

Imperial College London Consultants University of Reading fera Food Standards Agency

Potential transfers of organic contaminants to the human foodchain from the use of organic waste materials as fertilizers and soil improvers

Hannah Rigby¹, Sophia Acker¹, Alan Dowding², Alwyn Fernandes³, David Humphries⁴, Rupert G. Petch³, Radu Rautiu¹, Christopher K. Reynolds⁴, Martin Rose³, Stephen R. Smith¹

¹Imperial College Consultants Ltd., ²The Food Standards Agency, ³Fera Science Ltd., ⁴The University of Reading

Overview

- Organic Contaminants
- Waste-Derived Products
- Dairy Cattle Trial - Methods and Outcomes
- Conclusions



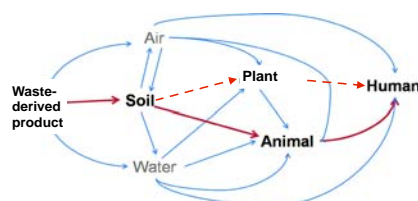
Organic Contaminants in the Environment



- Over 135 million unique chemicals in CAS database
- ~160,000 registered for industrial use in Europe
- Environmental and health concerns:
 - Toxicity, mutagenicity, carcinogenicity, endocrine disruption, developmental toxins, ecotoxicity, antibiotic resistance



Transfer Pathways to the Food Chain



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Waste Derived Products



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Organic Contaminants in Waste-Derived Products

	Biosolids	CLO	MBMA	PLA	PSA	Reference
PCDD/Fs & non-ortho PCBs (ng TEQ kg ⁻¹ DS)	14.6-20.4	18.9-12.0	7.5-84.8	1.0-12.7	0.2	20 ^a
Ortho PCBs (SUM µg kg ⁻¹ DS)	29.4-73	25.4-29.8	0.6-3.2	0.9-1.0	0.9	220 ^a
PBDD/Fs & non-ortho PBBs (ng TEQ kg ⁻¹ DS)	40.3-17.9	18-32.2	0.3	0.4-5	0.09	20 ^a
Ortho PBBs (SUM µg kg ⁻¹ DS)	0.05-0.06	0.1-0.4	0.01	0.01	0.01	220 ^a
PXDD/Fs (ng TEQ kg ⁻¹ DS)	0.20-0.27	0.18-0.29	0.24-0.57	0.06-0.21	0.10	20 ^a
PXBs (ng TEQ kg ⁻¹ DS)	0.02	0.014-0.02	0.01-0.02	0.01-0.03	0.018	20 ^a
PAHs (PAH16 µg kg ⁻¹ DS)	1125-2144	2481-3792	105-206	27.8-56.5	1575	4000 ^c
PBDEs (SUM µg kg ⁻¹ DS) (including BDE 209)	4393-6781	1717-1761	0.8-1.0	0.26-3.26	2.13	1400 ^c
Deca-BDE 209 (µg kg ⁻¹ DS)	4200-5690	1650-1720	0.6-0.7	<0.2 - 3.0	1.4	1000 ^c
HBODs (µg kg ⁻¹ DS)	5.5-490	3-536	<0.01-0.2	<0.01-0.1	<0.01	200 ^d
PBCD (µg kg ⁻¹ DS)	7.0	13-351	<0.09	<0.03		0.20 ^a
TBBPA (µg kg ⁻¹ DS)	33-45.2	100-517	<0.36	42		280 ^a
PCNs (ng kg ⁻¹ DS)	541-743	680-1980	45.4-108	8.8-61.5	39.4	44000 ^a
PFOS (µg kg ⁻¹ DS)	60.9-204	8.9-35.4				200 ^a
PCAs (short and medium chain) (µg kg ⁻¹ DS)	5425-140700	1100-59500	9-244	6-28	6	959000 ^b
Centile	0-25	25-50	50-75	75-100	>100	

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Dairy Cattle Trials - Methods

- 16 lactating dairy cows per trial
- Four treatments per trial – Biosolids, Biosolids-soil, CLO-soil, Control
- Groups housed in separate pens, bedded on straw
- Ingestion levels of 5% DM
- Cows fed once daily
- Fed treatments for a period of 3 weeks (4 weeks for biosolids treatment)
- Four week withdrawal period until week 7 (8 for biosolids treatment)
- Animals milked twice daily
- Measurements: diet composition, feed intake, live weight and milk yield and composition
- Milk samples stored weekly



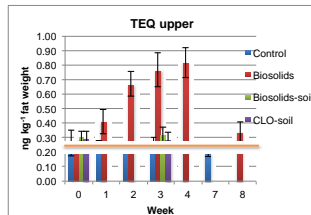
Transfer to the Milk of Grazing Cattle

Treatment	Biosolids	Biosolids-soil	CLO-soil	MBMA-soil	PLA-soil	PSA-soil
PCDD/Fs	✓	x	x	x	x	x
Non-ortho PCBs	✓	x	x	x	x	x
Ortho PCBs	✓	x	x	x	x	x
PBDD/Fs	✓	x	x	x	x	x
Non-ortho PBBs	x	x	x	x	x	x
Ortho PBBs	✓	x	x	x	x	x
PXDD/Fs	x	x	x	x	x	x
PXBs	✓	x	x	x	x	x
PAHs	x	x	x	x	x	x
PBDEs	✓	x	x	x	x	x
BDE 209	✓	x	x	x	x	x
BB 209	x	x	x	x	x	x
HBODs	x	x	x	x	x	x
PBCD	x	x	x	x	x	x
TBBPA	x	x	x	x	x	x
PCNs	✓	x	x	✓	x	x
PFASs	✓	x	x	x	x	x
Chlorobenzenes	x	x	x	x	x	x
PCAs	✓	✓	x	x	x	x
HBB	x	x	x	x	x	x
BTBPE	x	x	x	x	x	x

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Results – PCDD/Fs



— = FSA 2012 TDS value for milk (0.25 ng TEQ kg⁻¹ fat) (Fera, 2012)
Error bars show standard deviation

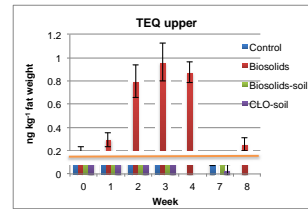
EC: European Commission (2011) Commission regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non dioxin-like PCBs in foodstuffs. *Official Journal* L320, 18-23.

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- Transfer of PCDDs (7 of 7 congeners) and PCDFs (7 of 10 congeners) to milk was observed in the biosolids treatment only
- The TEQ due to PCDD/Fs was raised in the biosolids treatment in comparison to the control
- The TEQ remained below the EU Maximum Level of 2.5 ng TEQ kg⁻¹ fat for PCDD/Fs (EC, 2011)

Results – PBDD/Fs



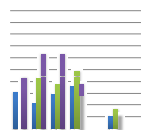
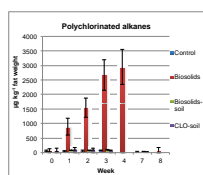
— = FSA 2012 TDS value for milk (0.163 ng TEQ kg⁻¹ fat) (Fera 2012)

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- Transfer of PBDD/Fs to milk was observed in the biosolids treatment (10 of 11 congeners)
- The transfer was particularly significant for PBDFs
- TEQ attributed to the PBDD/Fs was elevated in biosolids treatment
- PBDD/Fs transfer to milk to a lesser extent than PCDD/Fs

Results - Polychlorinated Alkanes in Milk



- Significant concentrations of PCAs were transferred to the milk in the biosolids treatment
- PCAs were present in greater concentrations in the milk of cattle ingesting the biosolids-soil and CLO-soil treatments compared to the control.

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