Facteurs écologiques structurant le virome des moustiques vecteurs

Serafín Gutiérrez
Using microbes to limit virus transmission

Wolbachia/Aedes aegypti/Dengue virus

- Self-sustaining
- Adapted to large surfaces
- Non-GMO
Using microbes to limit virus transmission

Wolbachia/Aedes aegypti/Dengue virus

• Self-sustaining
• Adapted to large surfaces
• Non-GMO
• But... not transferable to other virus/mosquito models
Can we use viruses to fight viruses?
Virus sources in the mosquito virome
Virus sources in the mosquito virome
Virus sources in the mosquito virome
Virus sources in the mosquito virome
Two ways to influence arbovirus infection

1. Arbovirus x virus
Two ways to influence arbovirus infection

1. Arbovirus x virus

With virus

Without virus
Two ways to influence arbovirus infection

1. Arbovirus x virus
2. Arbovirus x virome structure
Two ways to influence arbovirus infection

1. Arbovirus x virus
2. Arbovirus x virome structure

High diversity

Low diversity
Previous knowledge on ecology required

• Virus diversity?
• Geography?
• Seasonal dynamics?
• Mosquito species?
• …
The metagenomics revolution

• Huge improvement in the description of virus diversity
The metagenomics revolution
The metagenomics revolution

- Huge improvement in the description of virus diversity
- But limited knowledge in ecology
  - No barcode
  - RNA viruses wanted
  - Non-viral sequences dominate sequencing output
Deterministic patterns in the mosquito virome?

Example 1

- *Ae. aegypti* vs. *Cx. quinquefasciatus*
- 65 mosquitoes / 36 samples
Deterministic patterns in the mosquito virome?

Example 2

• *Cx. torrentium* vs. *Cx. pipiens*
• 270 mosquitoes/12 samples

Petterson et al et al 2019 *Viruses*
Deterministic patterns in the mosquito virome?

• Probably yes... but also high heterogeneity

Large sampling required!
The virome of *Culex pipiens*

*Culex pipiens* West Nile outbreaks in Europe since April
Is there a core virome in *Culex pipiens*?

- Core species should influence mosquito physiology
- Influence on vectorial competence?

![Diagram of mosquitoes with different virome compositions](image_url)
The virome of *Culex pipiens* in the Mediterranean

- 5 countries
- 6800 females!
Can we detect viruses?

- Detection of viruses with:
  - Pathogenic potential
  - Potential in arbovirus control
Main scenarios

Core virome

No core
Taxon distribution between countries

Gil et al. *in prep.*
Taxon conservation between countries

Gil et al. *in prep.*
Taxon conservation suggests a core

Core virome

No core

Gil et al. *in prep.*
But still conserved within a population?

% infected females below 10%!

Gil et al. *in prep.*
But still conserved within a population?

Core virome

No core

Gil et al. *in prep.*
Is there a core virome in *Culex pipiens*?

- Different levels of taxon conservation
  - between populations
  - between individuals

Population 1

Population 2

Gil et al. *in prep.*
Geography structures the virome?

Gil et al. *in prep.*
Geography structures the virome
Phylogeny also follows geography

Gil et al. *in prep.*
Technical issues hamper large-scale studies

• Only 10 samples can we do more?
• Cost per sample $\geq 5000$ €
Optimising metagenomics for virus discovery

- Nucleic-acid isolation
- Library preparation
- Illumina sequencing
- Homology search

Gil et al. under review
Optimising metagenomics for virus discovery

• Custom library preparation
• Validation of a full metagenomics pipeline
• **Cost per sample < 50 €**
• ~**10% viral reads**

Gil et al. *under review*
The future: detailed virome characterisation

• ArboSud project (MUSE)
# People involved

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**Funding**

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Thank you for your attention