Facteurs écologiques structurant le virome des moustiques vecteurs

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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?









1. Arbovirus x virus



1. Arbovirus x virus



- 1. Arbovirus x virus
- 2. Arbovirus x virome structure

High diversity

Low diversity





- 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

Redefining the invertebrate RNA virosphere

Mang Shi^{1,2}*, Xian-Dan Lin³*, Jun-Hua Tian⁴*, Liang-Jun Chen¹*, Xiao Chen⁵*, Ci-Xiu Li¹*, Xin-Cheng Qin¹, Jun Li⁶, Jian-Ping Cao⁷, John-Sebastian Eden², Jan Buchmann², Wen Wang¹, Jianguo Xu¹, Edward C. Holmes^{1,2} & Yong-Zhen Zhang¹



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



Samples

Shi C. et al 2019 Microbiome

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?



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





Core virome







Taxon distribution between countries



Taxon conservation between countries



Taxon conservation suggests a core

Core virome







But still conserved within a population?

% infected females below 10%!



But still conserved within a population?

Core virome

No core





Is there a core virome in *Culex pipiens*?

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



Geography structures the virome?



Geography structures the virome



Phylogeny also follows geography



Technical issues hamper large-scale studies

- Only 10 samples 📥 can we do more?
- Cost per sample ≥ 5000 €

Optimising metagenomics for virus discovery



Optimising metagenomics for virus discovery

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



The future: detailed virome characterisation

• ArboSud project (MUSE)





People involved

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Thank you for your attention

