≈ 60 µg/l**



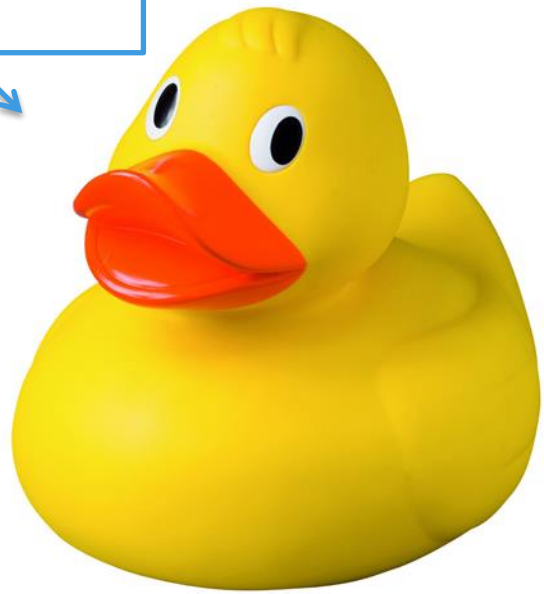
ATBC



TBC



BPA

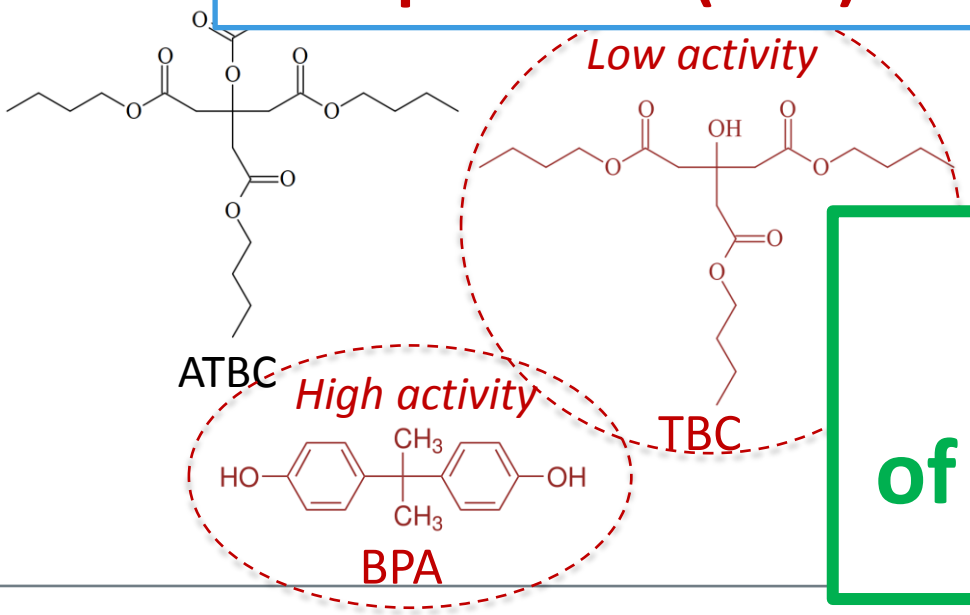


Identification of hormone active substances

„Babymoov Bathfriends“ (A362)

Substances identified by GC-MS & HPLC-MS:

- **Acetyl tributyl citrate (ATBC) ≈ 3.000 µg/l**
- **Tributyl citrate (TBC) ≈ 200 µg/l**
- **Bisphenol A (BPA) ≈ 60 µg/l**



Explains ≈ 80%
of the detected activity

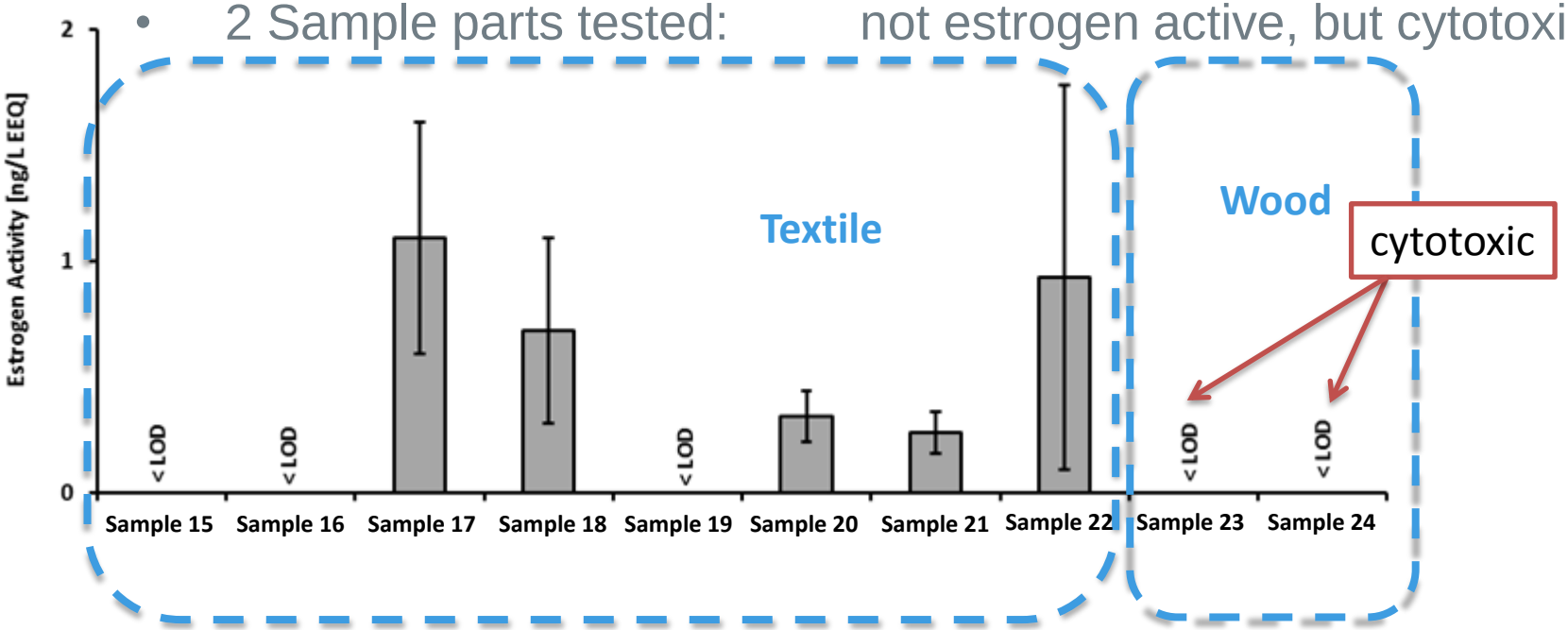
Results: Textile and Wood

Estrogen Activity in Textile Products:

- 5 out of 8 Samples: estrogen active

Estrogen Activity in Wood Products:

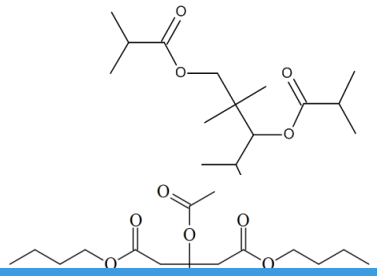
- 2 Sample parts tested: not estrogen active, but cytotoxicity



Androgen, Thyroid & PPARγ activity: no significant activity

Chemical Trace Analysis: Detected Substances

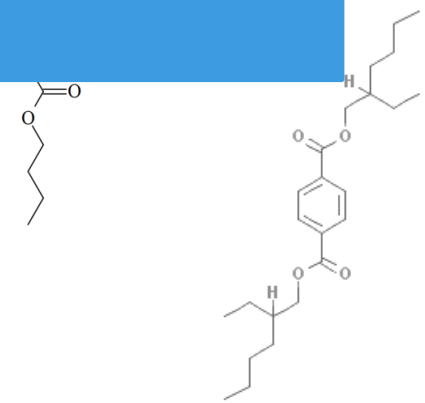
TXIB (up to ≈ 2 mg/L)



ATBC (up

TBC (up t

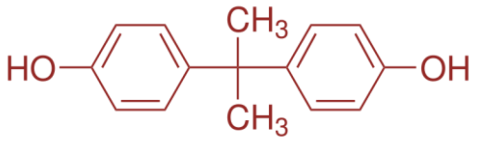
No Phthalates detected!



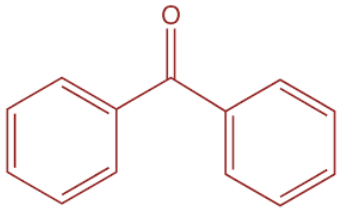
DEHTP (up to ≈ 0.6 mg/L)

Chemical Trace Analysis: Detected Substances

BPA (up to 0,07 mg/L)



Benzophenone (up to 0,03 mg/L)



Source for estrogen activity could not always be identified

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Antagonisten – Blockierung des Rezeptors