The ABC's of EDCs: Endocrine Disrupting Chemicals in the Environment

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What is an endocrine disrupting compound?

“An endocrine disruptor is an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny....”

Documented effects of EDCs in wildlife

- Adverse effects on fish development and reproduction
- Eggshell thinning in birds of prey
- Alligator population decline in a polluted lake (FL)
- Development of male sex organs in female marine animals such as whelks and snails
Gender-bending pollution
Strange fish live downstream from Boulder and Denver sewage plants, a new study reports. Researchers found white sucker fish with sexual deformities and far more female fish than males in certain sections of Boulder Creek and the South Platte. New work identifies hormone-laden wastewater treatment effluent as the cause. Utilities aren’t required to test for the chemicals, but federal officials are supporting more research to learn where the contaminants come from, how much is cleaned up in the treatment process and whether the contaminated river water could affect people.

STUDY RESULTS IN THE FIELD

White sucker fish:

Upstream from Boulder’s wastewater treatment plant:
18 females, 14 males, no intersex fish

Downstream:
49 females, 5 males, 4 intersex fish

Upstream from Denver’s wastewater treatment plant:
4 females, 2 males, no intersex fish

Downstream:
16 females, no males, 4 intersex fish

White sucker
(Castomus comersoni)
White suckers are the only fish found at some of the sites where wastewaters enters rivers, so field scientists compared sucker numbers, gender and physiology above and below wastewater treatment plants. Suckers grow between 12 and 20 inches long.

Fathead minnow
(Pimephales promelas)
Captive-bred fathead minnows are the EPA’s test organism, used in controlled experiments. The small, quick-growing fish (about 2 to 3 inches long) are the “lab mice” of aquatic science.
EDC effects at the population scale

• Field study at Canadian research lake, Ontario
• Fathead minnow population collapsed after two years of estrogen addition

Kidd et al. 2007: Proceedings of the National Academy of Sciences
Speculated effects of EDCs in humans

- Reductions in male fertility and declines in the numbers of males born
- Abnormalities in male reproductive organs
- Female reproductive diseases including fertility problems, early puberty, and early reproductive senescence
- Increases in mammary, ovarian, and prostate cancers
How do endocrine disrupting compounds act?

- reduce hormone production in endocrine glands
- mimic or counteract hormones at target tissues
The USEPA has identified three important categories of EDCs

- Estrogenic
- Androgenic
- Thyroid active
Examples of known EDCs in wastewater

• Natural hormones (*estrogens*)
  – Estradiol
  – Estrone
  – Estriol

• Synthetic compounds
  – Ethinyl estradiol (birth control pill)
  – Alkylphenols, e.g. nonylphenol (surfactant byproduct)
  – Bisphenol A (polycarbonate plastic)
  – PBDEs (flame retardant; partially phased out)
Common chemical in hard plastics may be hazardous to health

By Susanne Rust
MOLALLAH TRIBUNE

Although its name may not be familiar, bisphenol-A is everywhere. It's in the lining of your soup can, the clear plastic of your baby's bottle and the sealants covering your teeth. But it might be harmful to your health.

An expert panel of endocrinologists, statisticians and biologists was called together this month by a federal agency to review a report on this ubiquitous chemical. The final review, which was supposed to be announced earlier this month, was postponed.

For several years, scientists have been concerned about bisphenol-A. Hundreds of papers have shown that it can be toxic in extremely low doses. Traces of bisphenol-A have been found in nearly every American tested for it.

The chemical mimics estrogen and binds to estrogen receptors on cells. In more than 100 experiments conducted on lab animals, it has been shown to cause genetic changes leading to prostate cancer, as well as decreased testosterone, low sperm counts and signs of early female puberty.

Work also has been done on human

Bisphenol A

- Ingredient in polycarbonate plastic, epoxy resin
- Water bottles, CDs, epoxy lining in metal cans
- Controversial: some studies find low dose estrogenic effects, other studies do not
Did you mean: endocrine disruption

NRC: Endocrine Disruptors FAQ
Answers to these and other questions: What are endocrine disruptors? How do we know endocrine disruptors are dangerous? What can I do to reduce my risk of...
www.nrdc.org/health/effects/qendoc.asp - 19k - Cached - Similar pages

Endocrine disruptor - Wikipedia, the free encyclopedia
Endocrine disruptors are exogenous substances that interfere with the endocrine system and disrupt the physiologic function of hormones.
www.en.wikipedia.org/wiki/Endocrine_disruptor - 29k - Cached - Similar pages

Endocrine Disruptors Research Initiative
Describes the coordination of US federal government efforts to examine the hypothesis that there are chemicals present in the environment of humans and...
www.epa.gov/osp/ - 12k - Cached - Similar pages

Endocrine Disruptors
Learn about endocrine disruptor chemicals and women's health.
www.womentowomen.com

Find Endocrine Disruptor
Search the Environmental Industry's Largest Marketplace!
www.environmental-expert.com
Question:
How can we measure estrogenic compounds in environmental samples?

- Individual chemical measurements
- Collective measurement using bioassays

*Total estrogenic activity*
Yeast estrogen screen (YES) bioassay

17-α Ethinylestradiol

EC₅₀ = 1.1 x 10⁻¹⁰ M

Molar concentration in well

A₅₇₀ nm - A₆₃₀ nm

EC₅₀ = Estrogens

R = Receptor
Estrogenic Activity: Comparison of six Arizona WWTPs

<table>
<thead>
<tr>
<th>Process</th>
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<tbody>
<tr>
<td>Oxidation ditch</td>
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<tr>
<td>Membrane bioreactor</td>
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<tr>
<td>Nitrification/denitrification</td>
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<tr>
<td>Activated Sludge (pure O₂)</td>
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<tr>
<td>Biotower #1</td>
</tr>
<tr>
<td>Biotower #2 (longer SRT)</td>
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![Diagram showing the process flow from Influent to Effluent with Sludge output]
Preliminary Comparison of six Arizona WWTPs

Influent to effluent estrogenic activity removal (%)  
Overall estrogenic activity removal (%)  

<table>
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<tr>
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<th>Overall Activity Removal (%)</th>
<th>Influent to Effluent Activity Removal (%)</th>
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<tbody>
<tr>
<td>Oxidation ditch</td>
<td>98</td>
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Summary

1. EDCs include estrogens, androgens, and thyroid active compounds

2. Removal of estrogenic activity during wastewater treatment is dependent on process selection/efficiency

3. There is a lot we don’t know about a lot of trace organics in wastewater