

Relative bioavailability of tropical volcanic soil-bound chlordecone in farm animals

Jondreville C.¹, Jurjanz S.¹, Bouveret C.¹, Lerch S.¹, Lesueur-Jannoyer M.², Archimède H.³, Mahieu M.³, Feidt C.¹, Rychen G.¹

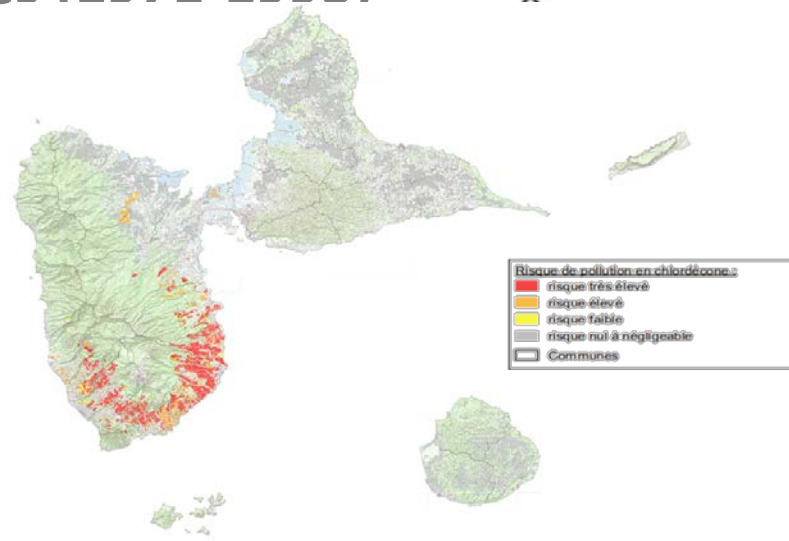
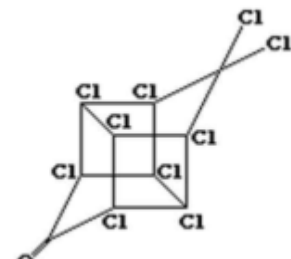
¹Université de Lorraine, INRA, URAFPA, Vandœuvre-lès-Nancy, France

²CIRAD, PRAM, UR HORTSYS, Le Lamentin, Martinique, France

³INRA, URZ, Petit Bourg, Guadeloupe, France

Chlordecone (kepone)

- Organochlorine insecticide
 - Persistent, Toxic : negative impact on fetal and postnatal development, increased risk of prostate cancer
 - Persistent Organic Pollutant (Stockholm Conv. 2009)
- Extensively used in French West Indies (1971-1993)
 - fight againts banana black weevil
 - long-term pollution of soils :
 - ➔ **10% of them exceed 1 mg.kg⁻¹**



Contamination of soils → contamination of local food resources

Outside rearing practices induce :

1) Ingestion of soil

- Hens : **up to 30 % soil** of total DM ingested
- Ruminants/pigs: **up to 10 % soil** of total DM ingested (Jurjanz et al. 2012)



2) Contamination of animal products

- Regulation EU 396/2005, MRL 100 µg/kg fat
- in contaminated areas, **near 10 % of controlled cattle are unfit for human consumption**



Contamination of volcanic soils

- Rich in organic carbon
- Different types of volcanic soils

chemical retention and physical trapping

Andosol

Allophane clay

Nitisol

Halloysite clay

Persistence

decontamination (leaching)

Concentration

Availability to plants

+

-

500-700 years

60-100 years

+

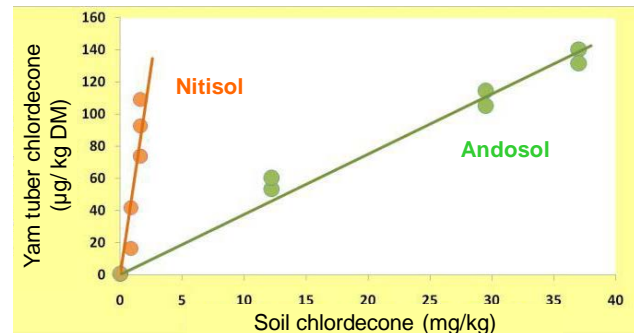
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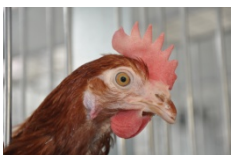
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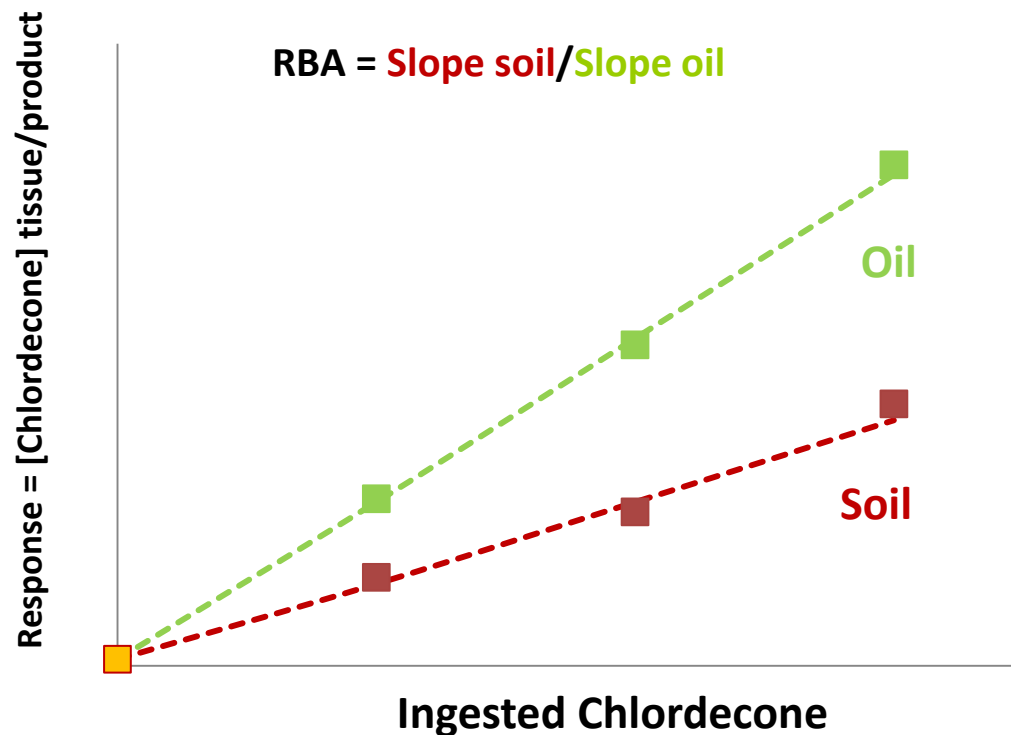
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Assessment of the impact of soil on chlordecone bioavailability: Relative bioavailability (RBA) studies

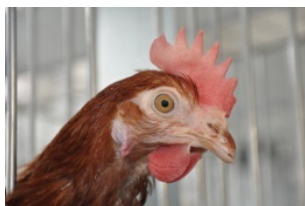


Response obtained with soil compared to the response obtained with a reference matrix (spiked oil)



Objectives of these RBA studies

- Comparison of two soils : Andosol vs Nitisol
- Comparison of the responses in different species : bird, mammals (monogastric, polygastric)



– Hypotheses

- Soil-bound CLD less available than chlordecone provided by oil
- Andosol-bound CLD less available than nitisol-bound chlordecone
- Soil-bound CLD availability may differ between animals species

Materials and methods: contaminated matrices

- Soils historically contaminated

- Hens and piglets

- Andosol: 4.8 mg CLD /kg DM

Martinique

- Nitisol: 2.5 mg CLD /kg DM

- Lambs

- Andosol: 26 mg CLD/kg DM

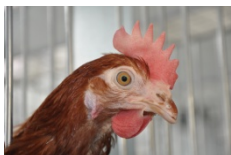
Guadeloupe

- Oil

- Spiked with Chlordecone (Kepone 49046, 99.9% purity, Sigma Aldrich)

Materials and methods: experimental diets

- soil or oil mixed in a basal diet
- Example of hen diets :



Basal diet : 89.6%

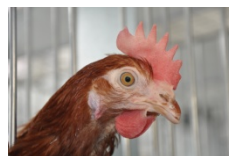
Sand + soil : 10%

Blank + spiked oil :
0.4%

	Control	Andosol	Nitisol	Oil
		4 levels	4 levels	4 levels
Composition (%)				
Basal diet	89.6	89.6	89.6	89.6
Sand	10.0	9.0 to 6.0	8.0 to 0.0	10.0
Contaminated soil		1.0 to 4.0	2.0 to 10.0	
Blank oil	0.40	0.40	0.40	0.33 to 0.00
Contaminated oil				0.17 to 0.40
Chlordecone (µg /kg)	ND	47 to 181	52 to 215	38 to 208

Materials and methods: animals and exposure

- Animals individually housed

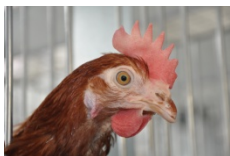


Duration (day)	28	14	15
Replicates	4	3	4
Daily level ($\mu\text{g}/\text{kg BW}$)	1 to 7	1 to 7	2 to 6
Response	Egg yolk	Liver	serum

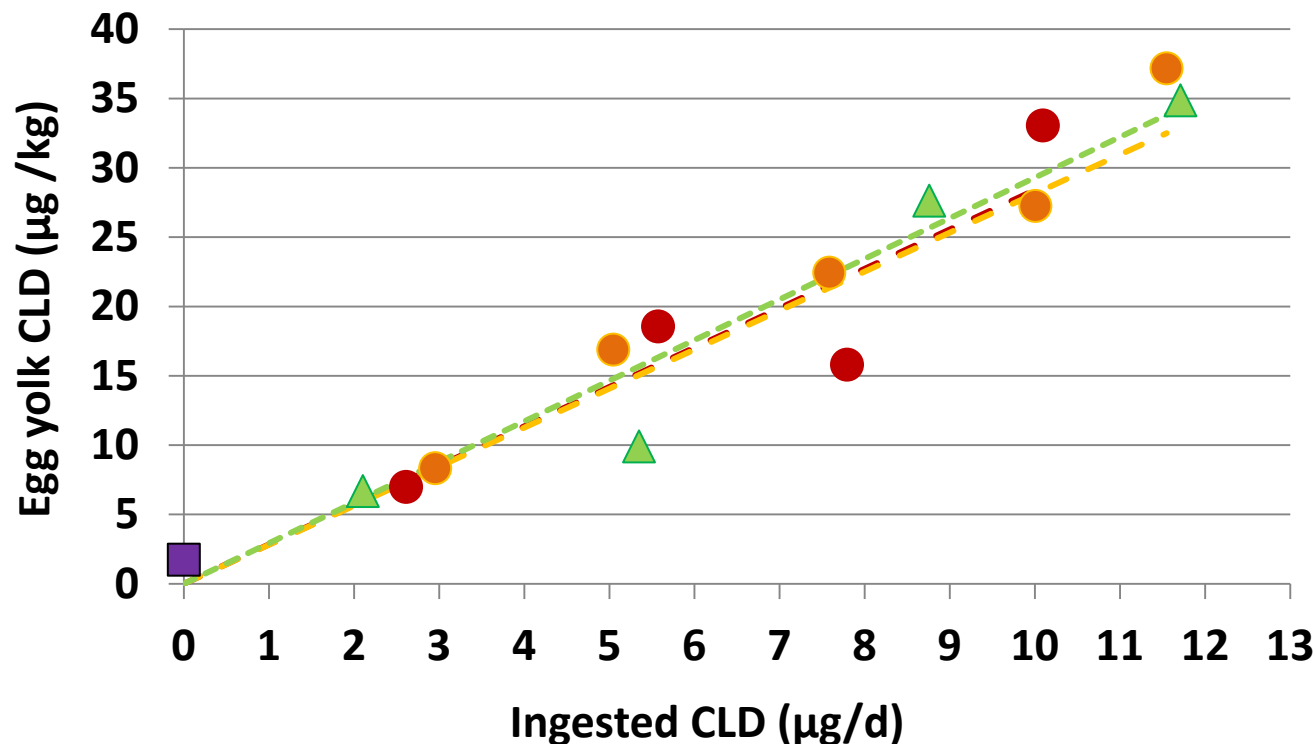
Materials and methods: statistical analysis

- Principle
 - Parameters of the response of chlordecone concentration in target tissues to ingested chlordecone
 - $RBA = \text{slope (soil)}/\text{slope (oil)}$
- Method
 - Covariance analysis (Matrix, CLD ingested (covariate))
 - Before adjusting the parameters (slopes)
 - Linearity of the response within each matrix
 - common intercept
 - the response to the zero level is equal to the common intercept value

Results: RBA of soil-bound chlordecone



Egg yolk



RBA

Andosol = 0.97

Nitisol = 0.96

NS (RBA \approx 1)

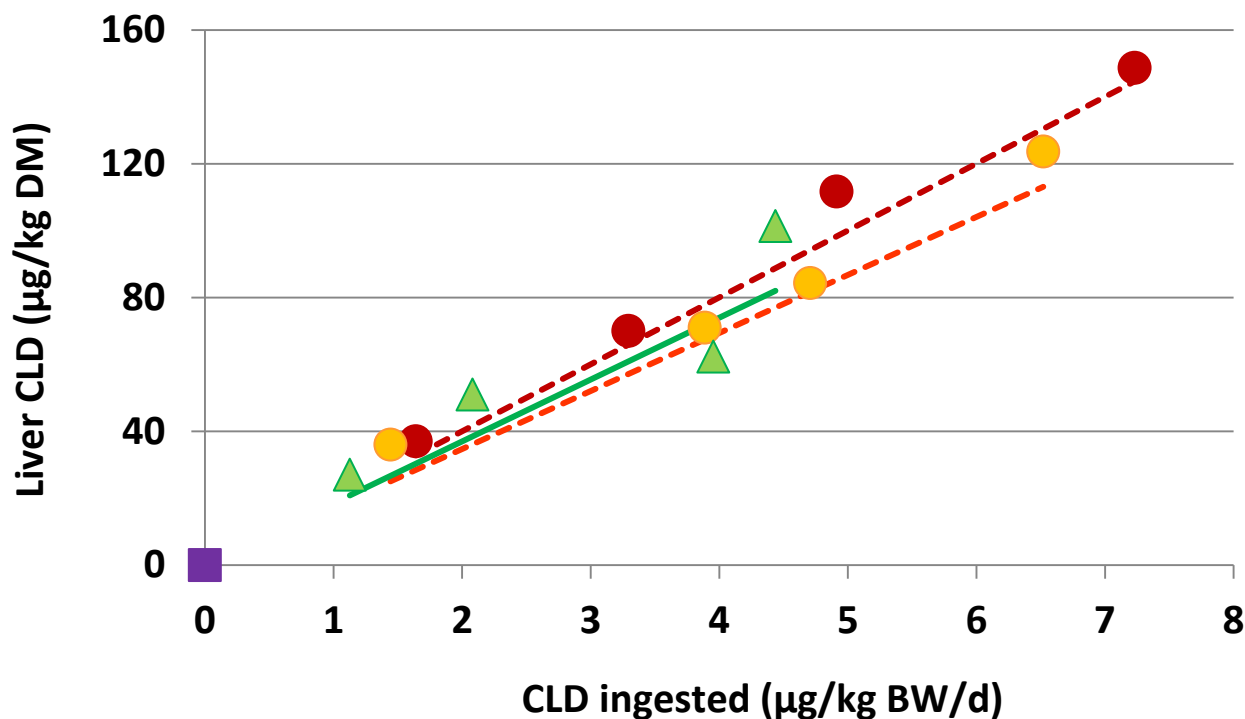
R²=0.79

- Control
- Andosol
- Nitisol
- Oil

Results: RBA of soil-bound chlordecone



Liver



RBA

Andosol = 1.00

Nitisol = 0.94

NS (RBA≈1)

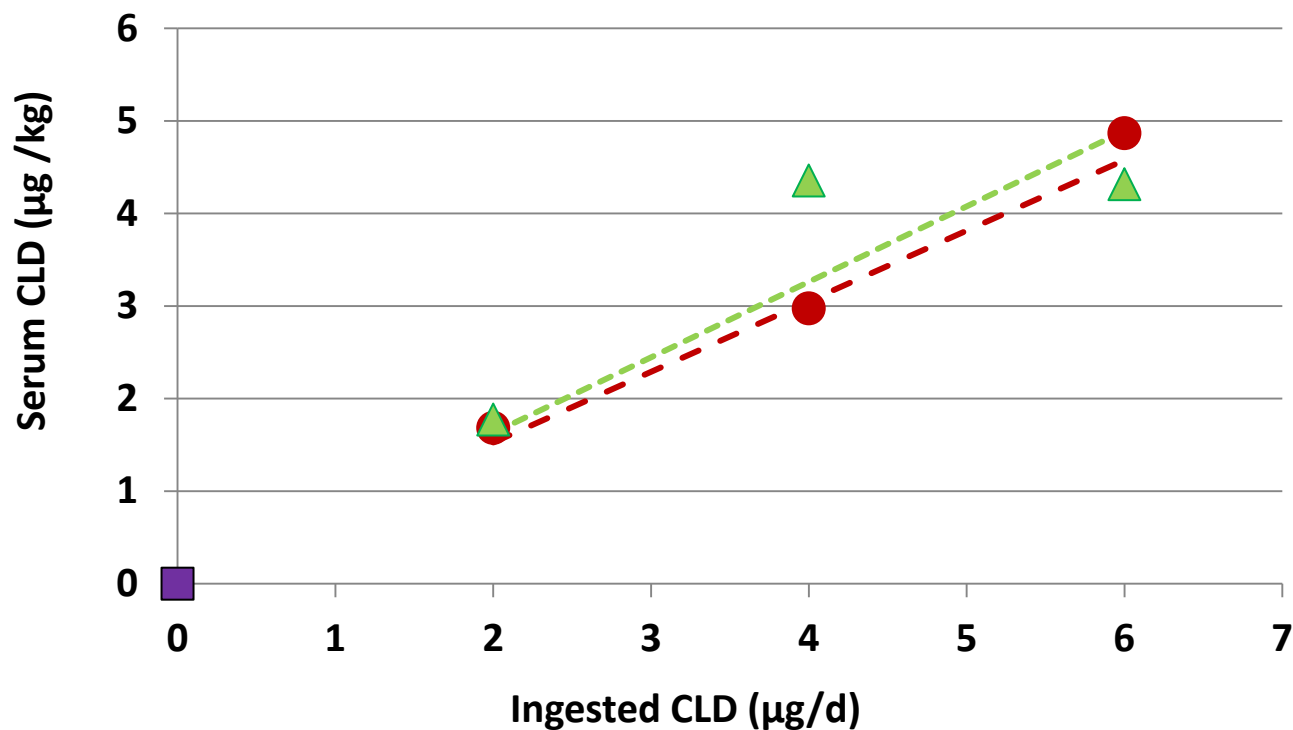
$R^2=0.81$

- Control
- Andosol
- Nitisol
- Oil

Results: RBA of soil-bound chlordecone



Serum



RBA

Andosol = 0.94

NS (RBA ≈ 1)

$R^2 = 0.66$

- Control
- Andosol
- Nitisol
- Oil

Conclusion

- Andosol- and nitisol-bound chlordecone are equally available. Since higher concentration of chlordecone are found in andosol → higher risk of products' contamination
- **Soil does not limit chlordecone availability** (compared to oil)
- **All three animal species respond equally**
- **Animal exposure to contaminated soil => involuntary ingestion !!! => contamination of animal products.**
There is need for further research to better characterize the risk rearing practices in the french West Indies

Acknowledgments

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Thank you for attention

