Monitoring Breast Milk and Drinking Water Supplies in Massachusetts, USA

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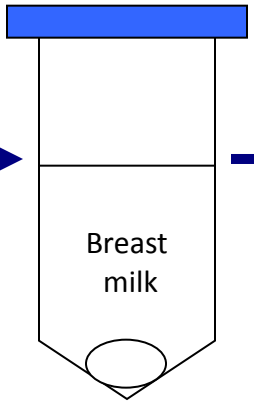
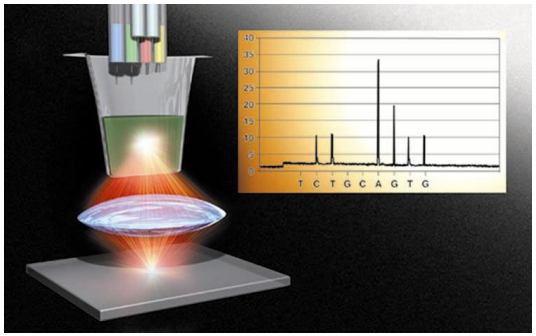
7th BioDetectors - Istanbul

Using breast milk to study breast cancer risk: biomarkers of exposure and effect



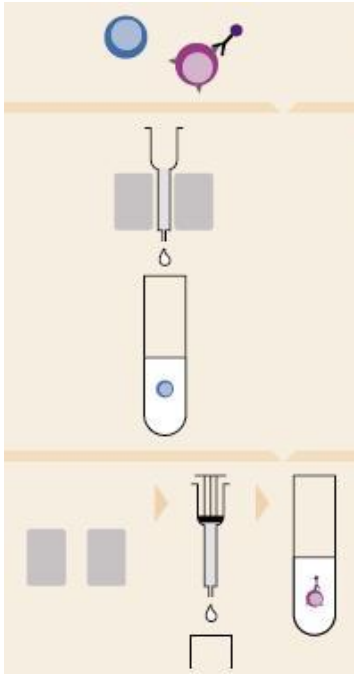
Measure pollutants in milk



Pyrosequencing to detect epigenetic changes

Separate cell populations

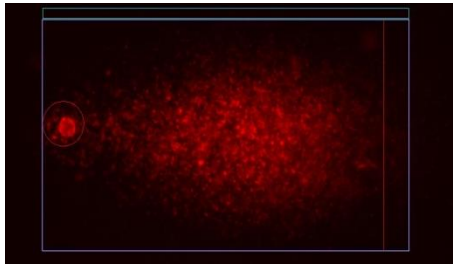
Collect Breast Milk & Administer Questionnaire
risk factors including personal and family cancer history, reproductive history, residence, age, ethnicity, etc.



Leucocyte population

Epithelial population

Bisulfite Conversion & PCR



Comet Assay

Breast milk

Breast milk is not a product, rather it is an integral part of maternal behavior, breastfeeding.

American Academy of Pediatrics *recommends breastfeeding for at least the* ***first year*** *of life, and cites "health, nutritional, immunologic, developmental, psychologic, social, economic, and environmental benefits."*

Breastfeeding is good for …

Infant – protects against

- *childhood leukemia*
- *sudden infant death syndrome (SIDS)*
- *acute otitis media*
- *gastroenteritis*
- *severe lower respiratory tract infections*
- *atopic dermatitis*
- *asthma*
- *obesity*
- *type 1 and 2 diabetes*
- *necrotizing enterocolitis*

Mother – protects against

- *type 2 diabetes*
- *breast cancer*
- *ovarian cancer*
- *postpartum depression*

Agency for Healthcare Research and Quality - 2007 Report

In the US Breastfeeding is fragile

- US breastfeeding initiation rate is 74%, but declines rapidly
- Rates vary significantly by age, race, education level, income
- 12% of mothers meet the recommendation of exclusive breastfeeding to six months

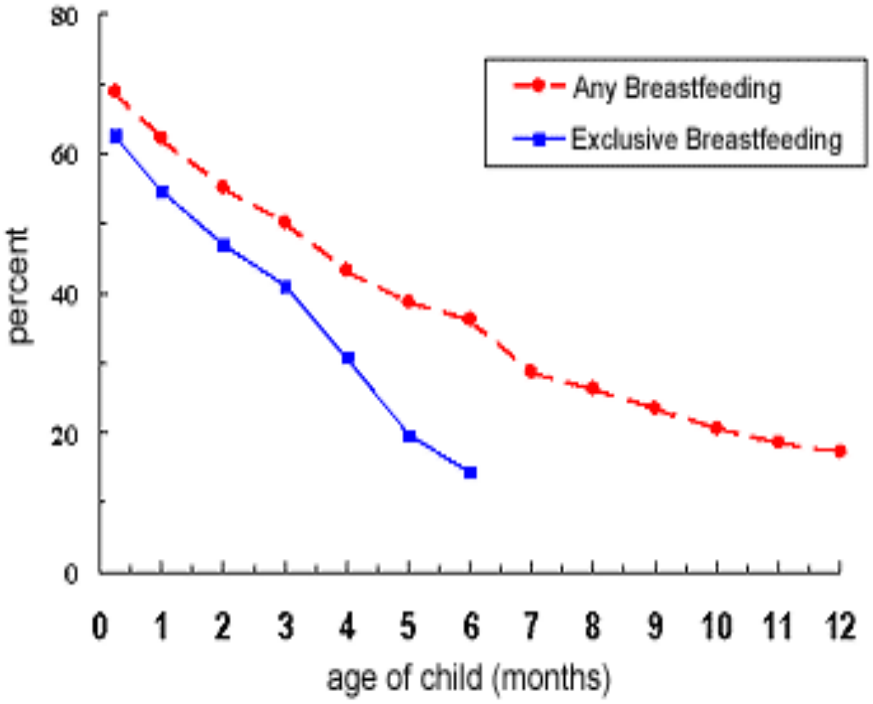
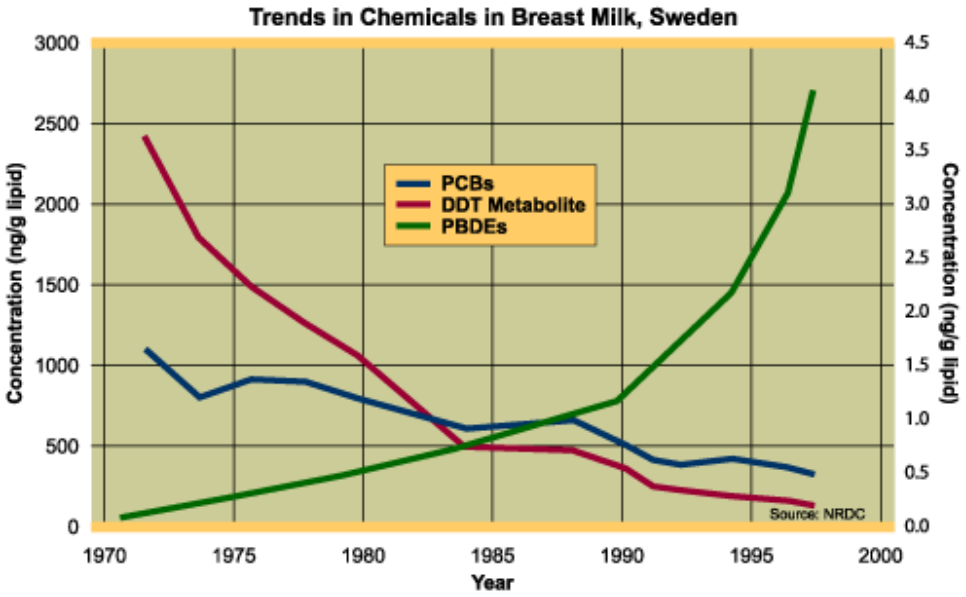


Fig. 1. Any and exclusive breastfeeding rates by age
2003 National Immunization Survey

Pros of reporting concentrations of pollutants in breast milk

- Important for regulating and banning compounds
- Provide individual women with helpful information about potential risks (they may want to change their behavior)



From: Meironyte *et al* ., 1999

Concentrations of Contaminants in breast milk

- Polybrominated diphenyl ethers and organochlorine pesticides (2007)
- Synthetic musk fragrances (2007)
- Perfluorinated compounds (2008)
- Polychlorinated biphenyls (2008)
- Bisphenol A (under review)

Perfluorinated Compounds in Human Milk from Massachusetts, U.S.A.

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Four of the nine PFCs measured occurred in ***23 or more of the 45*** breastmilk samples. The other five PFCs either were not detected or occurred in 5 or less of the 45 samples.

"We found that the daily ingestion rates of PFOS and PFOA did not exceed the tolerable daily intake recommended by the U.K. Food Standards Agency."

Concentrations were 1/100 of those found in female human serum

Research

Synthetic Musk Fragrances in Human Milk from the United States

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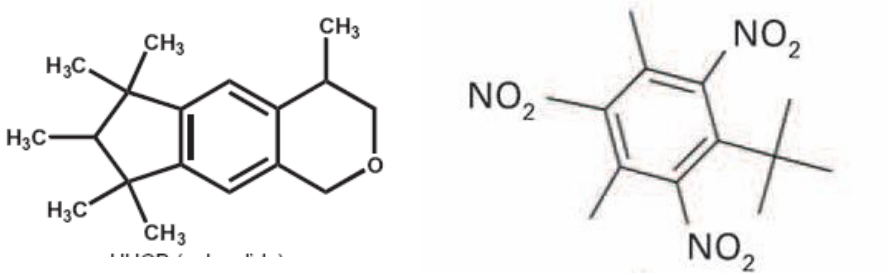
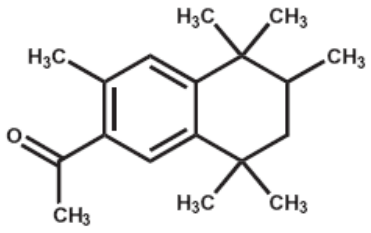
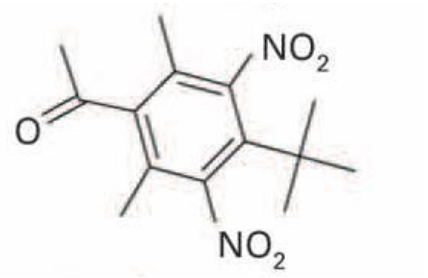






"Based on average daily ingestion rate of breast milk, an infant is estimated to ingest 297 ± 229 ng musk xylene, 780 ± 805 ng musk ketone, 1830 ± 1170 ng HHCB, 565 ± 614 ng AHTN, and 649 ± 598 ng HHCB-lactone per day. **The ingestion rate of synthetic musks by infants in the United States is lower than that estimated for persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs)**. Based on the residue patterns and accumulation features, it can be concluded that the exposure characteristics for synthetic musks are different from those of POPs, and that the major source of exposure to synthetic musks is probably via dermal absorption or inhalation."

Pros & Cons of reporting concentrations of pollutants in breast milk

- Important for regulating and banning compounds
- Provide individual women with helpful information about potential risks (they may want to change their behavior)

- Results are difficult for non-scientists to interpret
- Results may be misrepresented in the press
- Lack of understanding may cause women to worry unnecessarily or **stop breastfeeding**

Endocrine disruptors in…

	PubMed	Google
Breast Milk	20	~31,900
Infant Formula	4	~11,800
Cow Milk	2	~6,480

Endocrine disruptors and other pollutants are present in formula and cow's milk

Soy Baby Formula
EEQ = 1700 ng/L
265 ng/4 oz Bottle

From: presentation by S. Snyder

Conclusions (part 1)

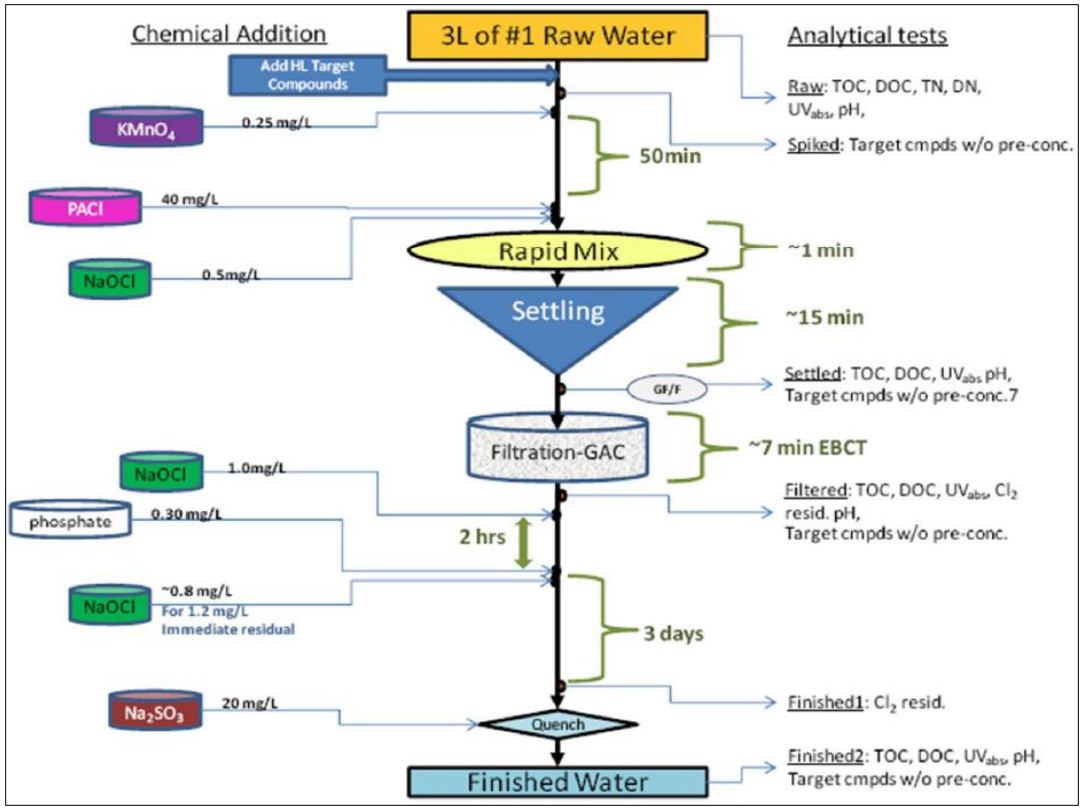
- Mechanistic-based bioassays that report only whether a compound is above (positive) or below (negative) the allowed limit could be helpful in reducing the anxiety and confusion associated with reporting concentrations.

  Important that bioassays detect all compounds - multiple mechanisms

- Cow's milk and formula should be tested and provided as a comparison when reporting contaminants in human breast milk.

Assessing the effectiveness of municipal drinking water treatment processes to remove EDCs and PPCPs

- Water Utility Companies provided samples of their **source water**
- A cocktail of pollutants was added to source water to provide the **spiked water**



- Spiked water was run through a replica of the treatment facility to produce **finished water**

Japanese Medaka Bioassay

Exposed male medaka fish

Source Water

Spiked Water

Finished Water

Positive Controls

Negative Control

After 48 hours (with water exchange at 24 hours) sacrificed fish, collected tissues and measured responsive genes with real time RT-PCR

Results

- None of the **source waters** had estrogenic or dioxin-like activity.
- All of the **spiked waters** had activity.
- There was no activity in 3 of 4 **Finished waters**
  - Results were provided directly to the Water Utility Companies

Conclusions/Future Needs

- Currently, tests with adult fish (fat head minnows and medaka) represent state-of-the-art testing for endocrine disruptors for the US EPA
- Short-term bioassays (cell-based, embryo) that do not require extraction or concentration would be valuable
- Long-term bioassays that do not include fish sacrifice (reporter fish) would be extremely valuable and well received
  - ***Let the fish concentrate the pollutants***

Collaborators

David Reckhow, Environmental Engineering, UMass- Amherst
US EPA
Massachusetts Department of Conservation
Water Utility Companies of Massachusetts

Thank you

army of women
LOVE/AVON Going Beyond a Cure

AVON Foundation for Women

Congressionally Directed Medical Research Programs
CDMRP
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