BIOAVAILABILITY OF TRIAZINE RESIDUES IN AGED SOILS

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Triazines

- The chemicals that launched 1000's of careers
- Atrazine, simazine, terbuthylazine, cyanazine, propazine, prometryn, etc

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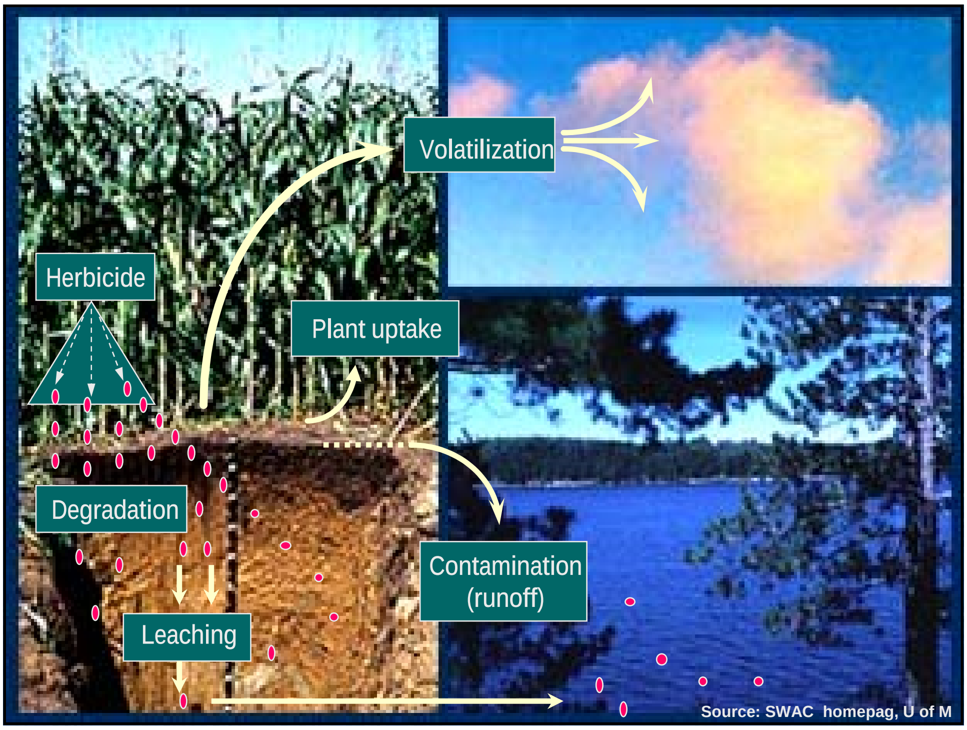
  - transport to water and air
  - exposure to and uptake by target and nontarget organisms
  - degradation
- Sorption-desorption is arguably the most important process; it directly or indirectly controls all other processes



Characterization of Availability

- Indirect methods
- Direct methods

Characterization of Availability – Indirect Methods

- Aqueous extractable

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Characterization of Bioavailability – Indirect Methods

- Aqueous extractable
- Solvent extractable
- SFC method – pesticide in soil water at typical field moisture levels
- Isotopic exchange technique
- Batch equilibration method; K_d; K_{oc}; K_f , $1/n$

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- Little data to support solvent extractable = bioavailabilty
- Slurry method doesn't represent reality
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- K_{oc} - Sorption on mineral surfaces?
- Changes in availability with time

Direct Methods

- Measured uptake by plants, earthworms, microorganisms

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- Degradation by specific pesticide-degrading microorganisms

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- It requires identifying a plant or microorganism that can rapidly take up and/or degrade the pesticide

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- Determine mineralization of aged triazine residues by a triazine-degrading organism
- Correlate bioavailability (mineralization) of aged triazine residues to solvent extraction

Chemicals

- UL-ring-^{14}C-atrazine (>98% pure), unlabeled atrazine (>99% pure)
- UL-ring-^{14}C-simazine (>98% pure), unlabeled simazine (>99% pure)

Soil Properties

Expt.	Orig.	%OC	%clay	pH
Atrazine	US	0.5	3	5.8
		4.1	35	6.7
Simazine	US	1.0	4	6.3
		2.3	19	6.3
	BR	1.0	22	5.6
		1.3	40	5.5
	HW	2.6	15	8.0
		1.4	74	5.5

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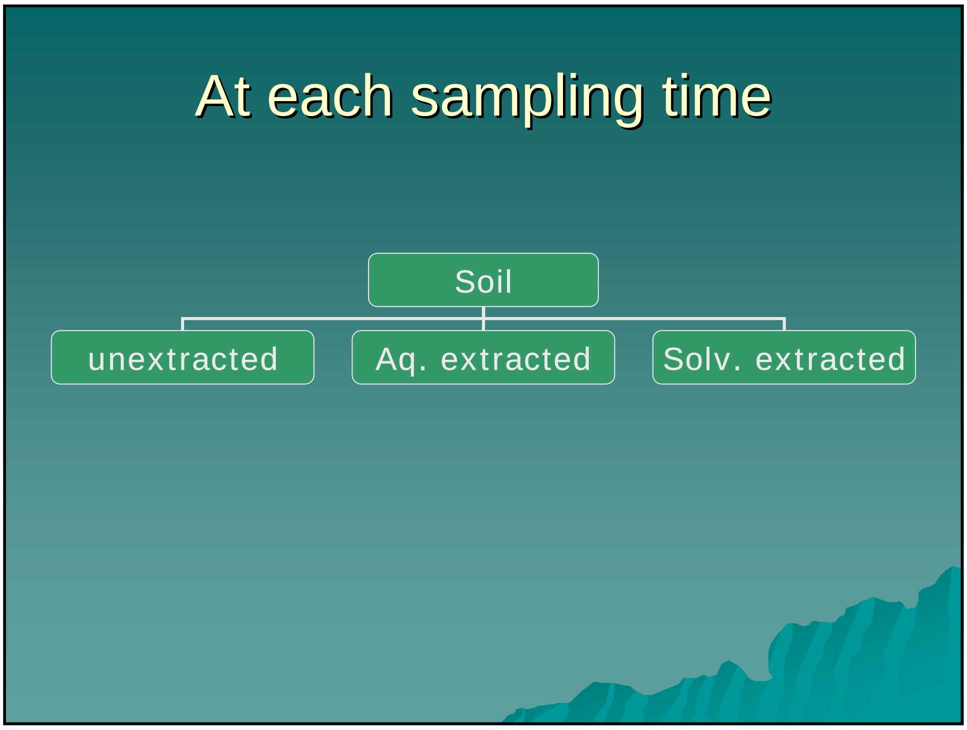
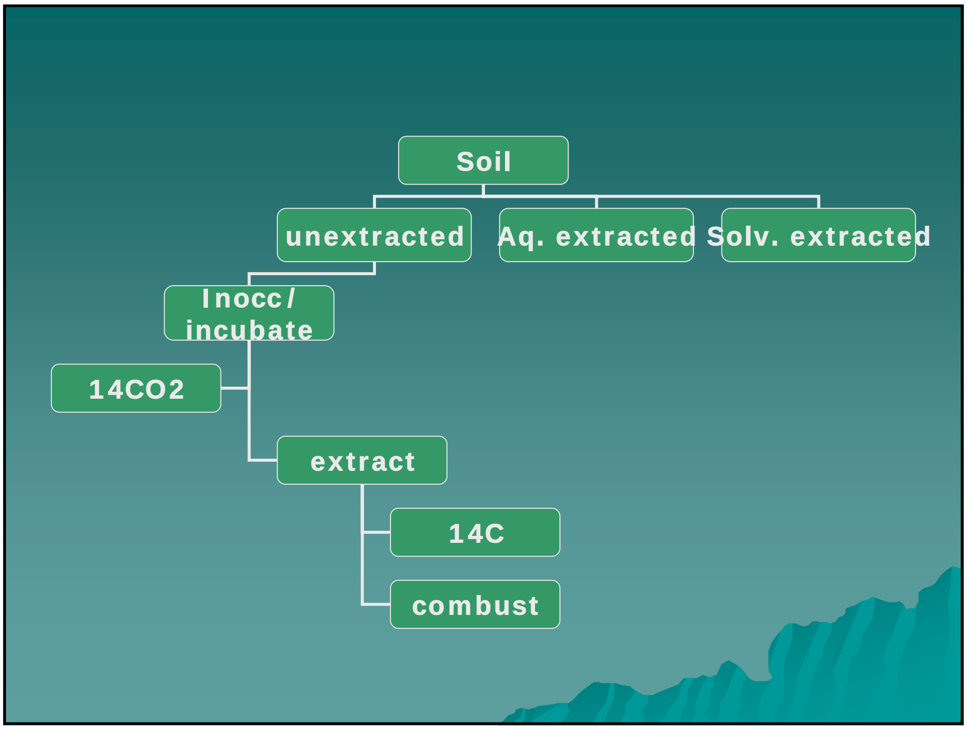
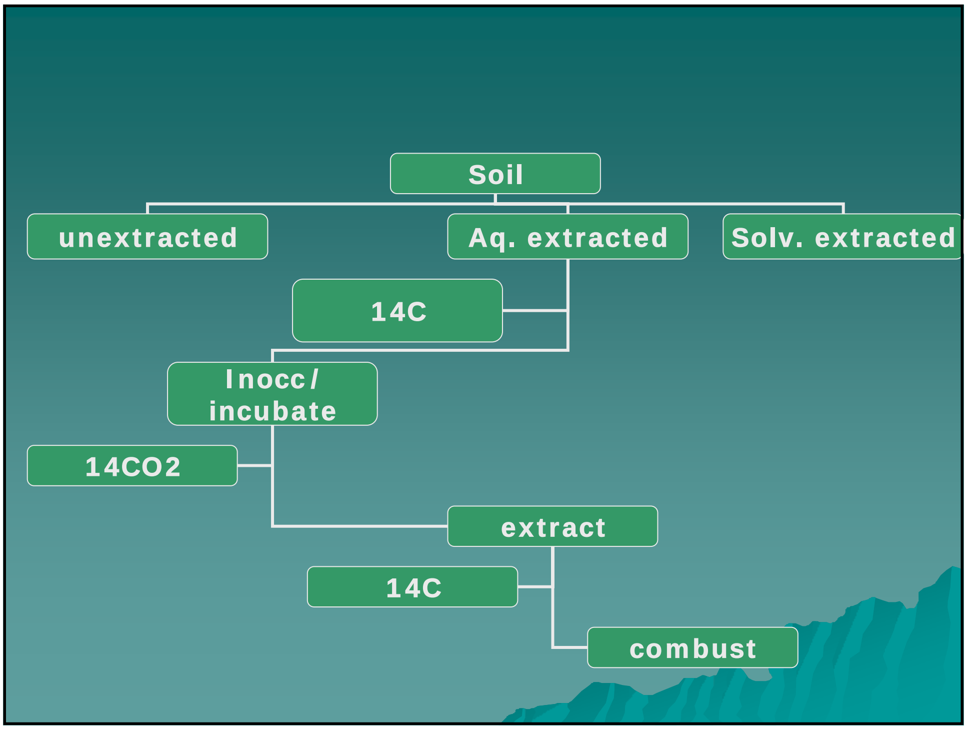
  - Soils were incubated at 25 °C for up to 8 weeks.


At each sampling time
Soil
unextracted
Aq. extracted
Solv. extracted


Soil
unextracted
Aq. extracted
Solv. extracted
Inocc/
incubate
14CO2
extract
14C
combust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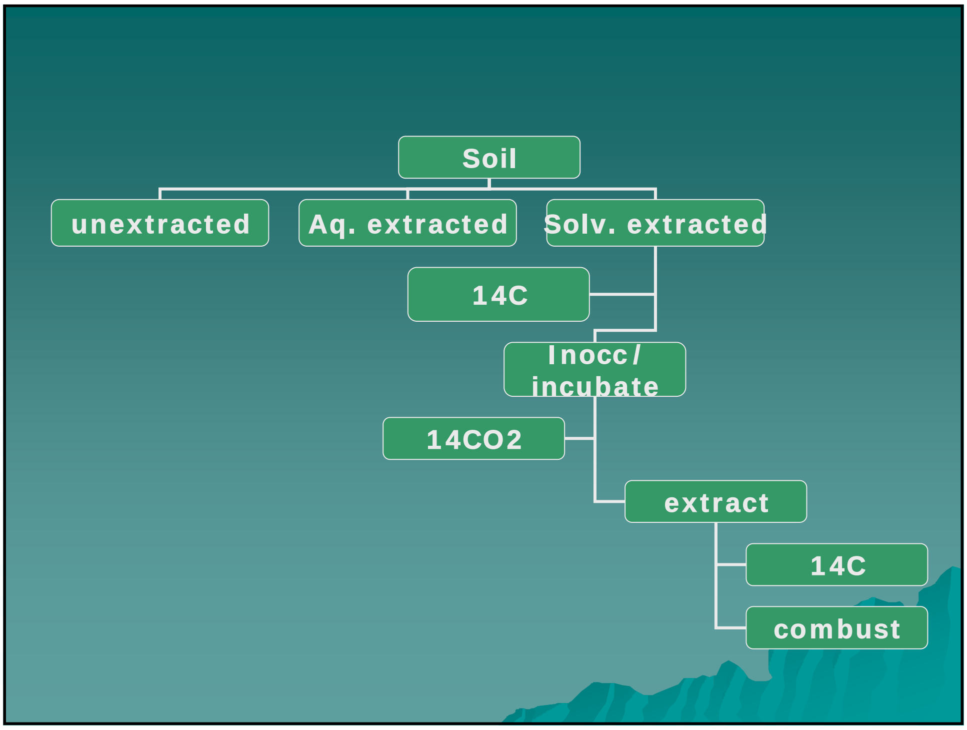
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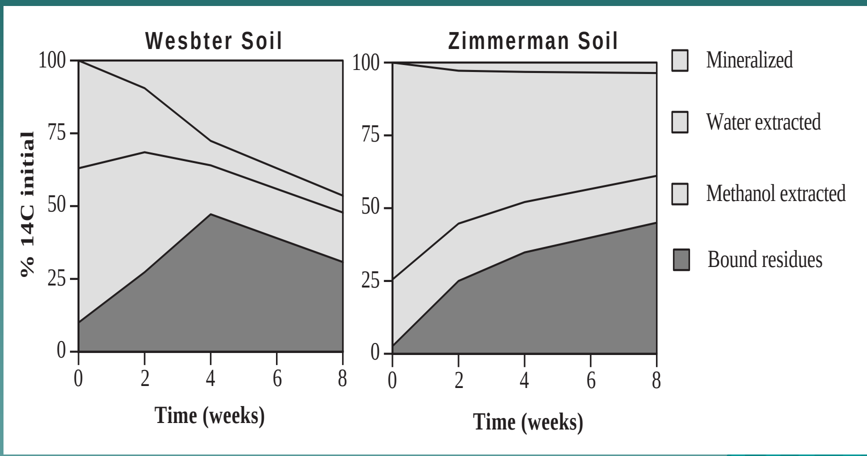
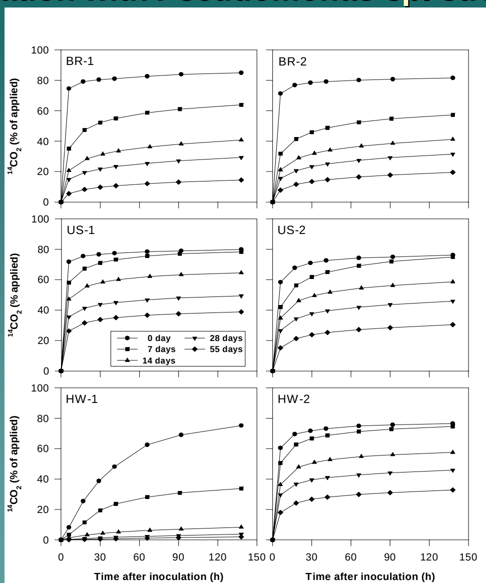
- Inoculum density = 1 x 10^8 ADP cells g^{-1} soil
- Soil moisture = -33kPa
- Incubated up to 20 d at 25 ^oC.
- $^{14}CO_2$ evolution monitored

RESULTS

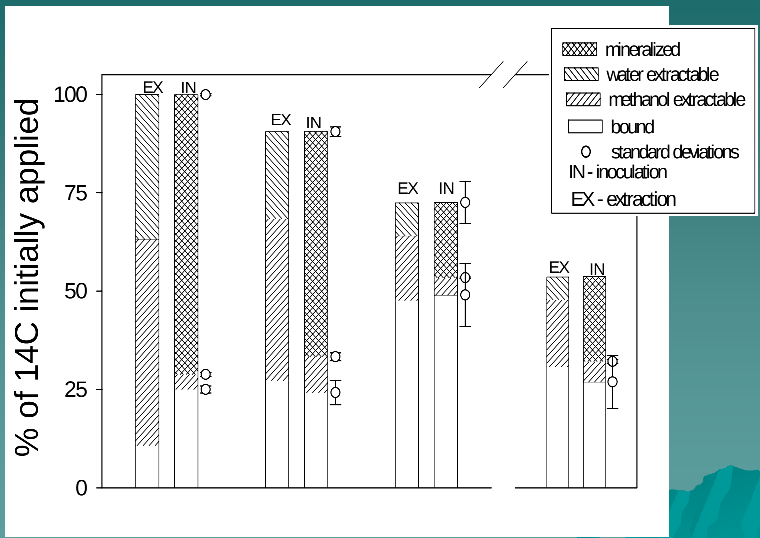
^{14}C-atrazine residue distribution



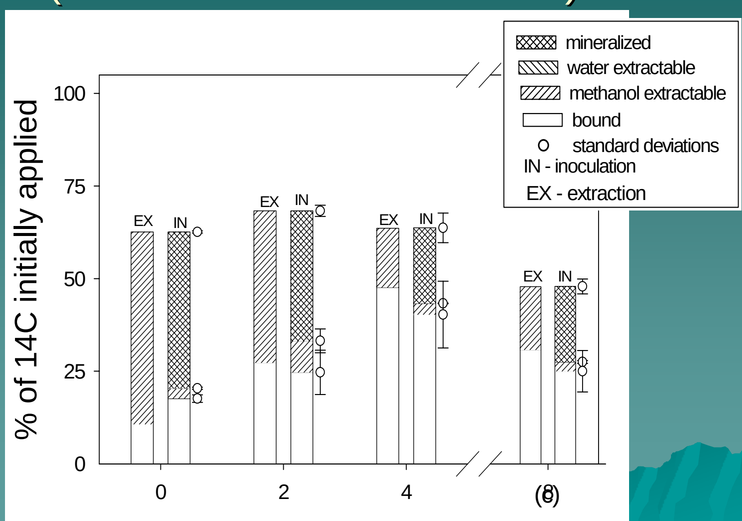
14CO2 evolution from 14C-simazine-treated soils after inoculation with *Pseudomonas* sp. strain ADP.



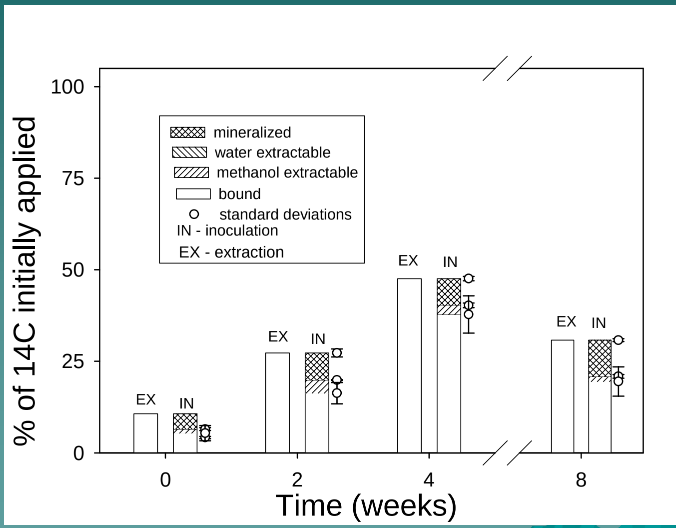
Extractable vs. Mineralizable



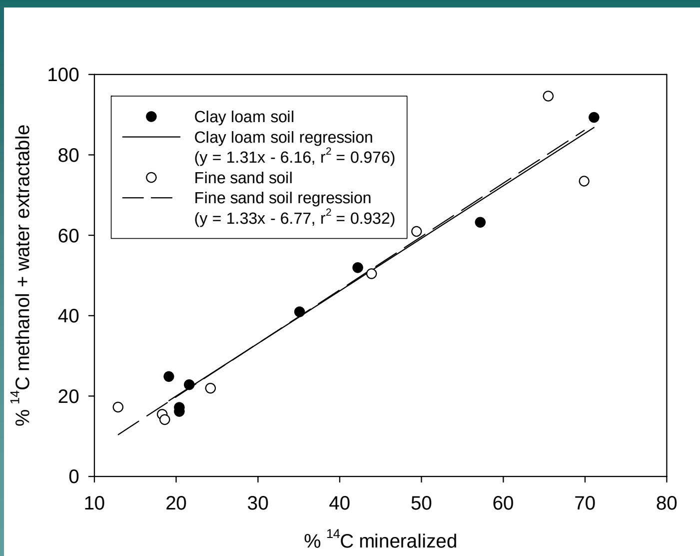
Extractable vs. Mineralizable (water-extractable removed)



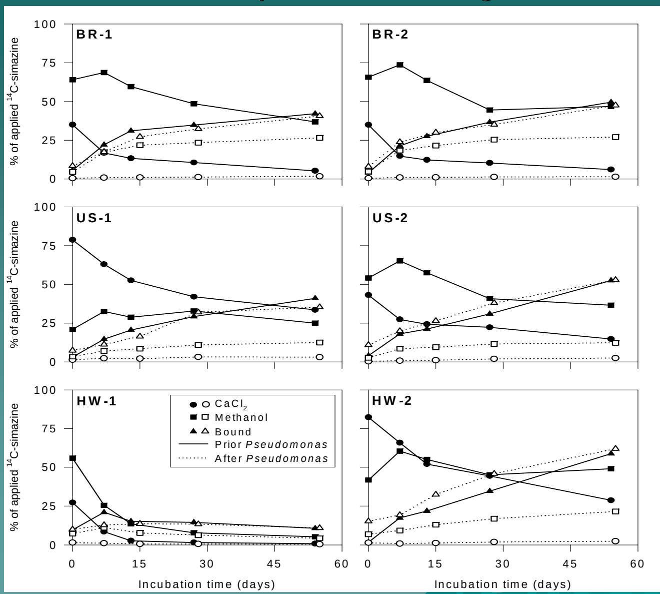
Extractable vs. Mineralizable (water-, methanol-extractable removed)



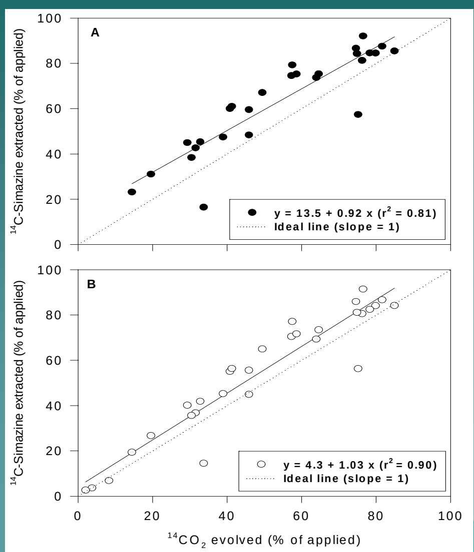
Atrazine Extractable vs. Mineralizable



Simazine residues distribution before and after inoculation with *Pseudomonas* sp. strain ADP in aged soils.



Simazine extractable vs. mineralizable



Summary/Future

- After 40 years of research, there is still no universal method to characterize bioavailability
- The topic is wide open and we need to look for innovative methods
- Sequential solvent extraction correlated to bioavailability is a start
- Possibilities – biosensors???