

ENDOCRINE DISRUPTORS

Hormonally active substances

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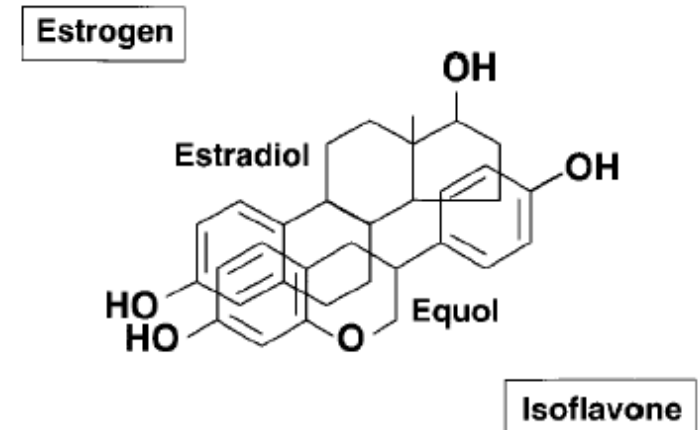
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Endocrine disruptors

Are hormonally active substances

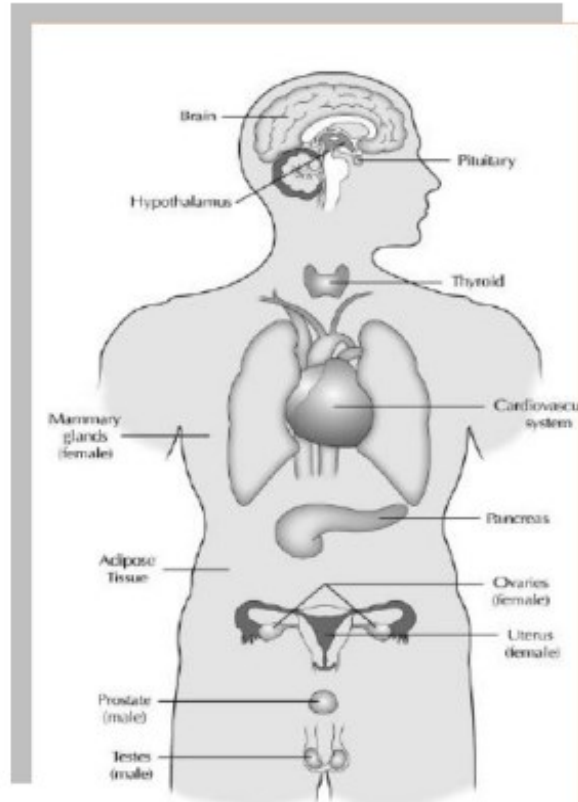
- affect the hormonal system at all levels
- similar structure to hormones
- may occupy receptors
- may modify receptors
- impaired hormone pathways
- connected with metabolic diseases, DM, impaired reproduction, reduction number of sperm
- changed sex of fish, other water organisms (crayfish) – the impossibility of reproduction, growth retardation



Obrázek č. 5: Podobnost estradiolu a equolu

Used: google: pictures-wikipedia

Endocrine disruptors



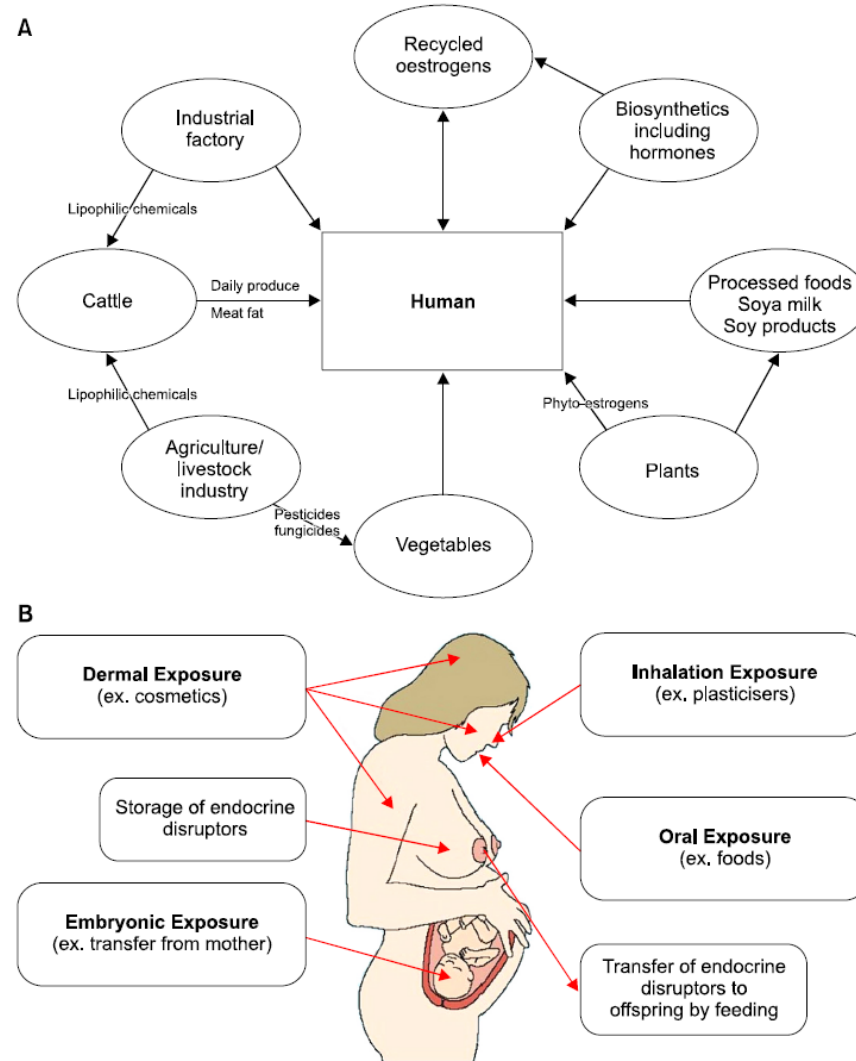
The endocrine system keeps our bodies in balance by maintaining homeostasis and guiding proper growth and development.

On the other hand, endocrine disruptors interfere with the endocrine system and cause adverse effects both in human and wildlife.

Fig. 6. Model of endocrine systems that include brain and hypothalamic neuroendocrine system; pituitary; thyroid; cardiovascular system; mammary gland; adipose tissue; pancreas; ovary and uterus in females, and testes and prostate in males physiology (Diamanti-Kandarakis et al., 2009).

Kabir E.R., Rahman M.S. and Rahman I.: A review of endocrine disruptors and their possible impact on human health. *Environmental Toxicology and Pharmacology*, 2015, vol.40,p.241-258.

Endocrine disruptors



Sharpe, R.M., Irwine D.S.: How strong is the evidence of a link between environmental chemicals and adverse effects on human reproductive health? *BMJ*,2004,vol.328,p447-451

Endocrine disruptors

Hormonally active substances – harmful for animals, water animals, fish, crayfish

- discovered irreversible changes in fish - **1962 y.** Rachel Carson: **Silent Spring** – dangerous pesticides, DDT
- **1993** – first study, hazard of chronic exposure (Colborn et al.)
- **R. 1997 - G7/8 Miami, Florida, 5th-6th May in 1997**
„Declaration of Environmental Leader of the Eight on the Children’s Environmental Health - Risk Assessments: **Children's Exposure to Lead, Microbiologically Safe Drinking Water, Air Quality, Environmental Tobacco Smoke**

Emerging Threats to Children's Health from Endocrine Disrupting Chemicals

DISRUPT HUMAN reproduction

↑ ca mammy by 1% /year

↑ prostate cancer and ca of testes

↑ incidence of endometriosis

↑ disrupt reproduction

From 1940 y. ↓ number of sperms, decrease of quality to 50%

Endocrine disruptors in environment

- **First study- high levels in wild animals -** damage of hormonally system, → **danger chronic exposure to low concentration of ED in human** (Longnecker et al., 2003)
- **present in rivers**, streams, fresh waters in low concentration, chronic exposure
(drugs for treatment: contraceptives-estrogenes, metabolites of antihypertensives, antidiabetics, antiflogistics, psychopharmaceuticals, from household using: detergents, for personal hygiene...)
- **In fish**: retardation of growth, damage of reproduction due to change of sex (male to female, hormon vitellogenin), reduce number of fish in streams, rivers

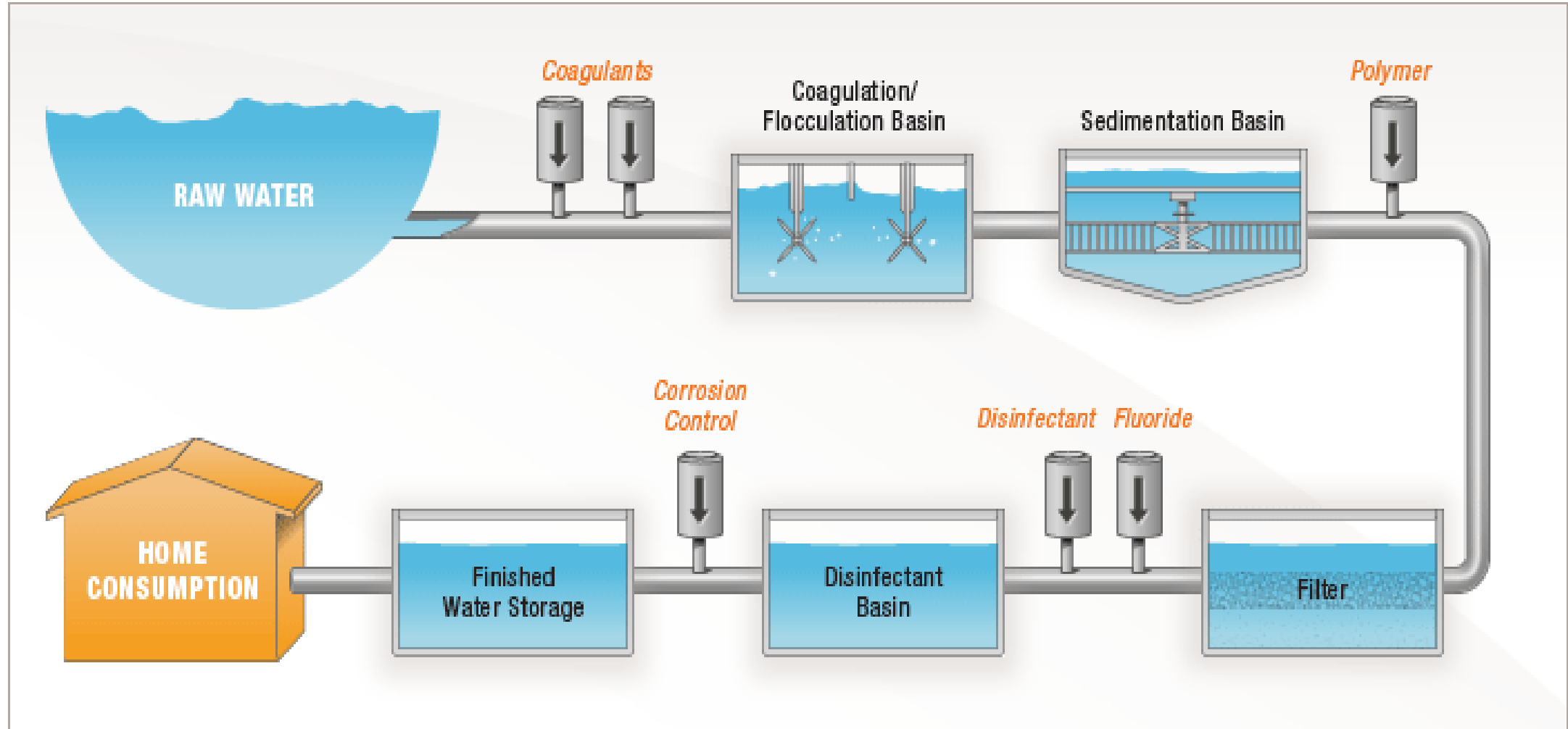
2009 - American Society of Endocrinology - declaration to ED problem

Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement (published in Endocrine Review)

Endocr Rev. 2009 Jun; 30(4): 293–342) <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2726844>

Longnecker , M.P. et al: An approach to assessment of endocrine disruption in the National Children's Study. *Environmental Health Propectives*, 2003, vol.111, No.13, p.1691-1697.

Imperfect cleaning process



Example

Concentrations of some EDCs in some of their common sources (Kidd et al., 2012).

EDC	Source	Concentration
Triclosan	Municipal effluents	Upto 3 µg/l
	Biosolids	Upto 33 µg/g
	Receiving waters	Less than 2.3 µg/l
	Sediments	Less than 800 ng/g
Bisphenol A	Ground and surface water	Upto 20 µg/l
	River sediments	Upto 1.63 mg/kg
Fluoxetine	Effluents	Upto 99 ng/l
	River water	Upto 46 ng/l
	Treated sewage sludge	Upto 0.37 mg/kg
Levonorgestrel	Municipal effluents	At low ng/l

Kidd et al., 2012: Human and wildlife exposures to EDCs. Chapter 3. State of the science of endocrine disrupting chemicals, UNEP, 189-250.
UNEP – United Nations Environment Programme

Endocrine disruptors in environment

- Pesticides
- Pharmaceuticals
- Brominated flame retardants (BFR)
- Chemical compounds using in bild materials, carpets, textiles
- Plastic softeners
- Some aditives - are suspected (artificial colourings)
- Exogenous contaminants of food (metyl mercury)

Brominated flame retardants - BFR

BFRs are mixtures of man-made chemicals that are added to a wide variety of products to **make them less flammable**

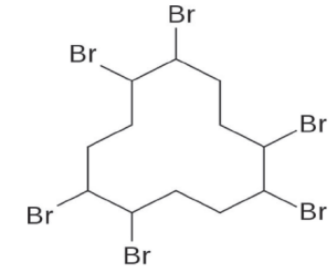
- Commonly used in plastics, textiles and electrical equipment (in textiles, carpets, components of cars, computers, electronics, building materials, isolations...)
- Danger : many are **persistent, bioaccumulative, and toxic to humans** and the all environment
- Between October 2010 and October 2012, **EFSA's Panel on Contaminants in the Food Chain (CONTAM Panel)** published six scientific opinions on the main **groups of BFRs and the potential risks to public health from their presence in food!** → **intensively monitored**

BFRs

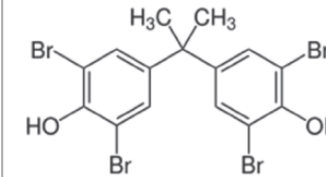
Organobromine compounds, lipophilic, persistent in environment

✓ **HBCDD** – hexabromcyclododecane

r.2010 Stockholms declaration - proposed prohibition of use worldwide



TBBPA-tetrabrombisfenolA - in epoxides, electronics



➤ **PBDE**-polybrominated difenylethers –

209 congeners - structure similar as PCB (polychlorinated bisfenols)

➤ **released from materials**, ↑ temperature, sun lights, abrasion – released from plastics (interiors of cars, automobiles, airplanes, electronics, monitors, PC components, materials for building, insulations, textiles..)

BFRs

Properties:

- ✓ **nonpolar**— hydrophobic - not present in hydrosphere, not transported by water, danger is - **bioaccumulation!**
- ✓ **lipids, fat tissue – accumulation, chronic toxicity**
- ✓ structurally similar as **thyroid hormones**
- ✓ **binds to transport proteins of blood**

Mobilised from lipid tissue – released - affinity to CNS, reproductive system

Plastic softeners

Food packaging materials - containers - **bottles, cups and plates**, used to improve food handling and transport, can contain chemical substances such as

plastic softeners - elements can migrate into content (food)- contaminate them

➤ can have effect as endocrine disruptors



www.primarodina.cz



www.blesk.cz

E.g. Packing, plastic objects, PVC, apartment interiors, cosmetics, plastic toys

for babies – (phthalic acid esters =phthalates (PAE) use is prohibited – in plastic bottles for babies, prohibited in toys, bottles....

Dangerous especially for little boys – can cause feminization

E.g. di-(2-ethylhexyl) ftalát (**DEHP**), di-butyl ftalát (**DBP**), benzylbutyl ftalát (**BBP**)

DANGER: low acute toxicity x **but long term exposition of low dose** – proven bad negative effects:
embryotoxicity, teratogenity, spermioxicity, hepatotoxicity, nefrotoxicity, carcinogenity, disturb blood coagulability

Bisphenol A - BPA

Bisphenol A - bisfenol-A-diglycidylether (BPA)

- basic component epoxy - resins, are used as inner coating of food cans, water tanks ...

Toxicity: carcinogenity **is not** strictly proved, but from 2006 y. in objects used in contact with food of BPA **prohibited** !

➤ **TDI = 0,05 mg/kg**, established from **NOAEL 5 mg/kg** a safety factor 100 = for phtalates ((EFSA)

Occurence in food:

- ✓ small amounth – in spirits and bottled water (long period of storage)
- ✓ in food with high content of **fat** - can migrate (phtalates are lipophilic) - due to contact with **plastic bottle cap** (peppers or olives in oil, dressings, peanut butter)

Reccomendation: plastic bottles and doses marked: **BPA free**

BIOMONITORING in Czech Republic

- **EFSA (European Food Safety Authority)** – Parma , Italy
- **National Institute of Public Health (NIPH)** – Prague, Czech Republic

➤ NIPH biomonitoring in Czech Republic:

study exposition of population by POPs, (polyaromatic organic compounds, include BFR), heavy metals, environmental pollutants in **body fluids, lipid tissue, breast milk, hair**

- ✓ international study coordinated by WHO
- ✓ result are published in Annual Reports (each year)

Annual Report 2014 y. (NIPH) published results:

Breast milk samples - analysis of **PBDE** (polybrominated difenyl ethers):

- 50 % samples < limit of detection (0,1 – 1 ng/g tuku)

Results - concentration of PBDE: 0,317 – 10,8 ng/g lipid tissue (treshold: **520 ng/g tuku**)

NIPH: www.szu.cz