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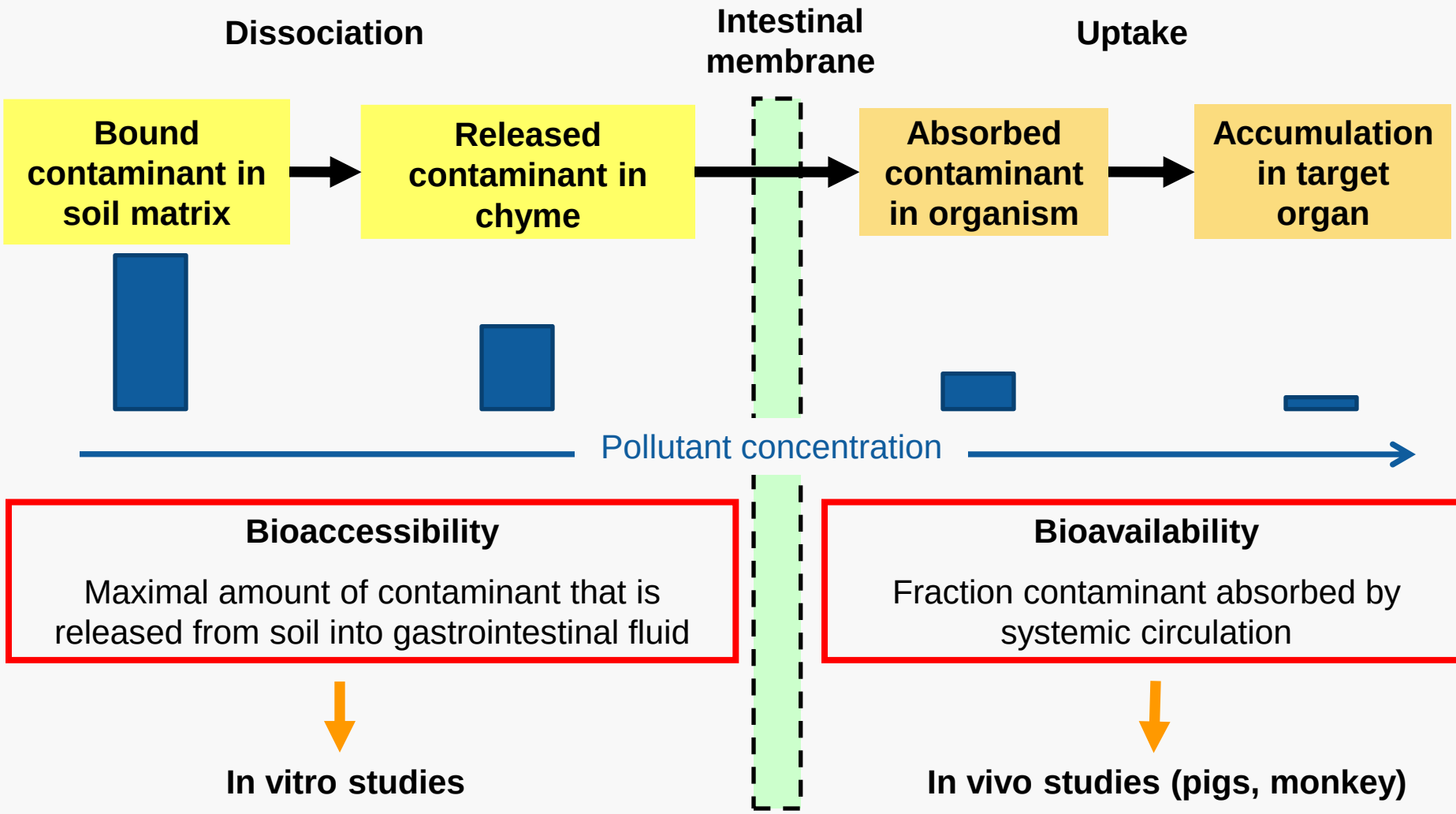
Towards a unified approach for the determination of the bioaccessibility of organic pollutants

Chris Collins

Bioaccessibility and bioavailability



Why do we do bioaccessibility tests?

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The Telegraph

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Allotments really are good for your health

Keeping an allotment really is good for your health, the first study t directly has found.

By Stephen Adams, Medical Correspondent
6:30AM GMT 23 Nov 2010

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1 Comment

Dutch researchers have found that allotment keepers in their 60s tend to be significantly healthier than their more sedentary neighbours.

While plenty of anecdotal evidence exists to suggest growing one's own fruit and vegetables protects against ill-health, no one had carried out such a direct comparison before.

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News › Politics › Planning policy

Free up green-belt land for new housing, says Policy Exchange

Thinktank set up by new planning minister, Nick Boles, argues that releasing 2% of land would create extra 8m homes

Nicholas Watt, chief political correspondent
guardian.co.uk, Thursday 13 September 2012 07.00 BST
Jump to comments (...)

Nick Boles was appointed as planning minister in last week's reshuffle. Photograph: Christopher Thomond for the Guardian

Green-belt land in England should be freed up for new housing

Why do we do bioaccessibility tests?

- Fine tune risk assessments of human exposure, particularly when soil concetration close to guidance value
- Reliance on total contaminant soil concentrations is likely to over-estimate risks, resulting in unnecessary determinations and remediation.
- Ingestion dose for critical pathway in many scenarios e.g. new housing, urban agriculture

Where are we now ?

- '…. part of body of evidence….'

  EA, England and Wales

- Flanders bioaccessibility HHRA for PAH
- 'Careful use of oral bioaccessibility data in DQRAs can help clarify risks and has been supported by CLRs but its limitations and uncertainties must be recognised.'

  CIEH

- But generally applied for toxic elements. Even then regulatory guidance not complete.

What factors determine an acceptable test?

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BARGE (Bioaccessibility Research Group in Europe)

- It should be physiologically based, mimicking the human GI physico-chemical environment in the stomach and small intestine (colon).
- It should represent a conservative case;
- There should be one set of conditions for all potentially harmful elements (PHE) being studied;
- It must be demonstrated that the test is a good analogue of in vivo conditions
- The test must be able to produce repeatable and reproducible results within and between testing laboratories.

Idealised physiologically based extraction test system

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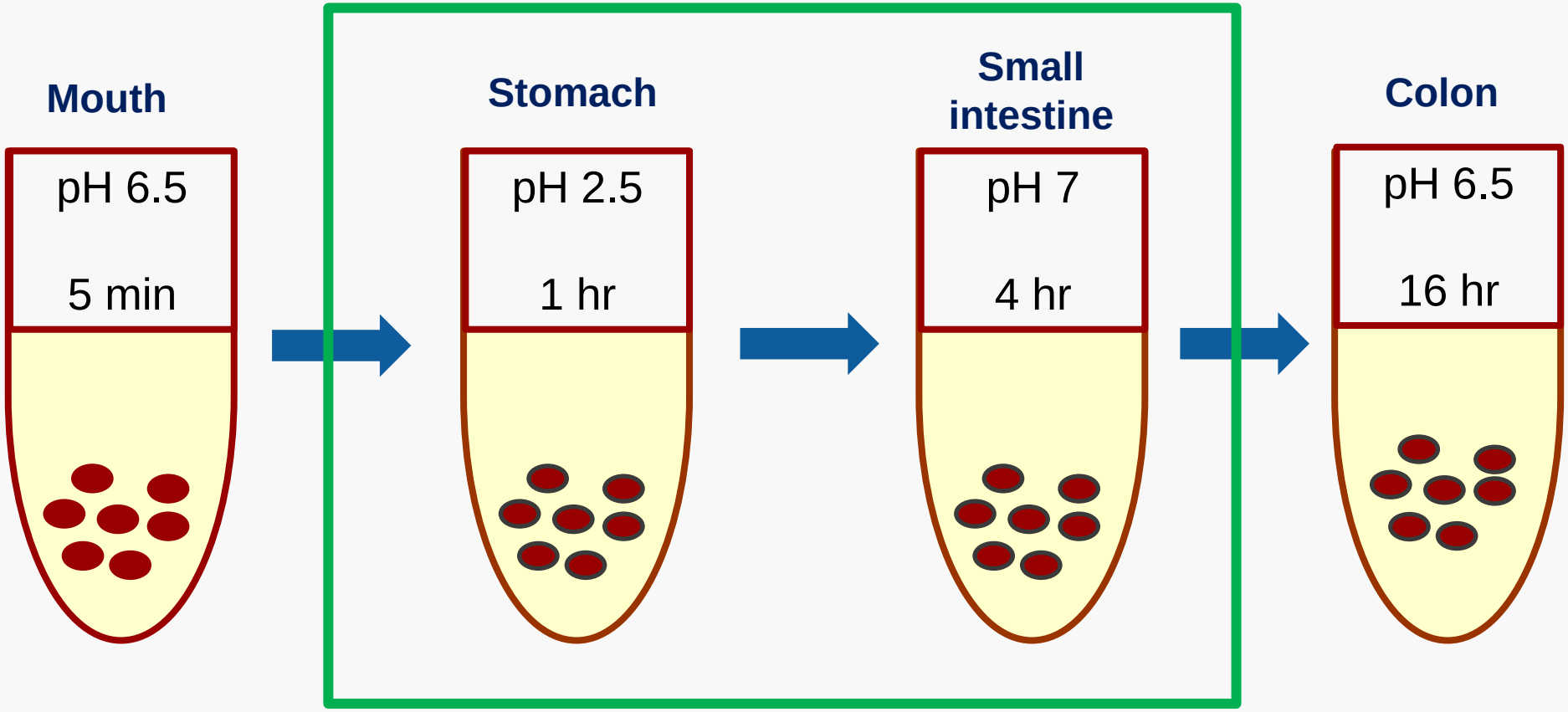
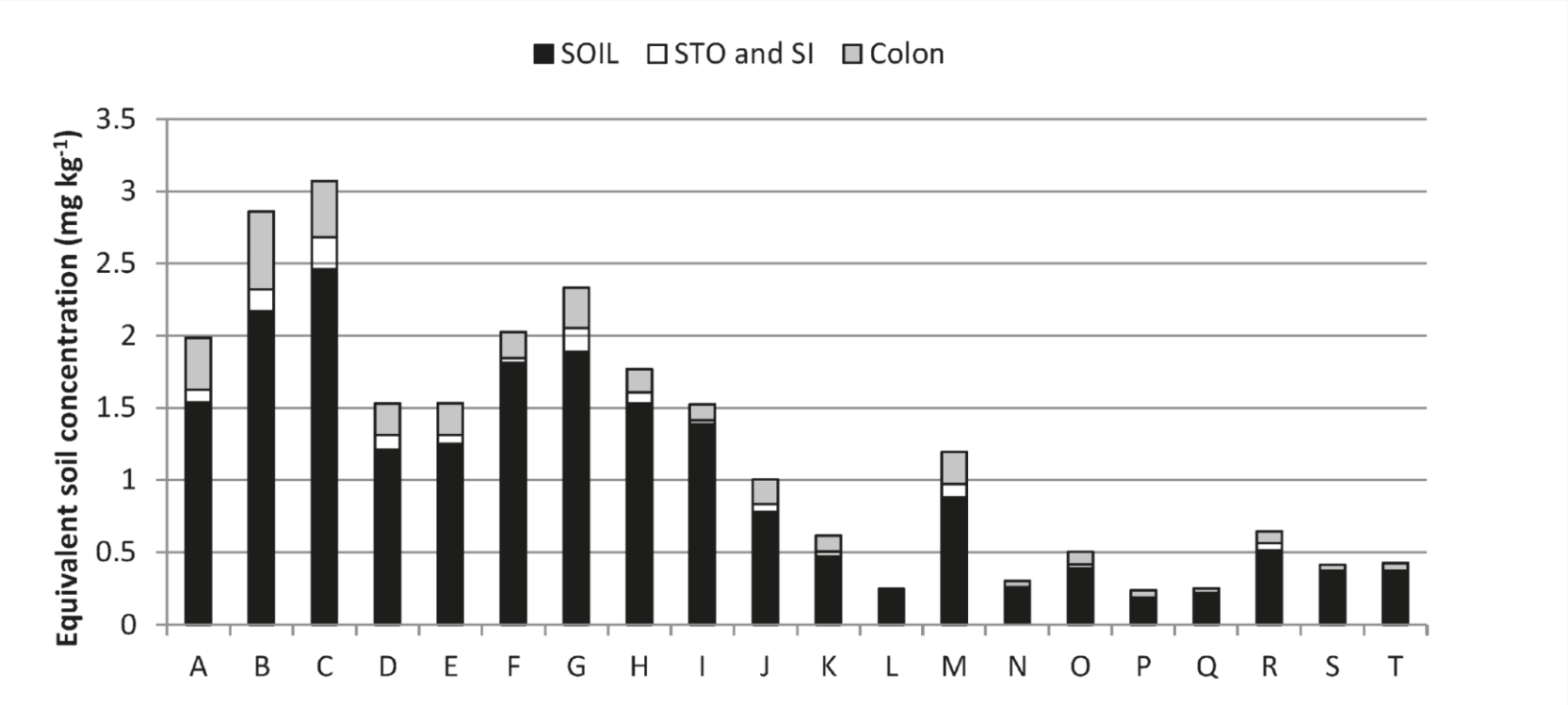


Standard format?

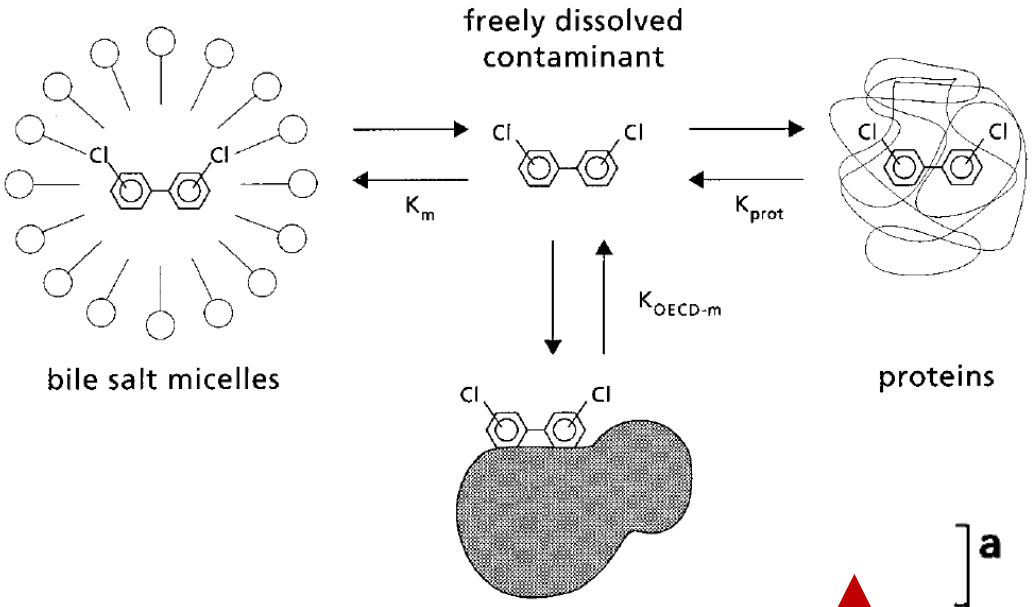
Model	Researchers	Compartments	Dietary status	Bile salts (g l^{-1})
FOREhST	Cave et al	Saliva, stomach, SI	Fed	1.1
SHIME (dynamic)	Cave et al	Stomach, SI, colon	Fed	2.5
CEPBET	Tilston et al	Stomach, SI, colon	Fed	1.75
PBET	Yu et al.	Saliva, stomach, SI	Un fed	0.9
PBET	Wang et al.	Stomach, SI	Un fed	2.5

Importance of the colon



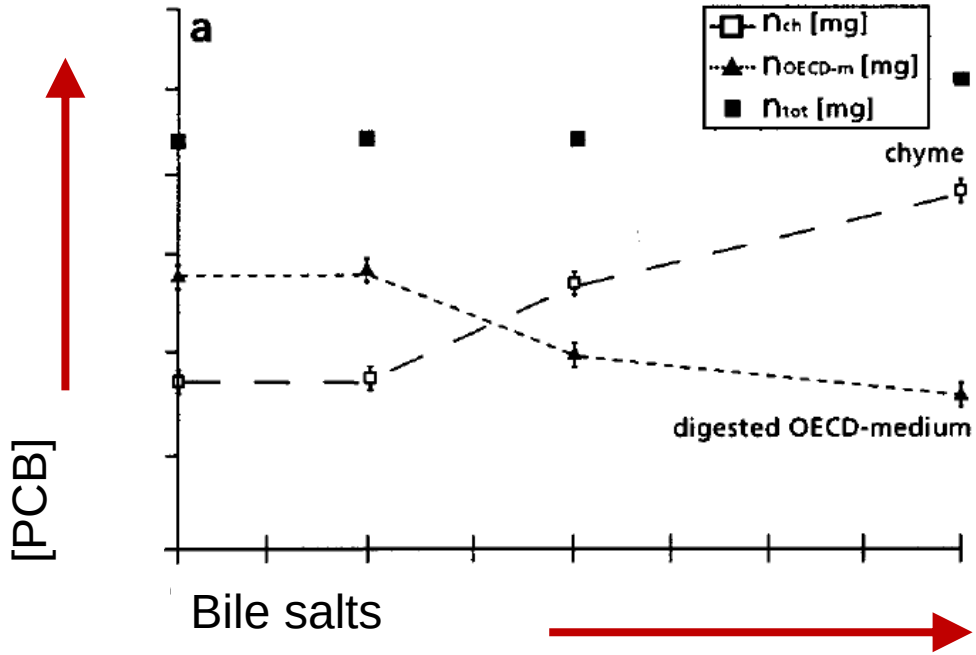
Tilston et al (2011) EST 45:5301- 5308

Influence of bile salts



Oomen, et al 2000. ES&T 34, 297-303.

Liquid to solid ratio and other test components e.g. proteins also have an impact.



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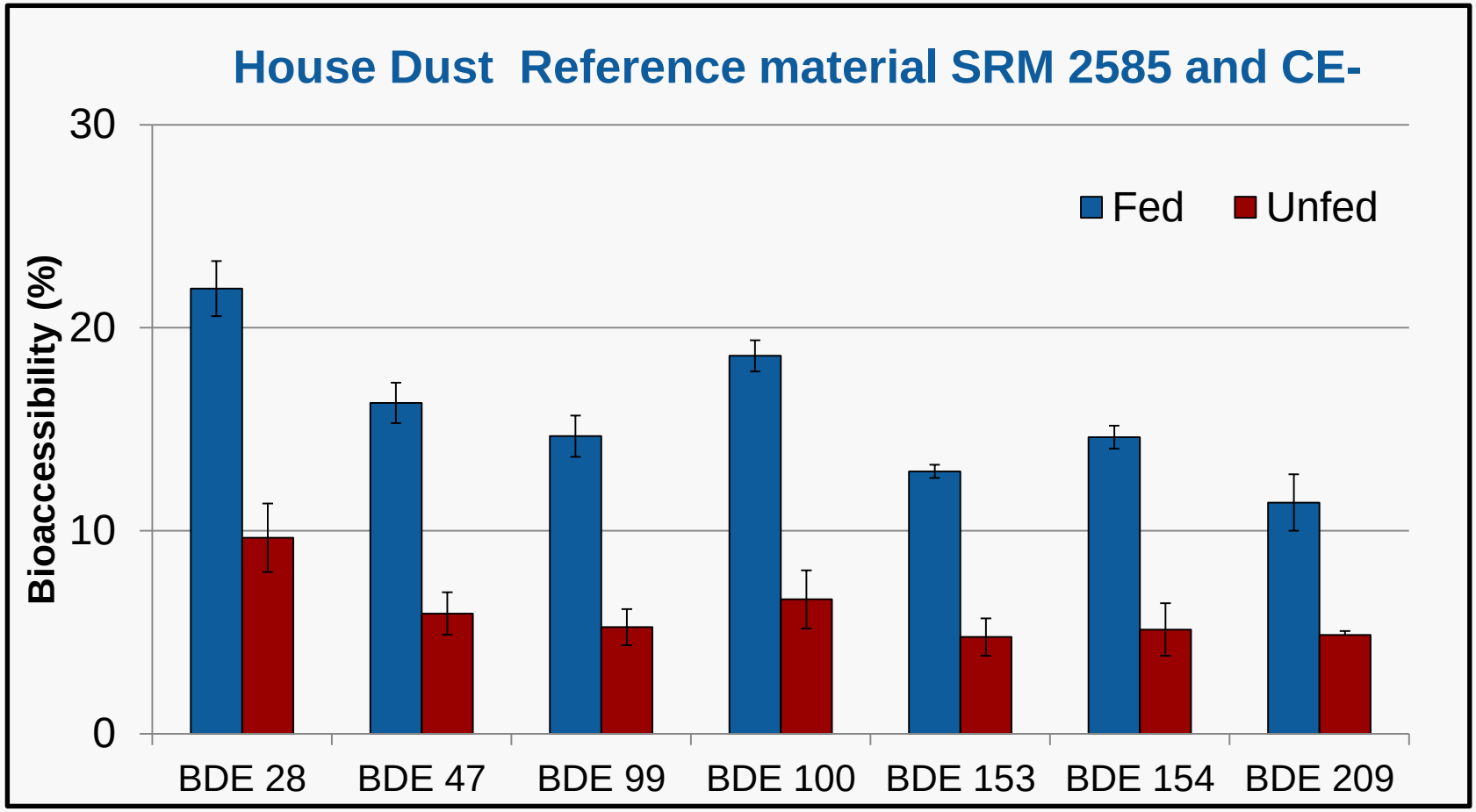
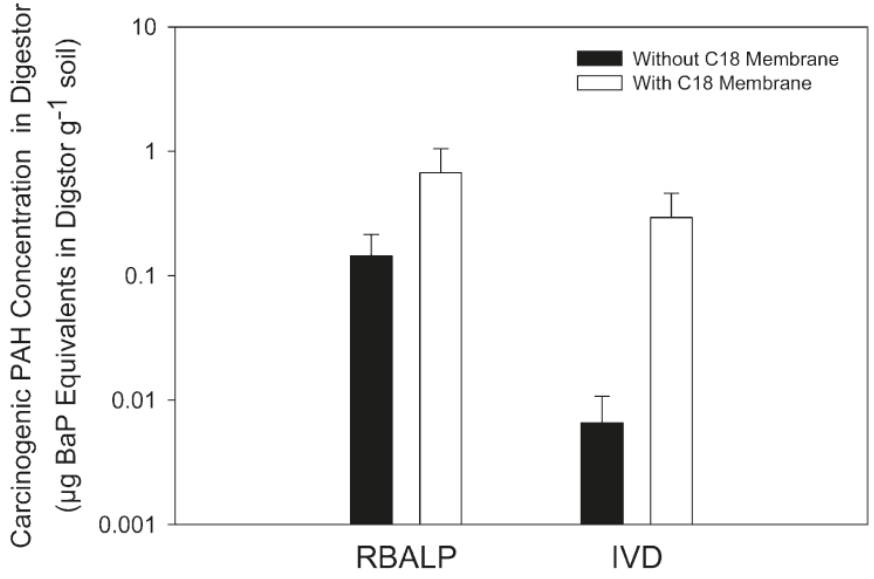
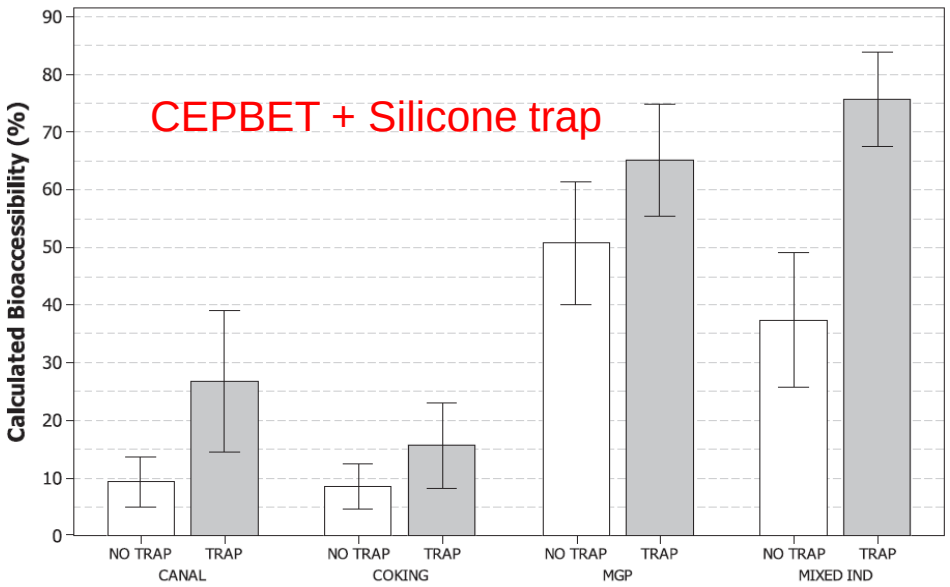
Fed state required



Do we need ‘sinks’

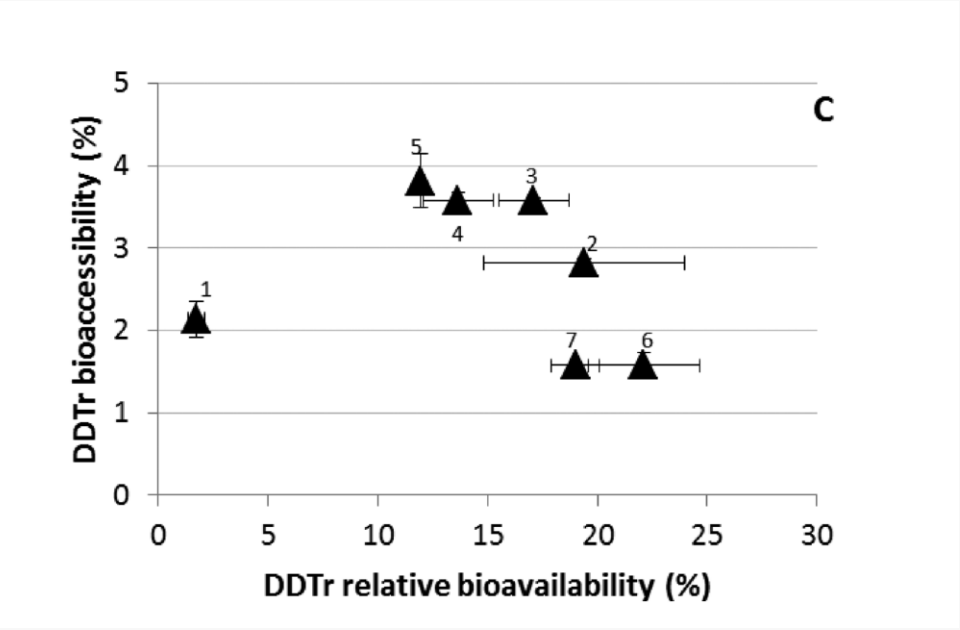


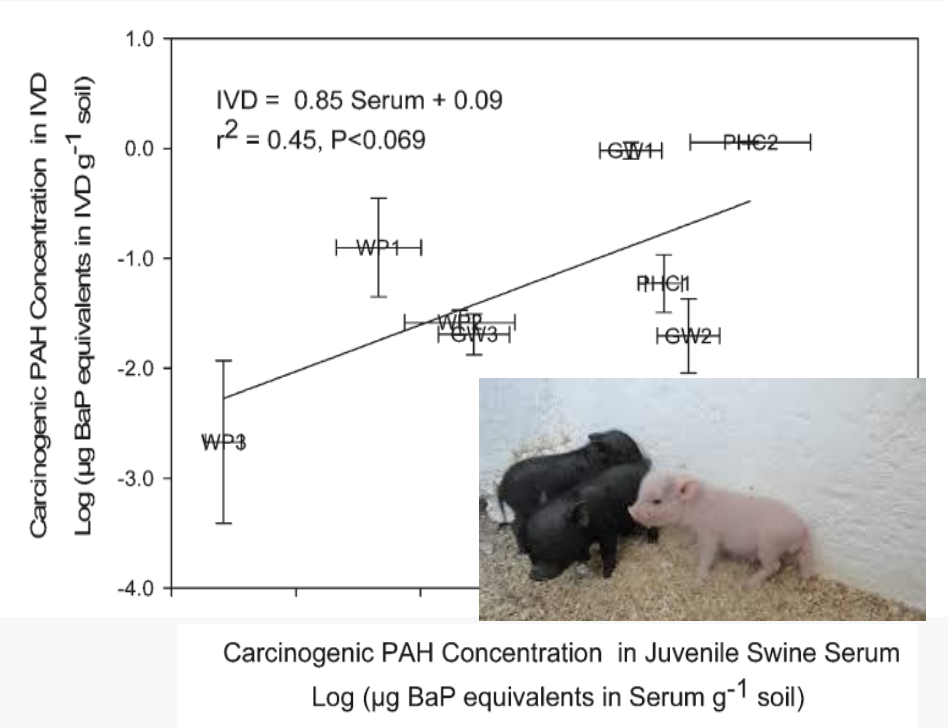


James et al (2011) EST 45:4586-4593

Collins et al (2013) Env. Poll. 181:128-132

In vivo

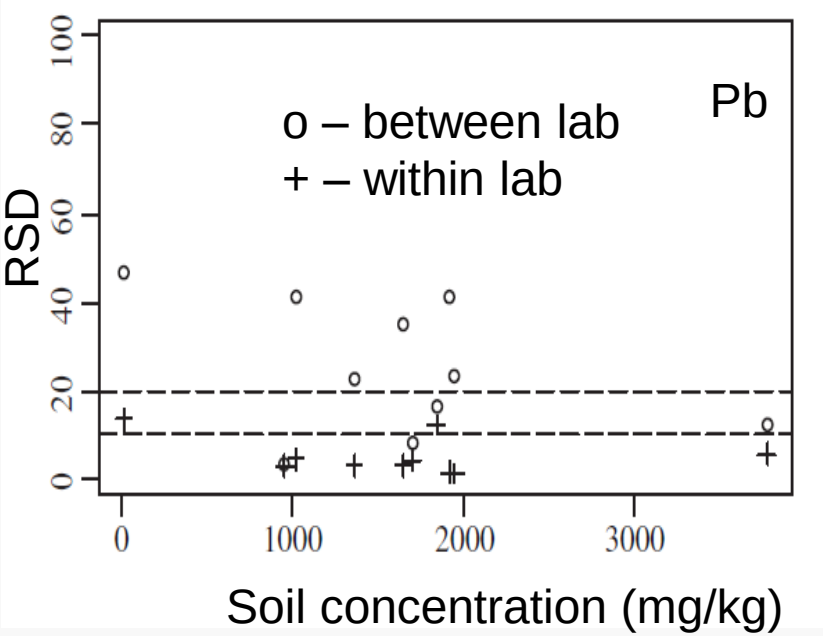


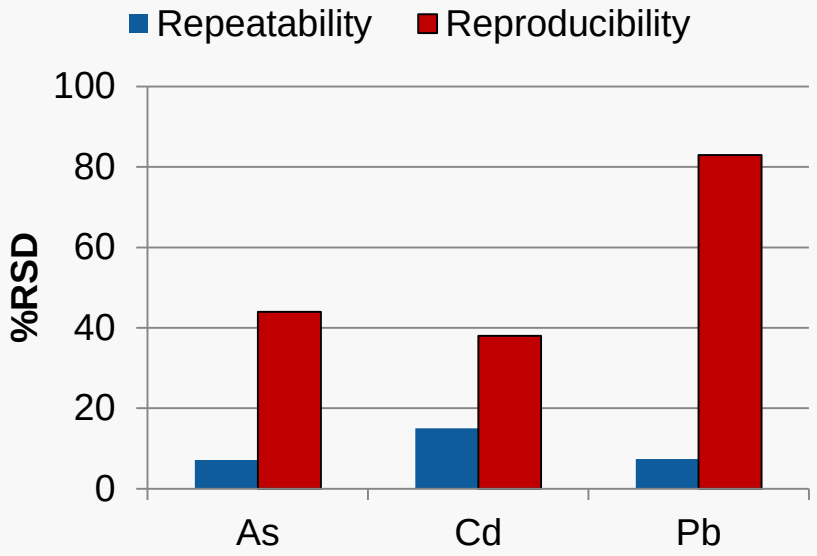


Smith et al (2012) EST 46:2928-2934

James et al (2011) EST 45:4586-4593

Variability reported





	As	Cd	Pb
NIST	626	22	5532
SGV (UK)	32	10	*450*

Wragg et al. (2011) Sci. Total Env. 409, 4016-4030

Koch et al. (2013) J. Env. Sci. Health 48, 641-655

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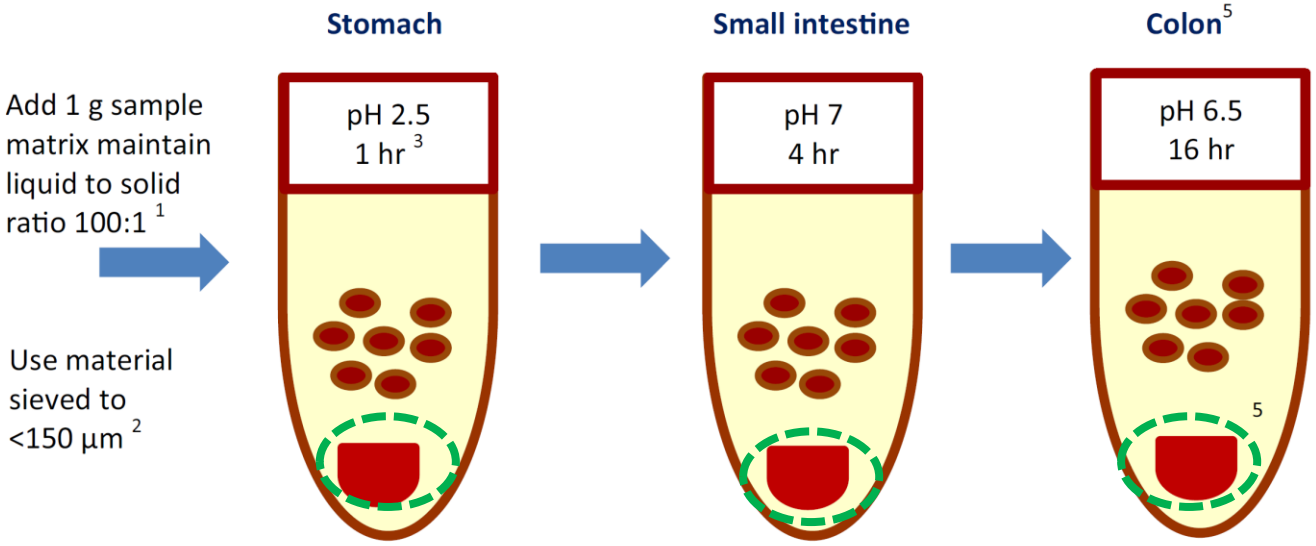
Recommended test format



Matrix of interest e.g. soil, dust, food

Sink e.g. silicone, TENAX

Dialysis membrane

Here's something we prepared earlier……

Conclusions

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Requirements of bioaccessibility test	Status

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Future needs

- We have made significant progress supported by knowledge from measurements for toxic elements
- Inter-laboratory comparisons required
  - Isolate reproducibility and repeatability
  - Appropriate soils and standards
  - High quality SOPs – video
  - Independent lab analysis
- In-vivo experiments
- End points – parent compounds/metabolites

Thanks

Funders

Researchers

- Emma Tilston
- Mark Craggs
- Katerina Kademoglou
- Sonia Garcia-Alcega
- Stephen Lowe
- Phillip Mayer
- Varvara Gouliarmou
- Monica Mosquera-Vasquez

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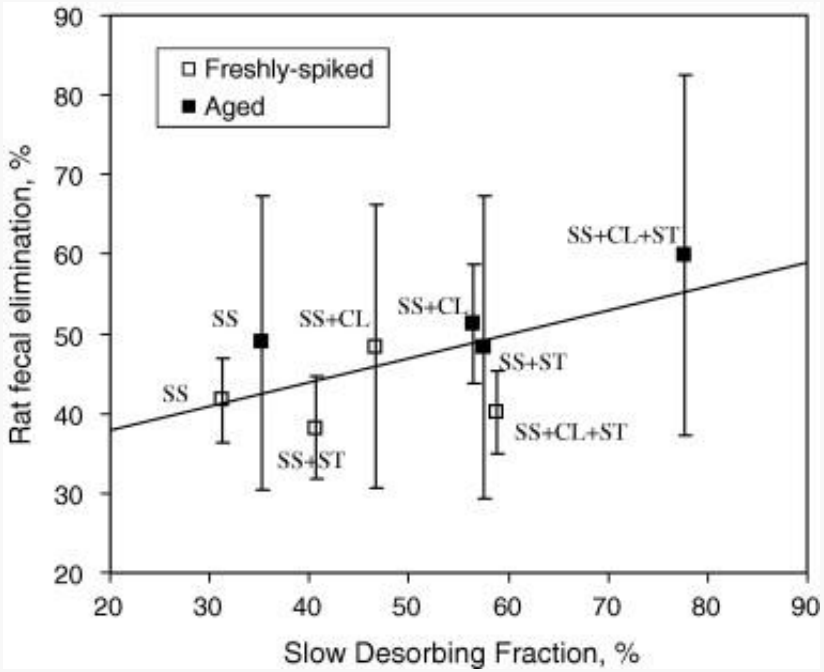
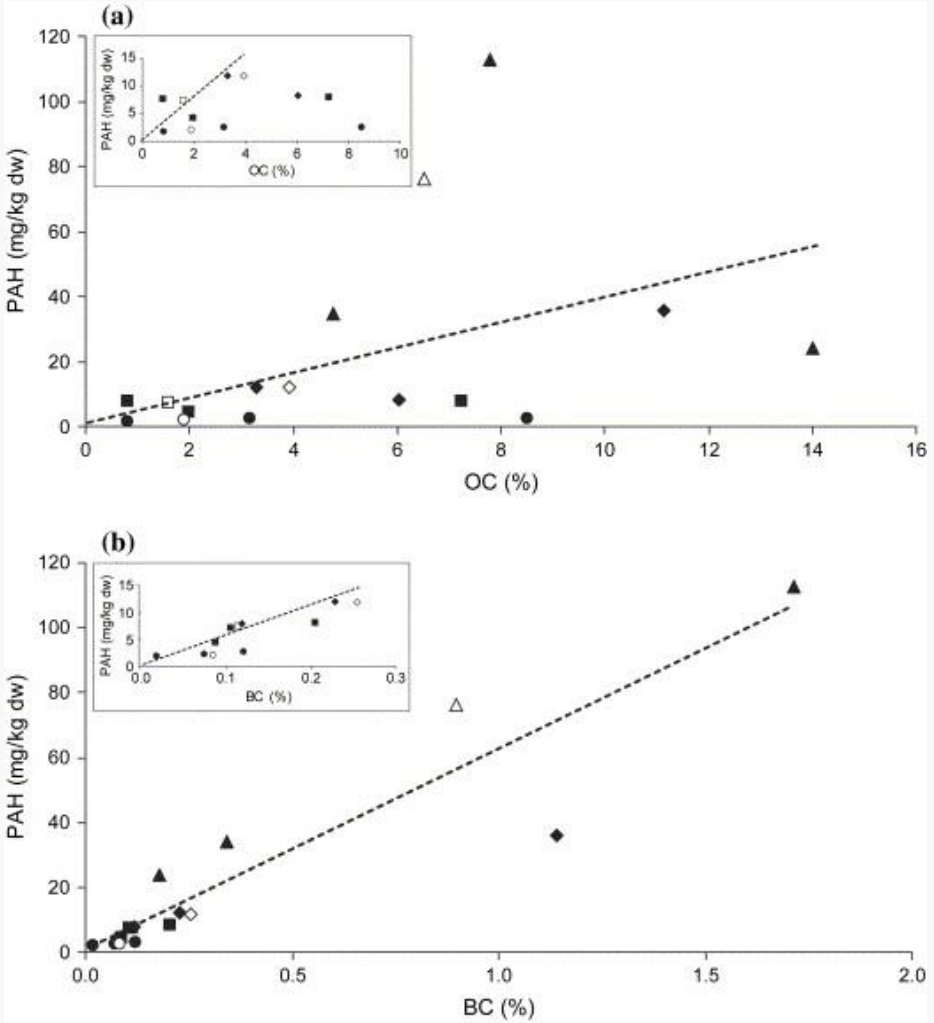
What controls bioaccessibility

Influence of matrix - carbon

SS = standard sediment
CL = clay
ST = soot



Chai et al. (2008). Chemosphere 72, 432-441.



Oen et al 2006. Env. Poll. 141, 370-380

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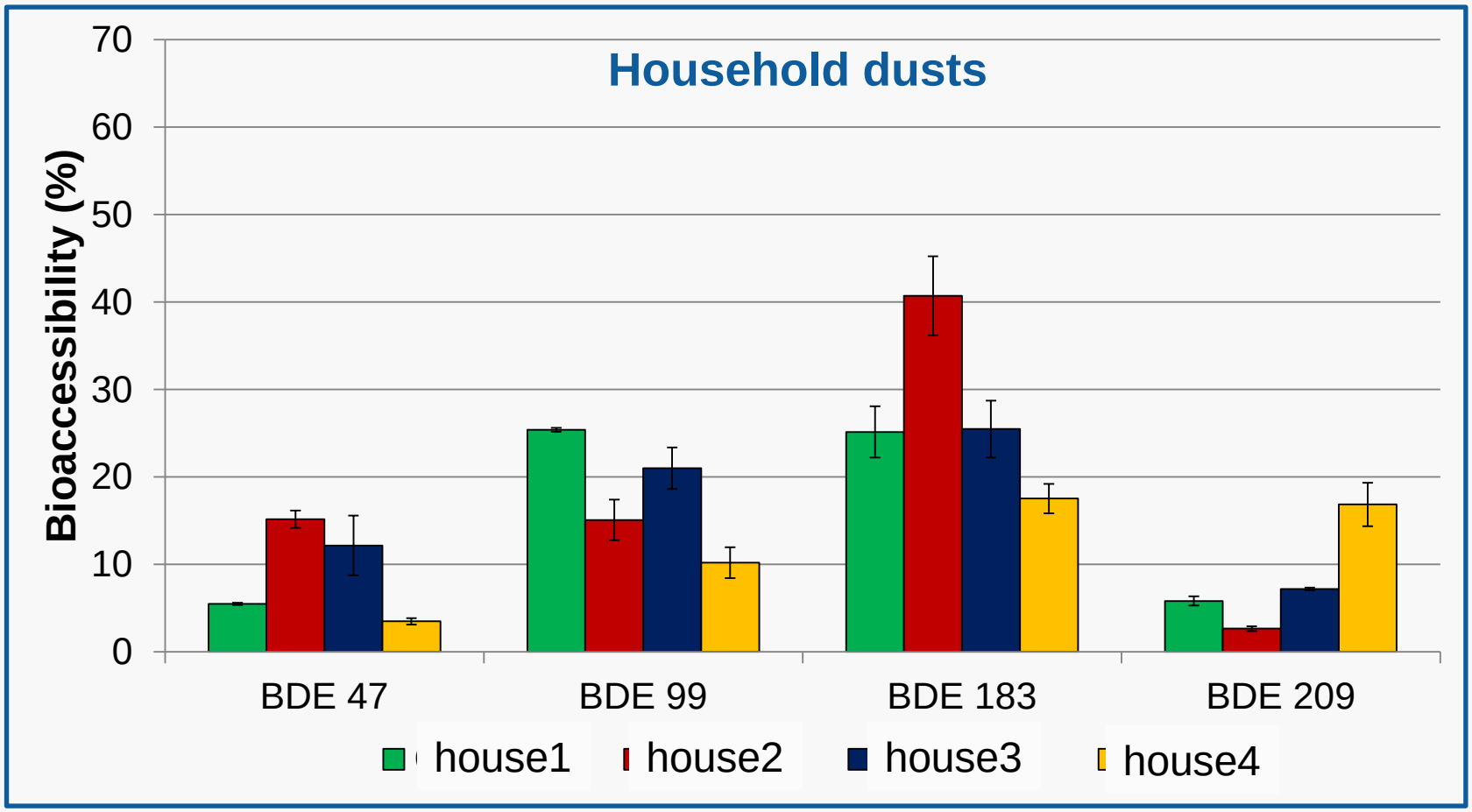
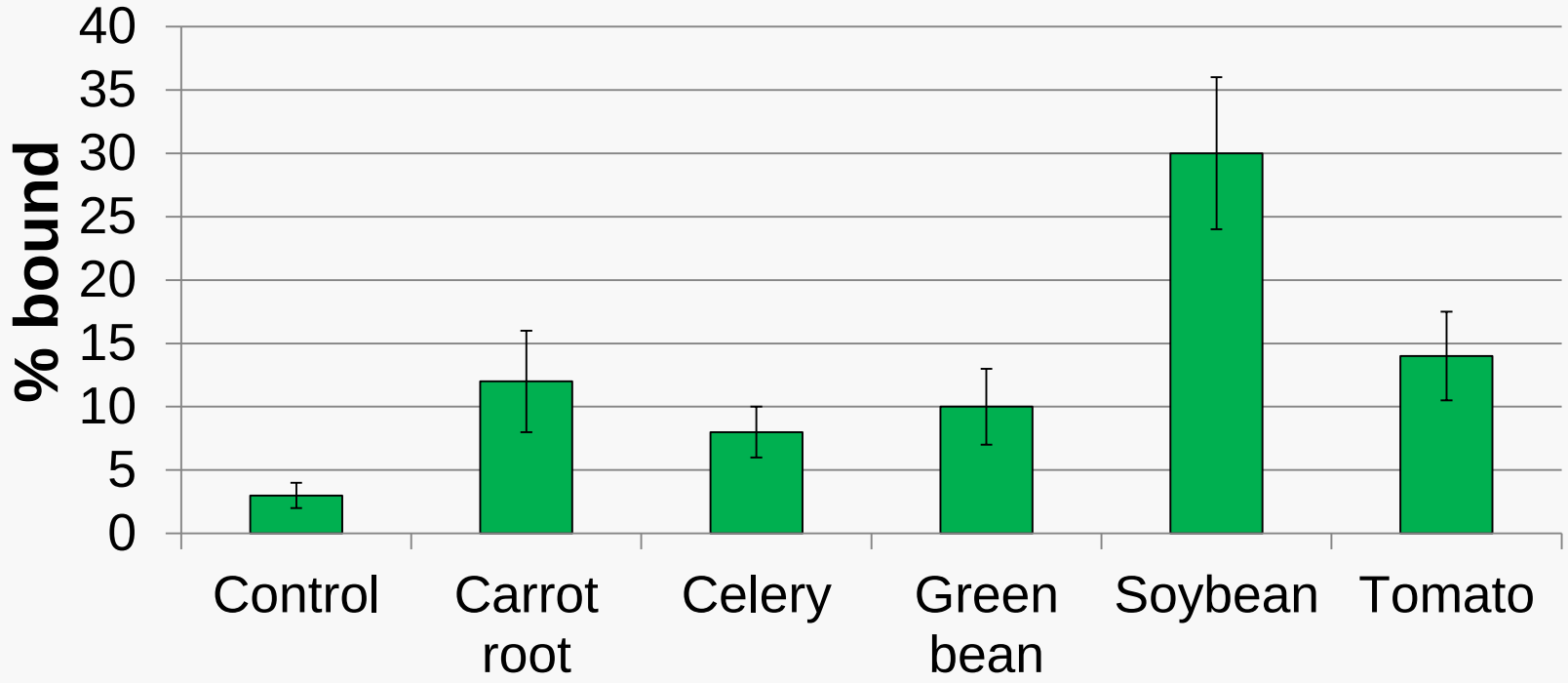
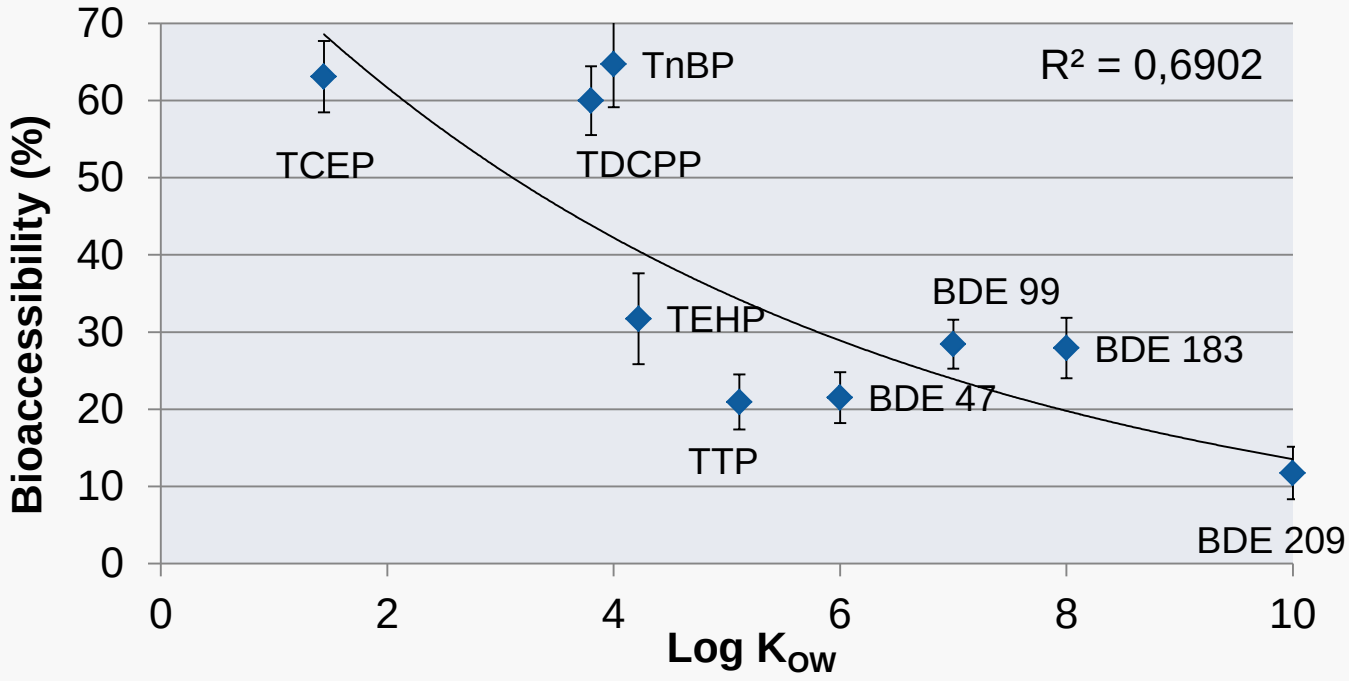
Influence of matrix - source



Influence of matrix – food type



Influence of chemical - Kow



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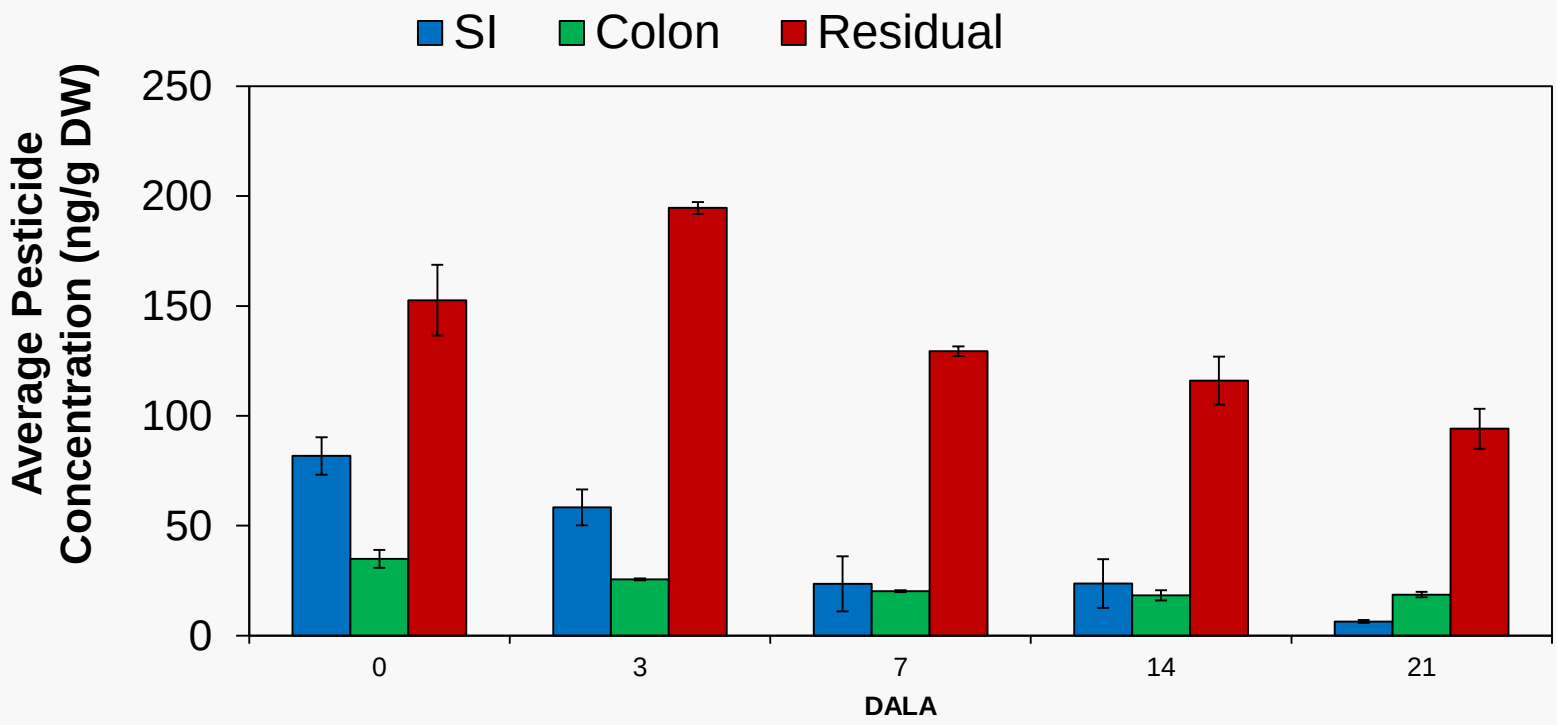
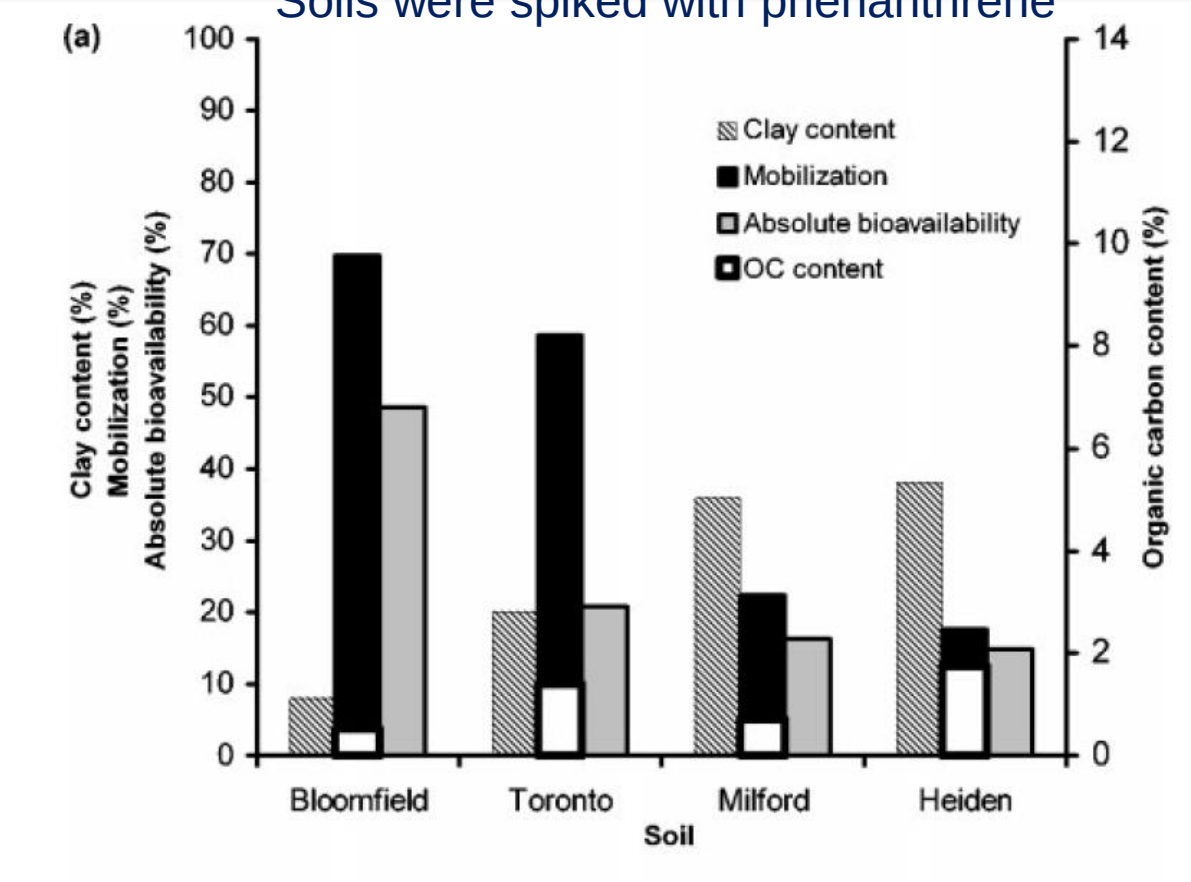
Aging



In vivo

Soils were spiked with phenanthrene



No linear relationship OC and clay

Pu et al. 2004. Toxicological Sciences 79, 10-17.