

Danish Pesticide Monitoring Programme 2004-2011: Assessment of cumulative dietary exposure of the Danish population

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$$f(x+\Delta x) = \sum_{i=0}^{\infty} \frac{(\Delta x)^i}{i!} f^{(i)}(x)$$

$$\int_a^b \epsilon \Theta + \Omega \int \delta e^{i\pi} = \{2.7182818284\}$$

$$\sqrt{17}$$

$$\infty$$

$$\chi^2$$

$$\sum$$

$$\gg$$

$$!$$



Overview

- **Average residue concentration:**
Modeling with left censored data
- **Cumulative exposure:**
Risk assessment of mixtures of pesticides
- **Results:**
Exposure and Hazard Index from
pesticide residues in Danish diets

Funding

 Monitoring activities:



Danish food authority, the Danish Veterinary and Food Administration.



Data collection and risk assessment at DTU Food:
Ministry of Food, Agriculture and Fisheries of
Denmark.

Data sources

- **Pesticide monitoring data**
 - Official control Denmark 2004 – 2011
 - Samples: 14 000 (excluding 3 400 without residues – organical grown, babyfood, animal products)
 - Commodities: 130 (excluding 120 without residues or only few samples)
 - Pesticides (residue definitions) searched: 250 (including 10 without ADI)
 - Analysis performed at accredited official laboratory
 - Data collection format: EFSA Standard Sample Description (SSD)

Data sources

- **Processing factors (peeling)**
 - JMPR; Rapport 7/98 Statens Livsmedelverk, Sweden
- **ADI values**
 - EU Pesticide database; JMPR; EFSA
- **Consumption data**
 - Danish National Dietary Survey 2003-2008
(7 days, 2700 persons, 4-75 years)

Calculation of exposure from the diet

- **Exposure has been calculated from**
 - Average consumption
 - Average concentration of pesticide residuei.e. **DETERMINISTIC**, not probabilistic
- **Toxicological reference value:**
 - ADIi.e. **CHRONICAL**, not acute effects

Calculation of exposure

- One pesticide in one commodity:

$$- \textit{Exposure} = \frac{C * M}{w} \quad (mg/kg \textit{ bw/day})$$

C = Average residue concentration in commodity,

M = Average consumption of commodity, w = body weight



- One pesticide, all commodities:

$$- \textit{Exposure} \textit{ (one pesticide)} = \sum \frac{C_i * M_i}{w}$$

$$- \textit{Hazard Quotient} = \textit{Exposure} / \textit{ADI} (\%)$$



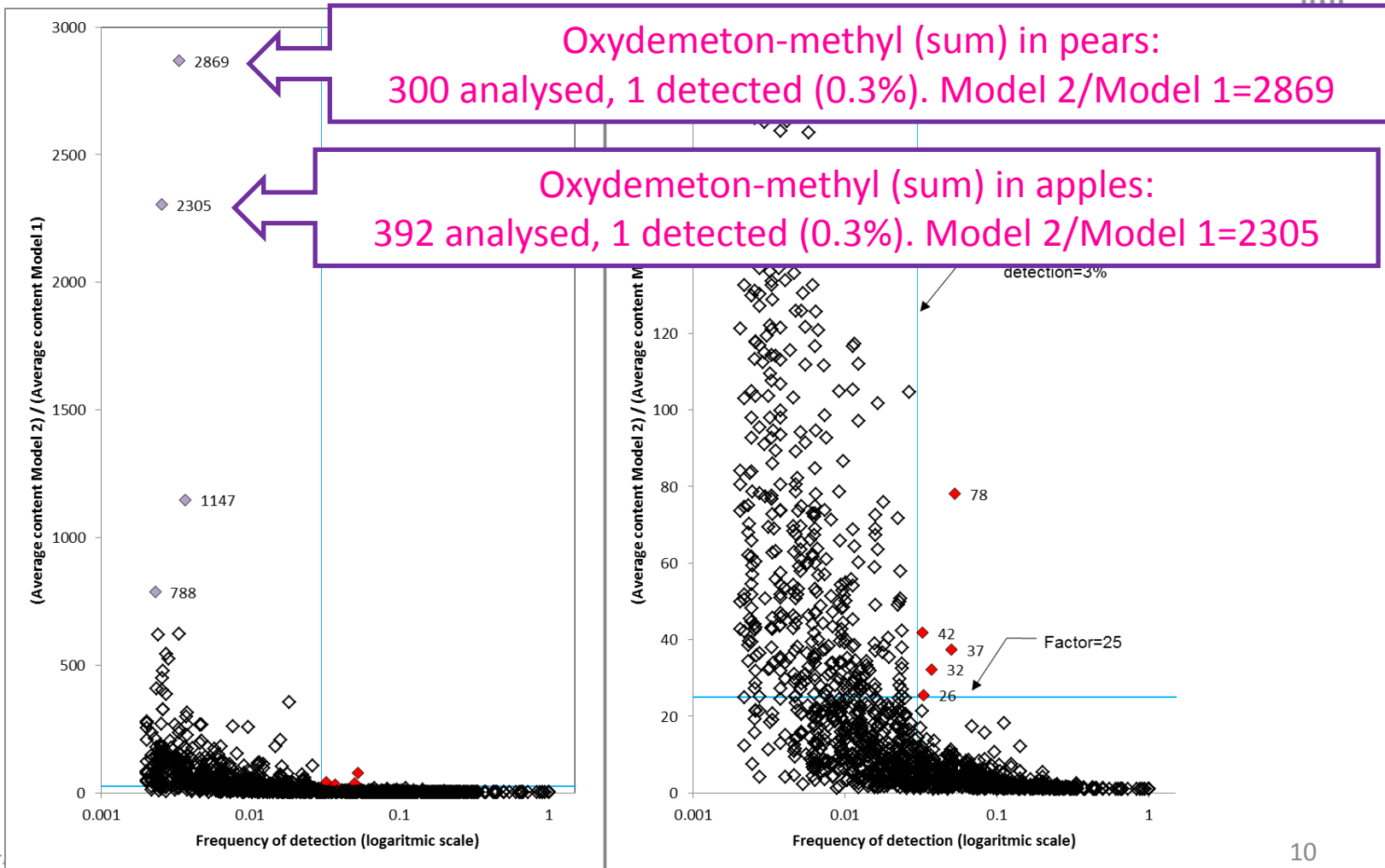
Calculation of average concentration

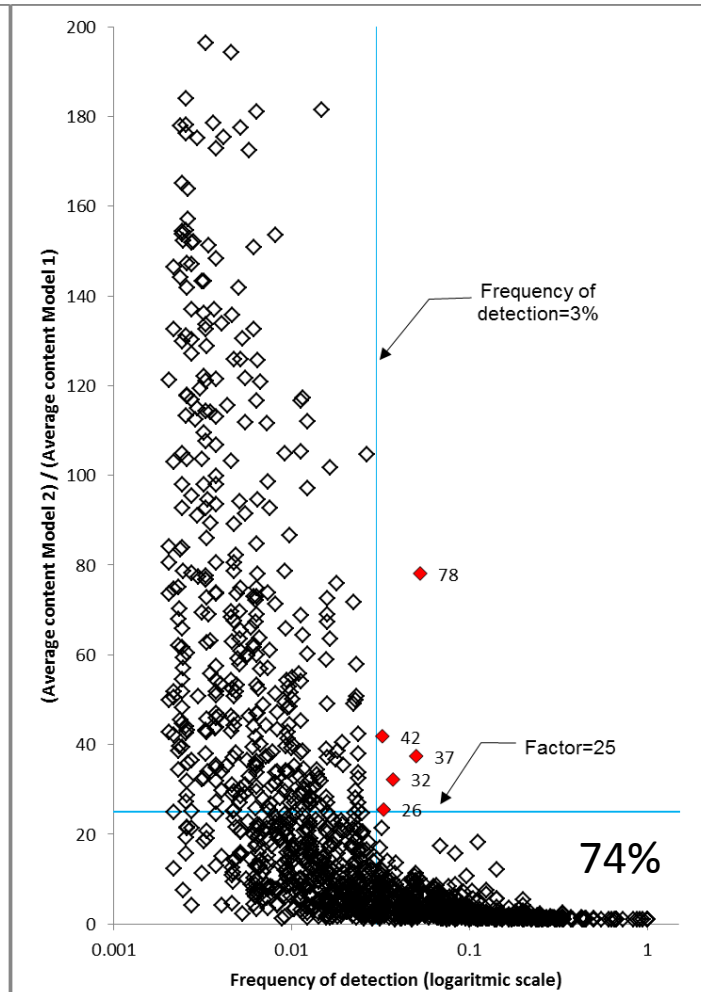
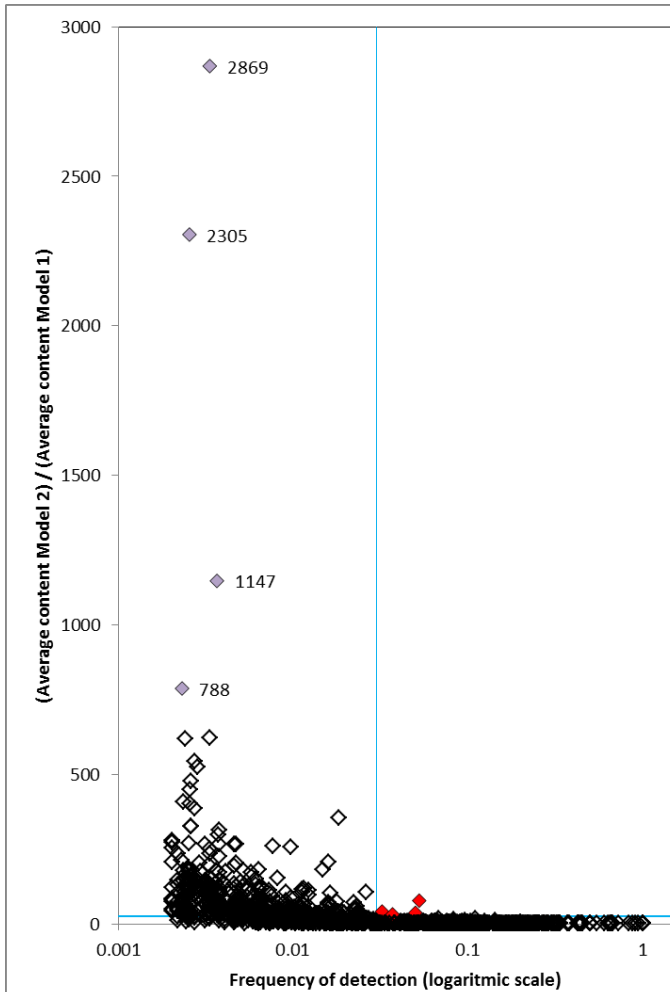
- How to deal with left censored data ???



Calculation of average concentration

- Grouping in calculations:
 - One pesticide (Residue definition)
 - One commodity
 - One origin (Domestic or foreign)
- Models for average residue concentration:
 - Model 1: Not detected => 0 (zero)
 - Model 2: Not detected => $\frac{1}{2}$ LOQ (if detected in group)
 - Model 3: Lowest value of: Model 2 –or– $25 * \text{Model 1}$





Calculation of exposure from the diet

- All pesticides, all commodities (diet):



- *Exposure* (all pesticides) = $\sum Exposure (pesticide_j)$

- *Hazard Index* = $\sum Hazard\ Quotient (pesticide_j)$

- The Hazard Index Method presumes **additive effects** from different pesticides
- In general, interactions between pesticides are not known.
- Assuming additive effects is considered a conservative (i.e. pessimistic) approach for most interactions

Cumulative exposure from the diet

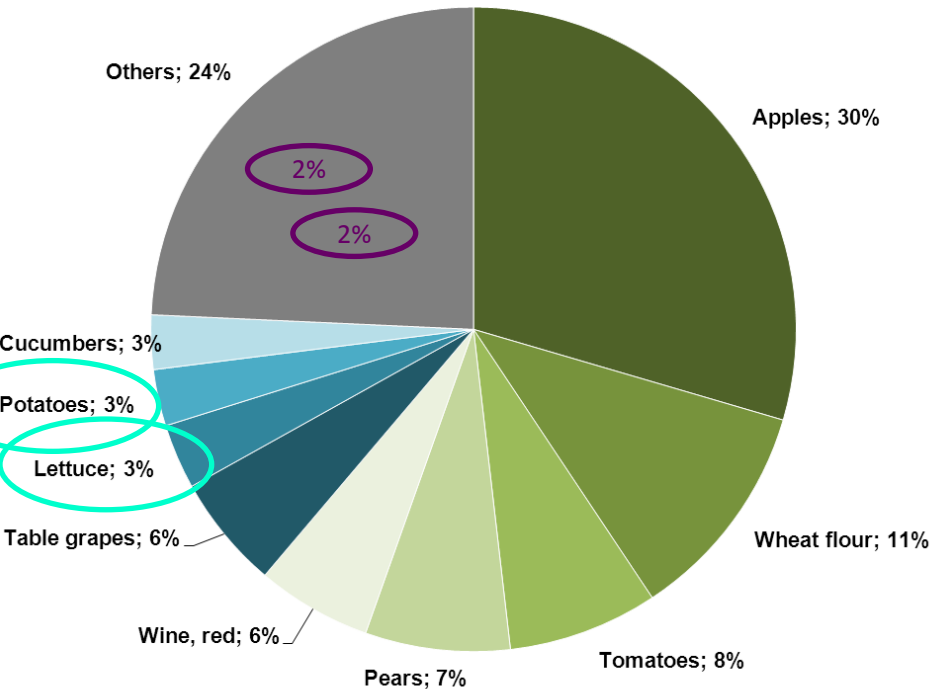
- Model 1: Not detected => 0 (zero)
- Model 2: Not detected => ½LOQ (if detected in group)
- Model 3: Lowest value of: Model 2 –or– 25*Model 1

Correction for undetected residues:	Hazard Index		
	Model 1	Model 3	Model 2
Adults, no reduction for peeling	7%	23%	49%
Children, no reduction for peeling	14%	56%	124%
Adults (15 - 75 years)	4%	18%	42%
Children (4 - 6 years)	10%	44%	108%

Commodities: Contributions to Exposure and Hazard Index (Model 3, adults)

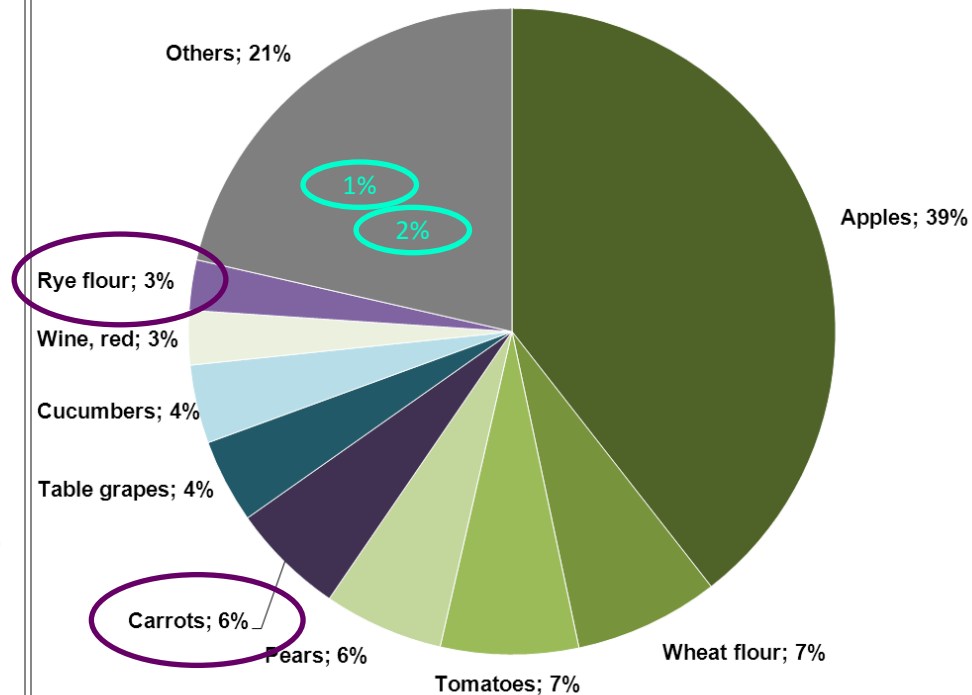
Contributions to exposure

Exposure: 1.9 $\mu\text{g}/\text{kg bw}/\text{day}$



Contributions to Hazard Index

Hazard Index: 18%



Consumer groups and preferences

Consumer group	Exposure ($\mu\text{g}/\text{kg bw}/\text{day}$)	Exposure ($\mu\text{g}/\text{day}$)	Hazard Index
Adults, average consumption	1.9	146	18%
Men, average consumption	1.6	134	14%
Women, average consumption	2.2	151	20%
Children, average consumption	4.5	98	44%

Consumer groups and preferences

Consumer group	Exposure ($\mu\text{g}/\text{kg bw}/\text{day}$)	Exposure ($\mu\text{g}/\text{day}$)	Hazard Index
Adults, average consumption	1.9	146	18%
Men, average consumption	1.6	134	14%
Men, high consumption ¹⁾	3.2	261	29%
Women, average consumption	2.2	151	20%
Women, high consumption	3.5	240	33%
Children, average consumption	4.5	98	44%

¹⁾ ≥ 550 g fruit and vegetables/day (excluding potatoes)

Consumer groups and preferences

Consumer group	Exposure ($\mu\text{g}/\text{kg bw}/\text{day}$)	Exposure ($\mu\text{g}/\text{day}$)	Hazard Index
Adults, average consumption	1.9	146	18%
Adults, average consumption, domestic preferred ²⁾	1.0	76	8%
Men, average consumption	1.6	134	14%
Men, average consumption, domestic preferred	0.8	67	6%
Men, high consumption ¹⁾	3.2	261	29%
Men, high consumption, domestic preferred	1.5	125	13%
Women, average consumption	2.2	151	20%
Women, average consumption, domestic preferred	1.2	80	10%
Women, high consumption	3.5	240	33%
Women, high consumption, domestic preferred	1.8	125	16%
Children, average consumption	4.5	98	44%
Children, domestic preferred	2.4	52	20%

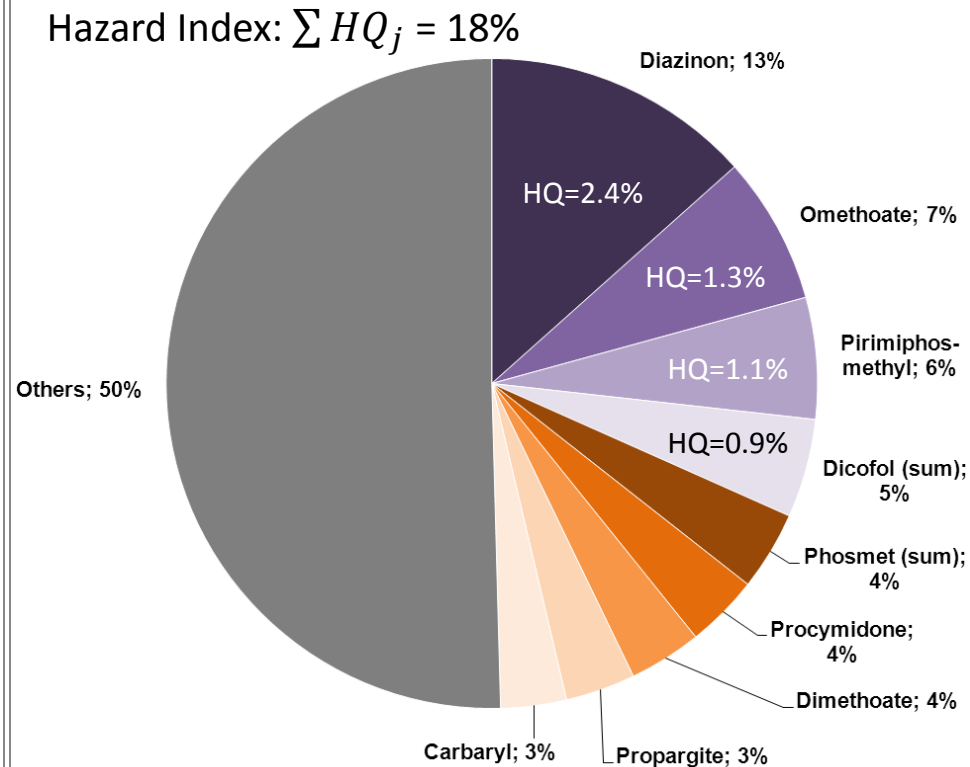
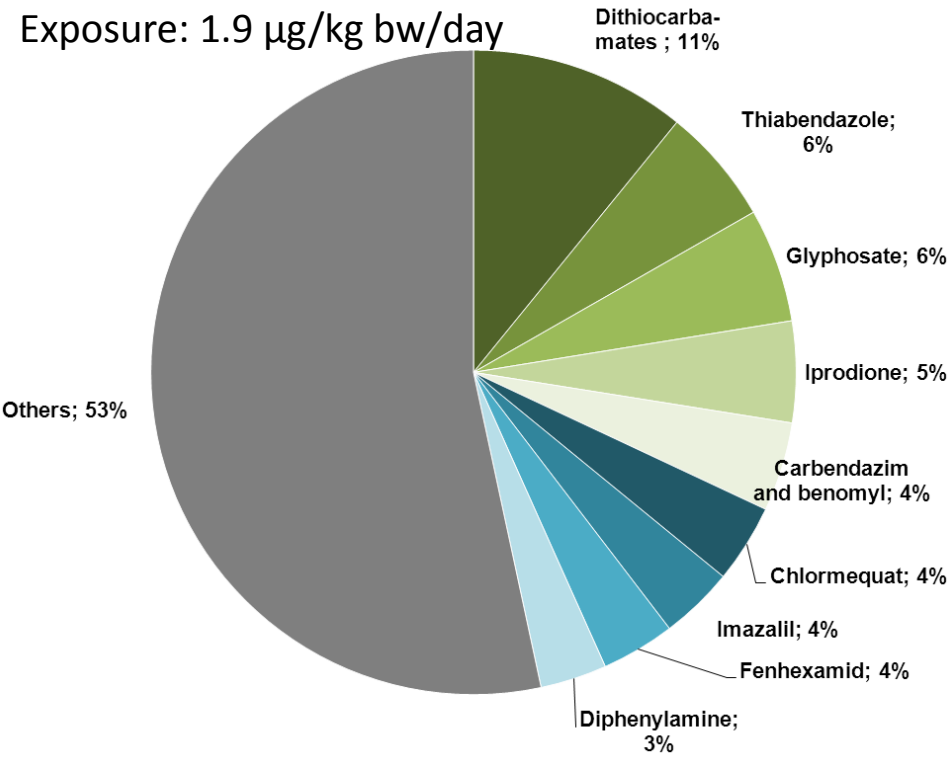
¹⁾ ≥ 550 g fruit and vegetables/day (excluding potatoes)

²⁾ Domestic when possible, e.g. domestic apples, foreign oranges

Pesticides: Contributions to Exposure and Hazard Index (Model 3, adults)

Contributions to exposure ($\mu\text{g}/\text{kg bw}/\text{day}$)

Contributions to Hazard Index



Aqknowledgements

Most of the presented results were based on the report

Pesticide Residues – Results from the period 2004 – 2011

(<http://www.food.dtu.dk/english/Publications/Food-safety/Chemical-contaminants>)

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