Dispersion on soil and lettuces of *Echinococcus multilocularis* and *Toxoplasma gondii* and efficiency of washing methods for lettuces of both parasites

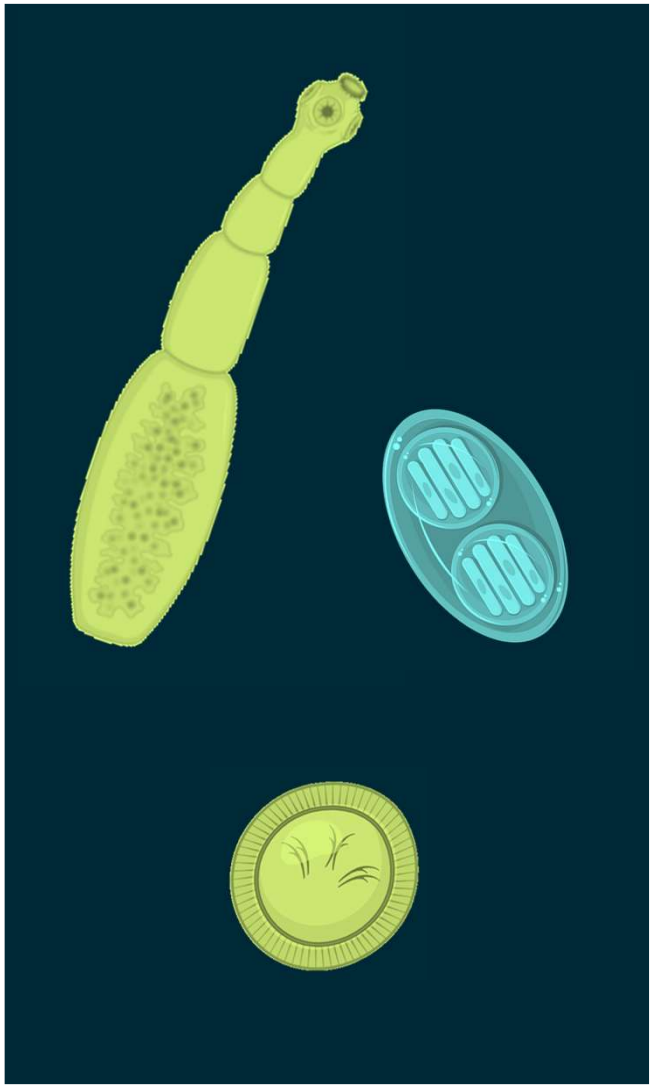
UMHANG Gérald

CALIPAR **PhD project**

of BAROSI Roxanne

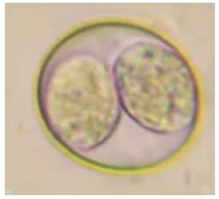
Isabelle Villena and Sandie Escotte

XXI Workshop of the National Reference Laboratories for PARASITES
28-29 October 2026



INTRODUCTION
Toxoplasmosis and Echinococcosis

PARASITE

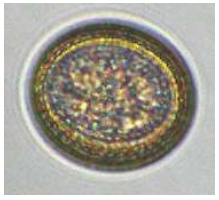


Species: ***Toxoplasma gondii***

Infectious stage: **sporulated oocysts**

Disease: **Toxoplasmosis**

PARASITES

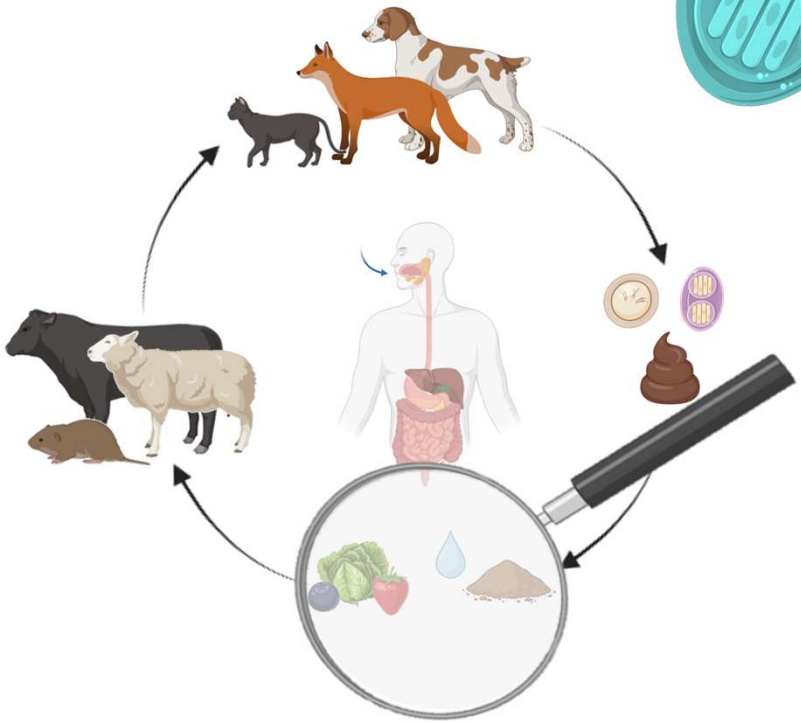


Emb: **Platyhelminthes**
Classe: **Cestode**

Species: ***E. multilocularis***
E. granulosus **sensu lato**

Infectious stage: **eggs**

Disease: **Alveolar echinococcosis**
Cystic echinococcosis



3 of the 4 most important foodborne parasites



01

DISPERSION

DISPERSION
Context and aims



Animals (carnivores, birds, invertebrates) and **climatic conditions** contribute to dispersion of the parasites in the environment

Contamination rates by matrix (soil, food, water) BUT only **limited data on correlations** between matrices

To describe the dispersion of *E. multilocularis* **eggs** and *T. gondii* **oocysts** in **soil** and on **lettuce** under natural conditions in kitchen gardens

DISPERSION
Field experiments

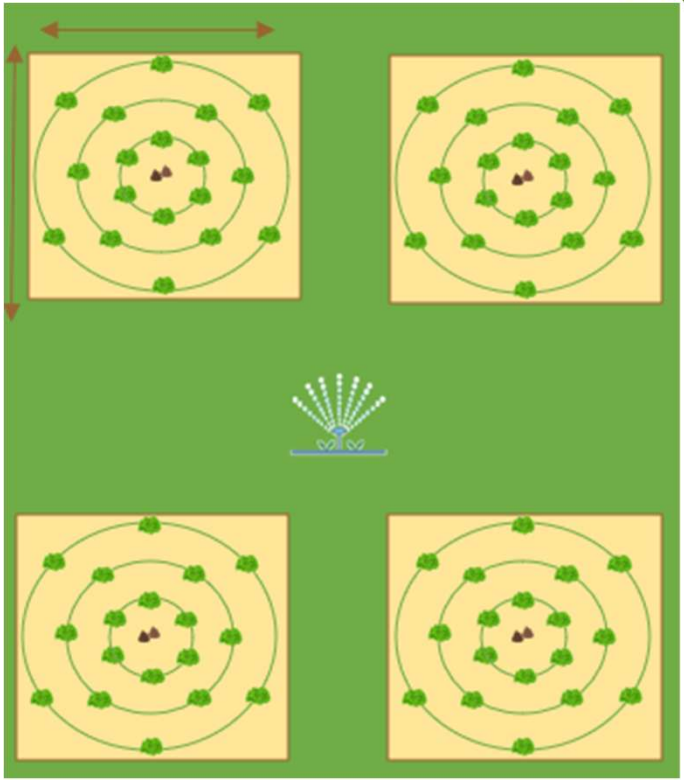


June 2024
(30 days)

4 small kitchen gardens (2x2m)

68 lettuces (15-18/kitchen garden)

Fox feces: 10^4 *E. multilocularis (Em)* eggs
Cat feces: 10^7 *Toxoplasma gondii (Tg)* oocysts



DISPERSION
Lettuces results



	June 2024	
	E. multilocularis	*T. gondii*
Contaminated lettuces	**6%** (4/68)	**25%** (17/68)
Distance between contaminated lettuces and fecal sample	**1 by kitchen garden** Always at 30cm	**At all distances** (30, 60 & 90cm)
Quantification of parasites in lettuces	**1** egg	**10** oocysts (5-17)

External leaves (1st ring of leaves)	4,8% (3/63)	17,5% (11/63)
Internal leaves (others leaves)	1,6% (1/63)	11,1% (7/63)

DISPERSION
Soil results



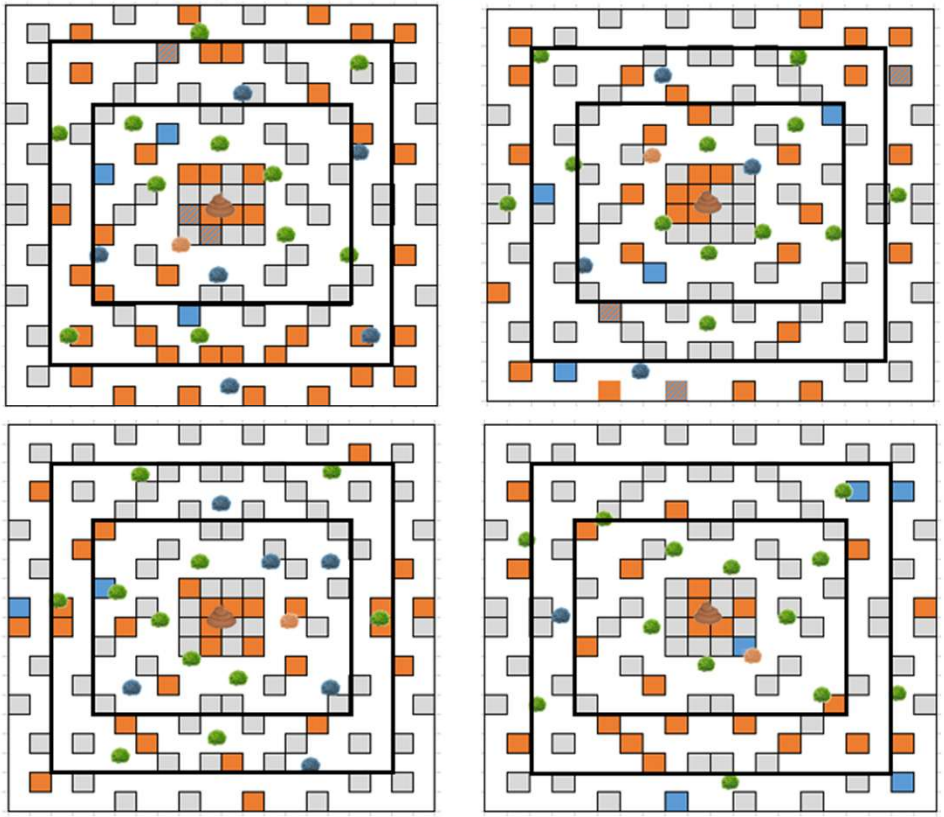
Soil

- Positive for both parasites
- Positive for *T. gondii*
- Positive for *E. multilocularis*
- Negative
- Not collected

N
W E
S

Lettuces

- Positive for *T. gondii*
- Positive for *E. multilocularis*
- Negative



E. multilocularis
32% (130/412)
[min 23% - max 42%]

T. gondii
5% (20/412)
[min 2% - max 7%]

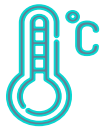
DISPERSION
Conclusion



Large dispersion in all directions (>1m in 30 days) of the two parasites at the **surface** (1-2cm) but also in **depth** (2-3cm)



Contamination of lettuces (external and internal leaves) but at **low rates** (5-25%) and **low number of eggs/oocysts** (1 egg/≈10 oocysts)
→ **similar to natural contamination** despite very high proximity of feces



The data on **weather conditions** and **invertebrates** contamination are **not robust enough** to draw any conclusions

Spatial correlation for ***E. multilocularis*** between contaminated soil samples and lettuces **but** not for ***T. gondii***

Dispersion is multifactorial (biotic and abiotic factors)
→ difficult to predict



02 Washing efficiency

Washing
Context and aims



Lettuce contamination
3-18% for *T. gondii*
1-12% for *Echinococcus* spp.

Government health agencies recommend **washing food with drinking water**.
However**, little or no data on the effectiveness** of water in removing parasites from food…

To assess the **effectiveness of domestic and industrial washing methods** in removing *E. multilocularis* eggs and *T. gondii* oocysts from lettuce

WASHING
Domestic and industrial tests



Washing solutions → Spiking → Washing → Analyses → DNA extraction & qPCR

Distilled water

Chlorine water
60mg/L (pH=6)

Whole lettuce (300g)
E. multilocularis = 10 eggs
T. gondii = 10^4 oocysts

Rinse 6s
(3L per 1min)

Soaking 30s (30L)

Soaking 30s (5L)

Spinning

Elution/ Filtration

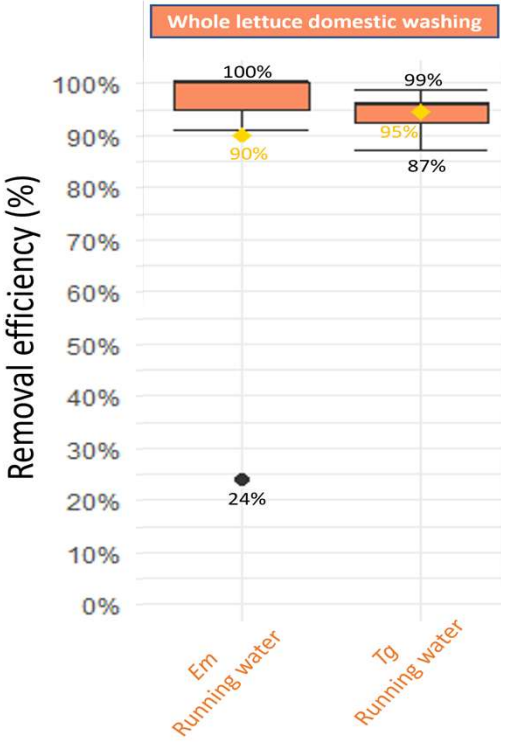
Filtration

LAVAGE
Results of domestic and industrial tests



Process	Spiked parasites	Positive lettuces after washing
DOMESTIC WASHING – Whole lettuces (300g)		
Running water	10 eggs *Em*	33% (3/9)
	10 000 oocysts *Tg*	100% (10/10)
Not washed control	10 eggs *Em*	10/10
	10 000 oocysts *Tg*	10/10

INDUSTRIAL WASHING – Whole lettuces (300g)		
Chlorine water	10 eggs *Em*	33% (2/6)
	100 000 oocysts *Tg*	100% (6/6)
Not washed control	10 eggs *Em*	3/3
	100 000 oocysts *Tg*	3/3



WASHING
Conclusion



All the washing solutions tested **positive**, **confirming the detachment** of the parasites

Washing food before eating it, even just with water, **reduces the risk of contamination**

Recommendations from government health agencies are well-founded and **effective** in eliminating parasites, but the **risk of contamination may persist**


CONCLUSION

GENERAL PERSPECTIVES



Study of dispersion is **challenging,** but the study brings **valuable descriptive information**, even though the **relative importance** of the **factors** identified remains unclear

Assessing the risk of infection requires further investigation about **survival** and **viability**



Our study combined to that of Temesgen et al. (2021) have confirmed that **washing is an effective means of prevention**

However, the **efficiency** of detachment may **depend on several factors** (e.g. pathogen, matrix, method)

Thank you for your attention

To all contributors
and especially
to the main investigator
Roxanne Barosi