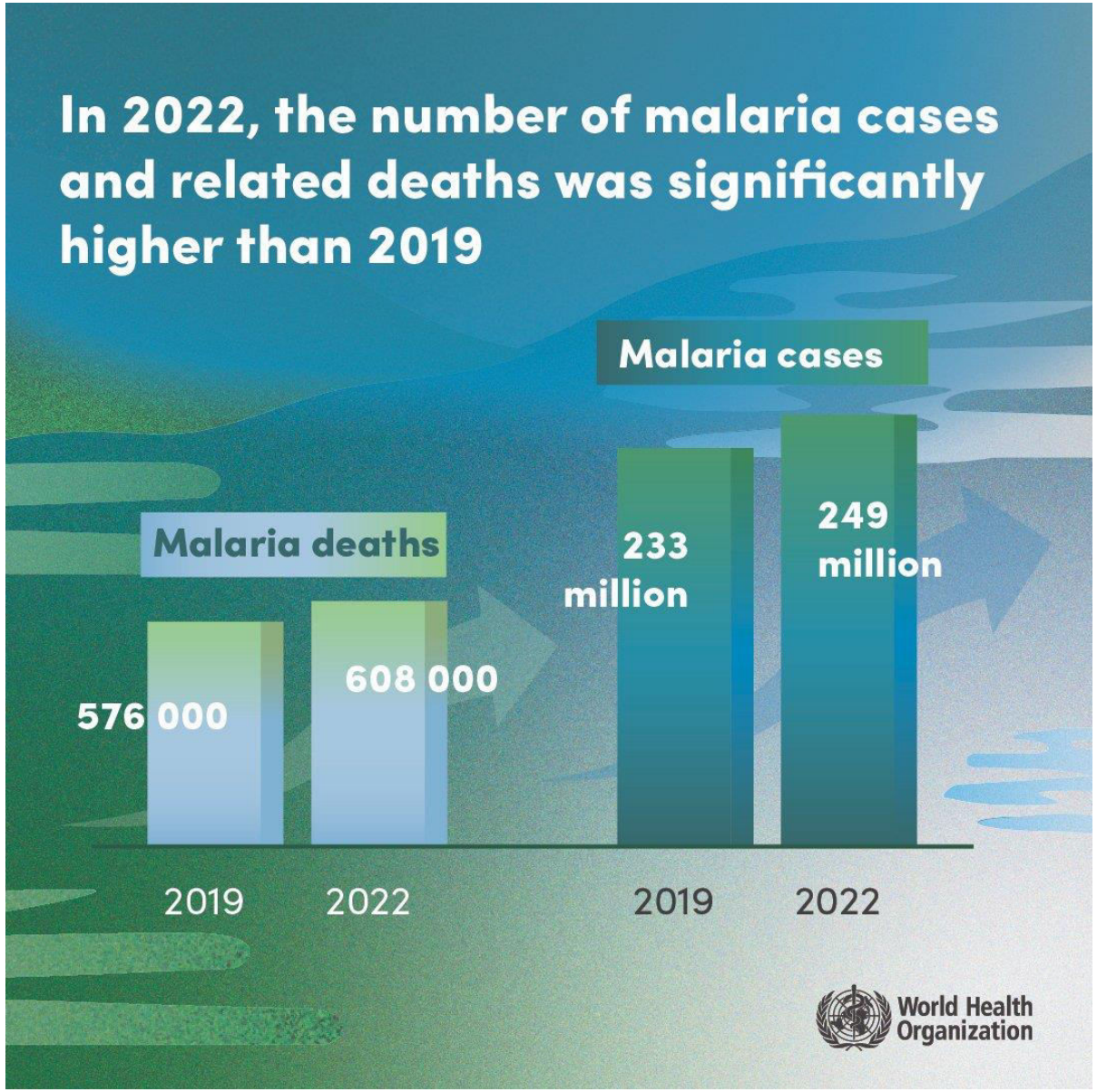
Combating malaria with the mosquito symbiont *Chromobacterium anophelis sp.nov* cell free bioactive supernatant

Jacques Gnambani, researcher assistant, IRSS/DRO; Burkina Faso

19th Annual Meeting Vector Control Working Group

15th - 17th April, 2024 ; Radisson Blu Hotel, Kigali , Rwanda

Background


In 2022, the number of malaria cases and related deaths was significantly higher than 2019
Malaria deaths
576 000
608 000
2019
2022
Malaria cases
233 million
249 million
2019
2022
World Health Organization

Background

Malaria Disease Control: Challenges and opportunities

❑ **Main challenge: residents being frequently reinfected**

✓ Altered vector ecology and behavior,

✓ Most anti-malarial drugs are not effective in gametocytes killing,

✓ RTS,S malaria vaccine has a modest effect on clinical and severe malaria, it is unlikely to have major impact on transmission.

❖ **Game changer for malaria control and elimination**

- Transmission blocking vaccine,
- Gene-drive technology,
- Transmission blocking microbiome.

Background

Novel technologies emerging for use in mosquito control

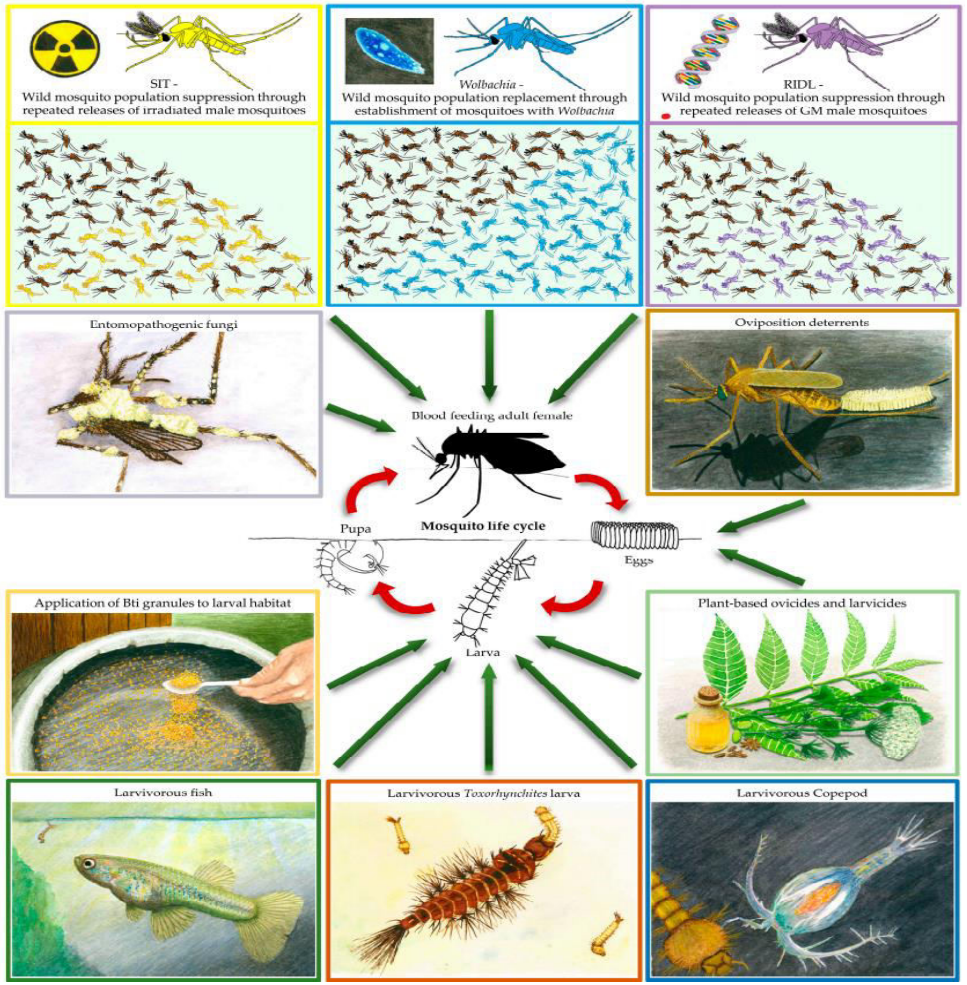
Using Biocontrol to Kill Mosquitoes:

- ✓ Plant-Borne Mosquitocides, Repellents and Oviposition Deterrents;
- ✓ Mosquito Predators ;
- ✓ *Bti, Chromobacterium sp* and Entomopathogenic Fungi ;

Releasing Mosquitoes for Disease Control:

- *Wolbachia* Endosymbiotic Bacteria ;
- The Sterile Insect Technique ;
- Genetically Modified Mosquitoes ;

Non-insecticide based strategies



Mosquito biocontrol strategies targeting different stages of the mosquito lifecycle

Background

Mosquitocidal property of *Chromobacterium anophelis sp.nov*: Mosquito survival, fecundity, and fertility

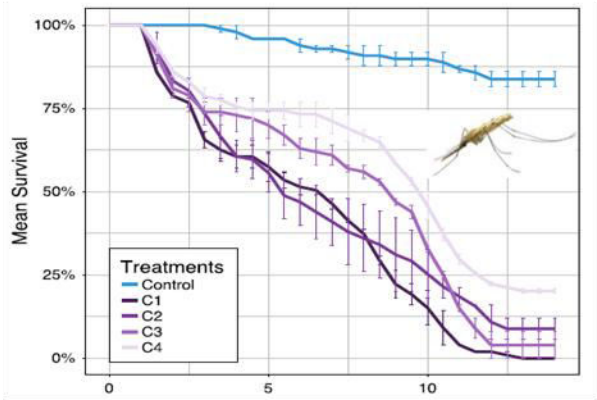
Gnambani et al. Malar J (2020) 19:352
https://doi.org/10.1186/s12936-020-03420-4

Malaria Journal

RESEARCH Open Access

Infection of highly insecticide-resistant malaria vector *Anopheles coluzzii* with entomopathogenic bacteria *Chromobacterium violaceum* reduces its survival, blood feeding propensity and fecundity

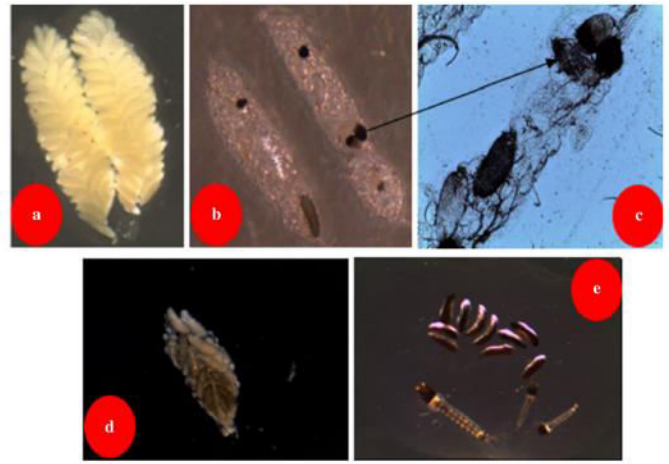
Edounou Jacques Gnambani[1,2], Etienne Bilgo[1*], Adama Sanou[2], Roch K. Dabiré[1] and Abdoulaye Diabaté[1*]



Day post-infection

Survival curves of *An. Coluzzii* mosquitoes exposed to different concentrations of *C. anophelis sp.nov*

host-seeking behavior design using guinea pigs and a tunnel choice chamber with nine small holes cut into a barrier between compartments



Impact of *C. anophelis sp.nov* infections on ovarian follicles and fertilized egg maturations in *An. coluzzii* mosquitoes. Legend: Eggs of an uninfected female (**a**); Follicles and fertilized eggs of infected female with *C. anophelis sp.nov* (**b–d**); non-viable eggs and larvae of an infected female (**e**)

Background

Effect of *An. coluzzii* mosquito reproductive potential by symbiont *C. anopheles* bacteria

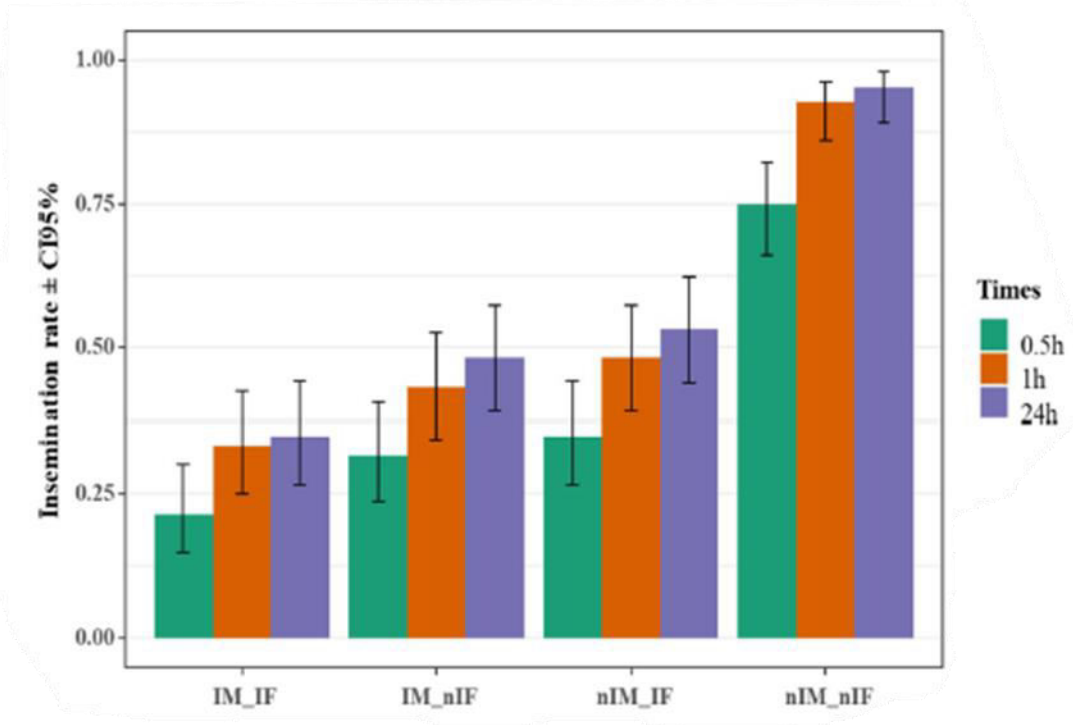
Gnambani *et al. Malaria Journal* (2023) 22:122
https://doi.org/10.1186/s12936-023-04551-0

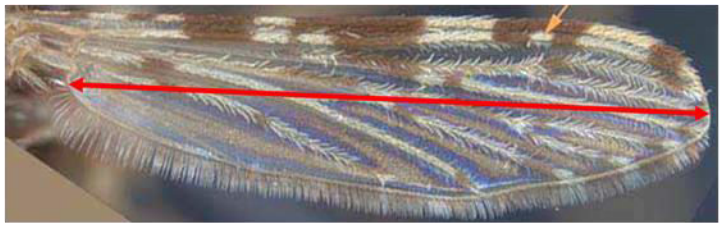
Malaria Journal

RESEARCH Open Access

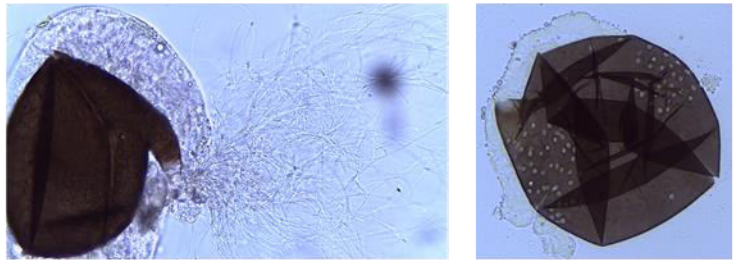
Infection of the malaria vector *Anopheles coluzzii* with the entomopathogenic bacteria *Chromobacterium anophelis* sp. nov. IRSSSOUMB001 reduces larval survival and adult reproductive potential

Edounou Jacques Gnambani[1,2,3], Etienne Bilgo[1,2,3*], Roch K. Dabiré[1,2,3], Adrien Marie Gaston Belem[4] and Abdoulaye Diabaté[1,2,3*]





An. coluzzii mosquito wing size



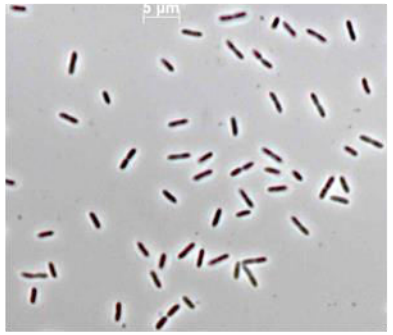
An. coluzzii mosquito insemination status

Effects of *C. anophelis* sp.nov; infection on insemination rates of female mosquitoes from different crossing types. *IM:* infected males, *IF:* Infected Females, *nIM:* non-infected males, *nIF:* non-infected females

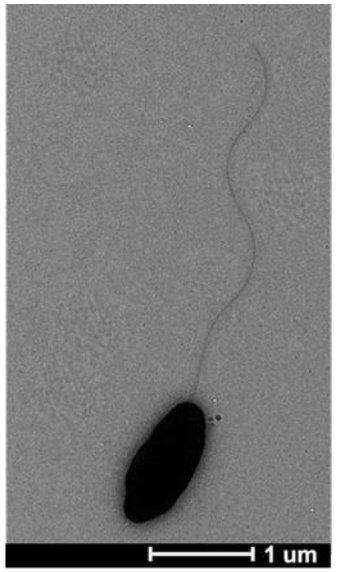
Methodology

Identification of *Chromobacterium sp.nov*: DNA sequencing

C. Anophelis sp.nov on King's B media



Microscopy of *C. anophelis* (Gram-négative)



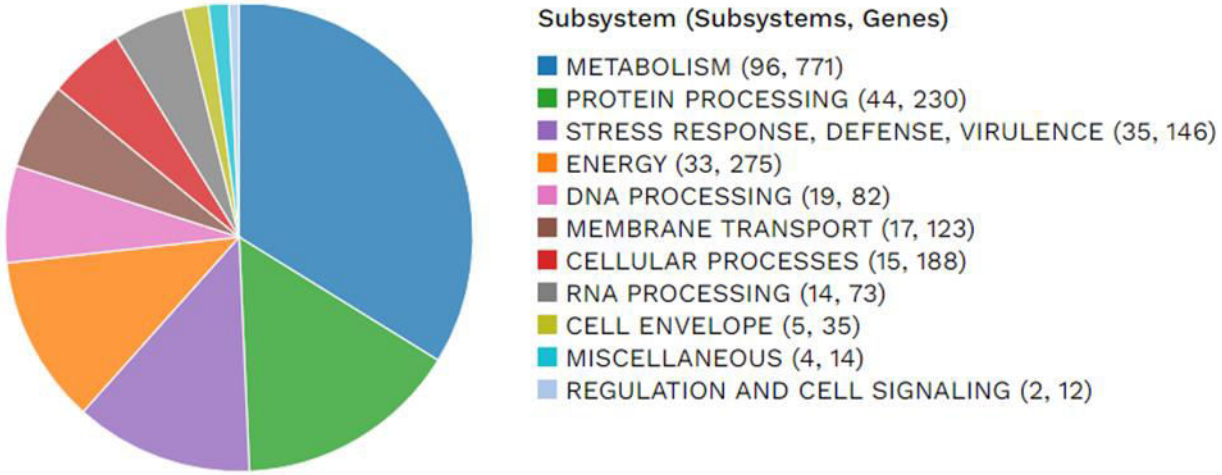
Amplicons d'ADN

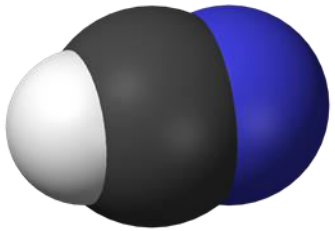
Illumina MiSeq platform 2x250

Genomic sequence

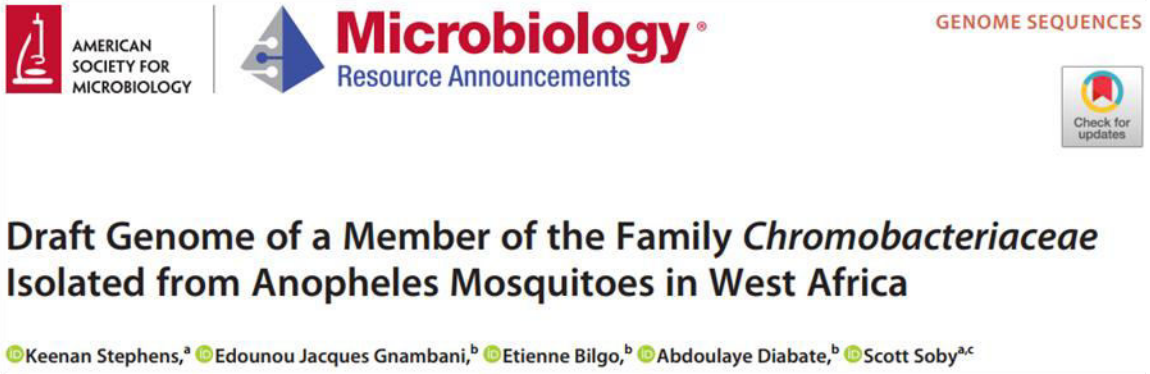
Methodology

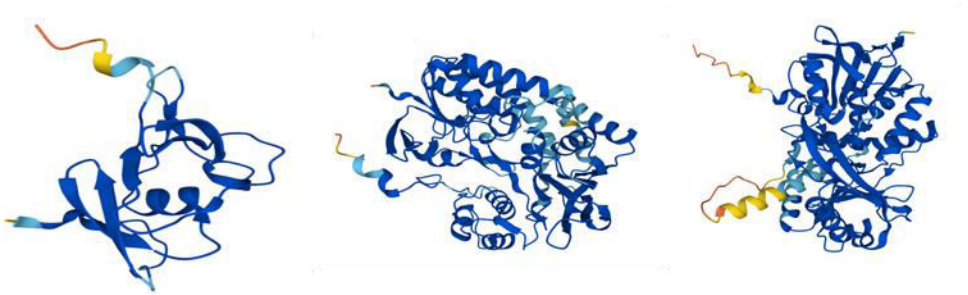
Potential effectors of *C. anophelis sp.nov*., virulence





Hydrogen molecule (cyanide)





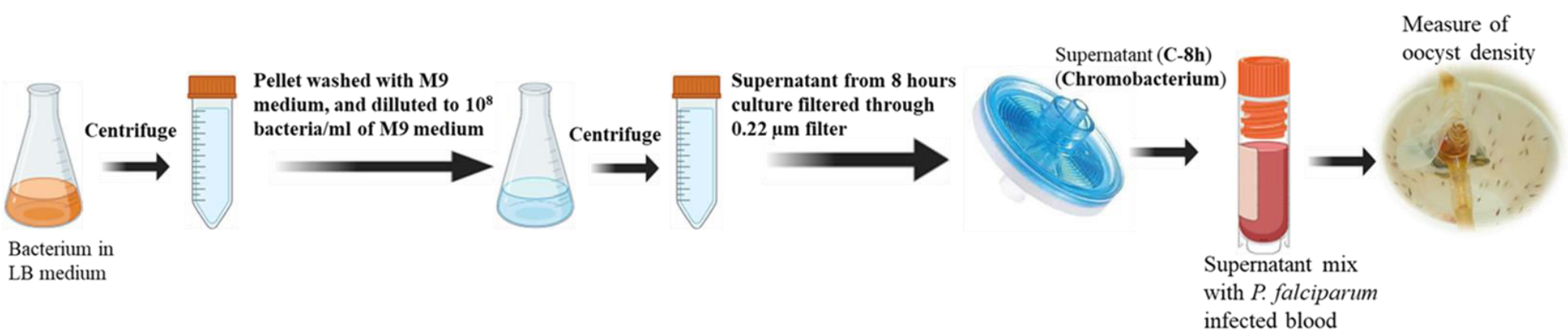
HcnA HcnB HcnC

Methodology

Bacteria cell-free supernatant as sources of metabolites for mosquitocidal and parasitological properties

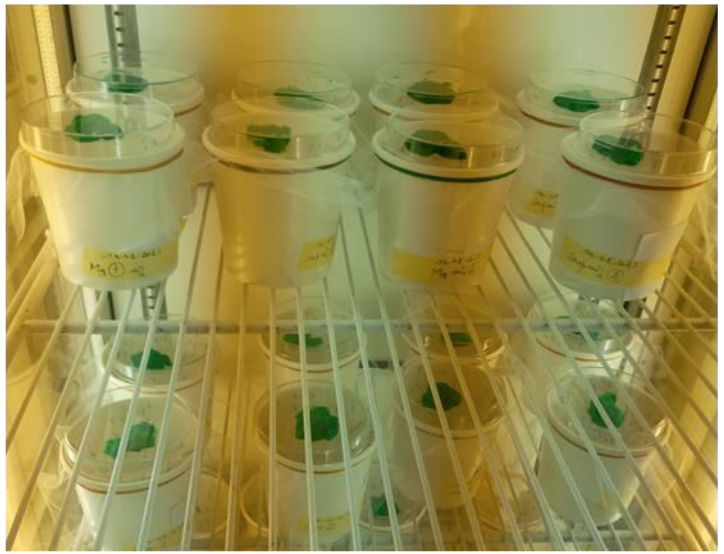
✓ Mosquito symbiont *C. anopheles* bioactive supernatant

C. Anophelis sp.nov on King's B media



Methodology

Contained for lab and field experiments



An. coluzzii mosquito feeding on *C. anophelis* cell-free supernatant

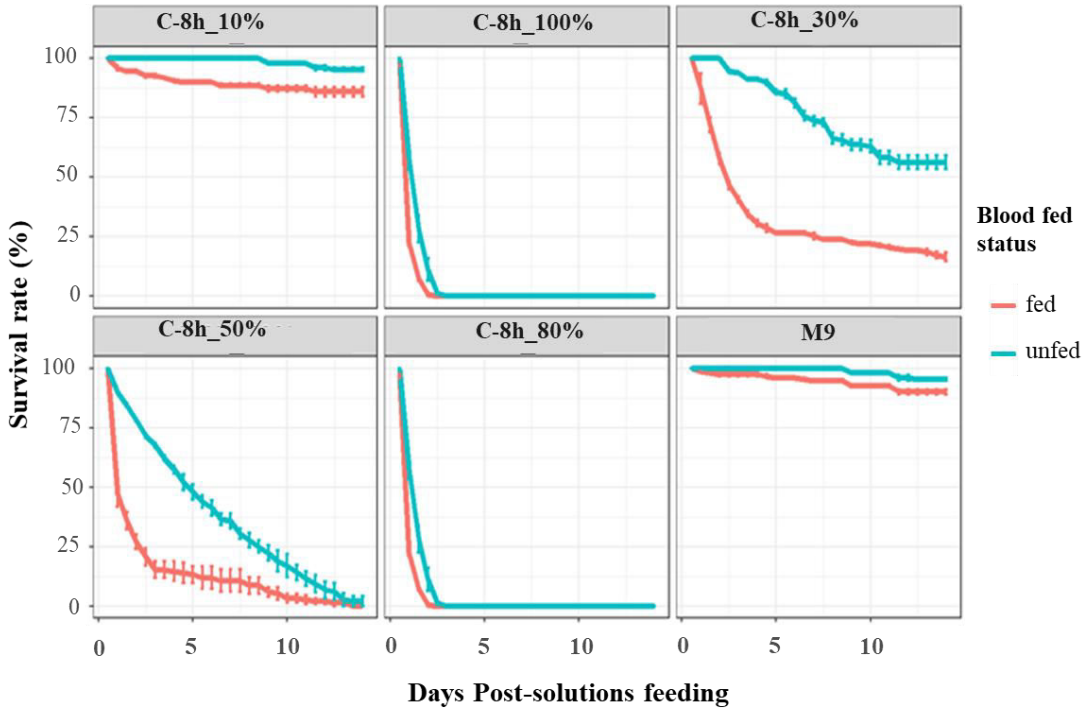
Laboratory experiments

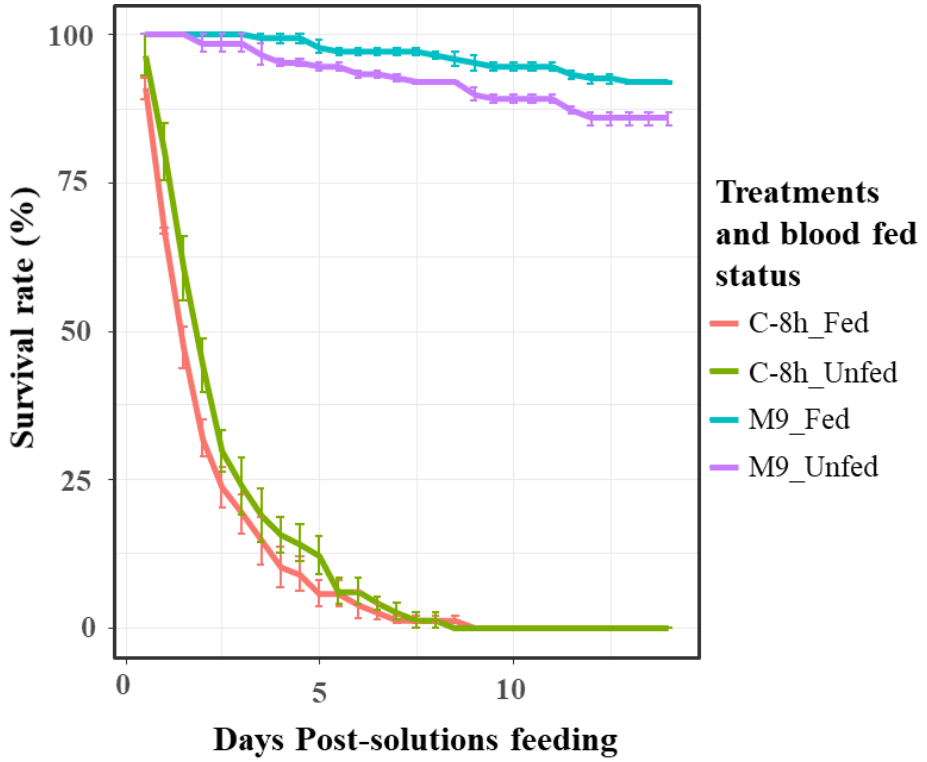
Field experiments

Results

Bacteria cell-free supernatant as sources of metabolites for mosquitocidal and parasitological properties

- ✓ Effect of *An. coluzzii* mosquito survival by symbiont *C. anopheles* bioactive cell-free supernatant



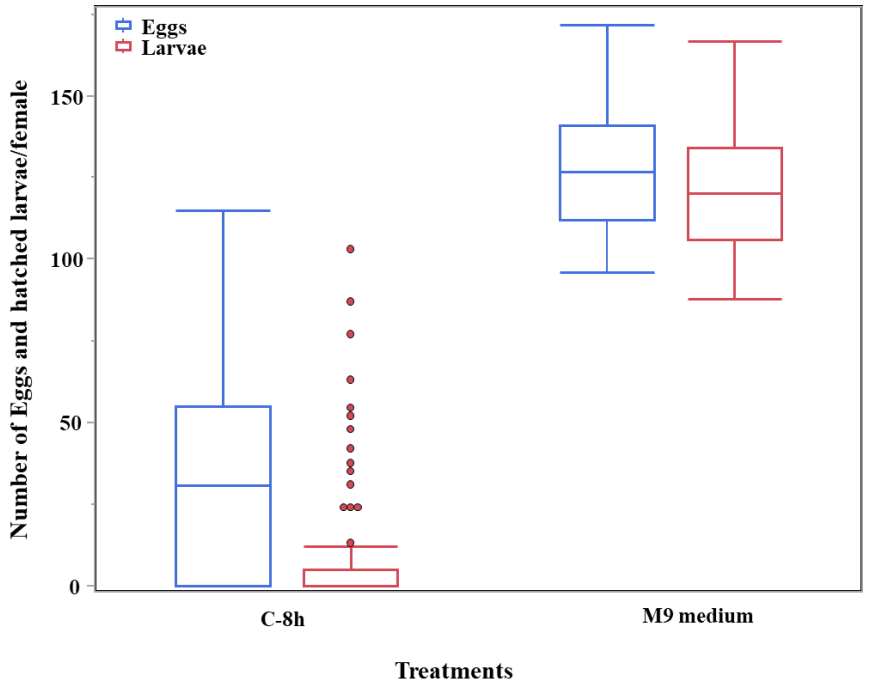


Results

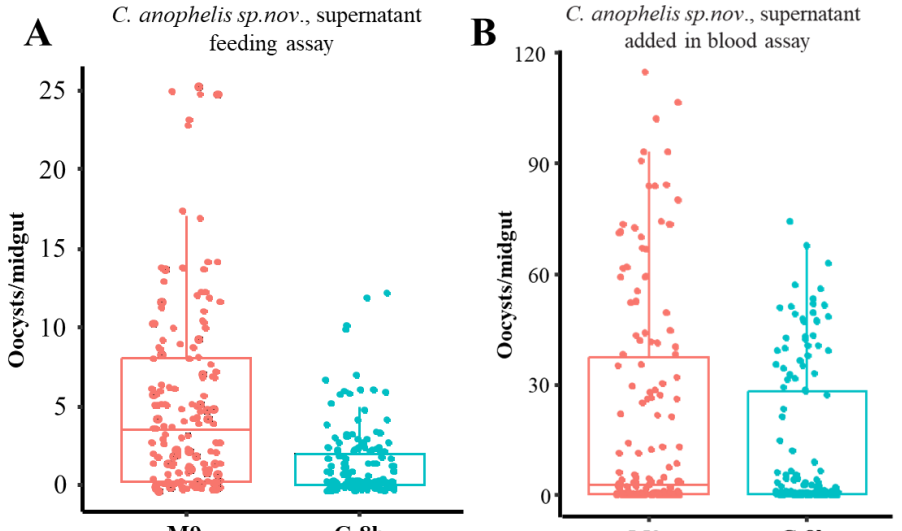
Bacteria cell-free supernatant as sources of metabolites for mosquitocidal and parasitological properties

✓ Effect of symbiont *C. anopheles* bioactive cell-free supernatant on parasitological properties

Reproductive potential by symbiont *C. anopheles*



Bacterial inhibitor(s) of Plasmodium development



Conclusions and Future Perspectives

Biocontrol strategies for mosquito-borne diseases are needed to help reduce the prolonged application of insecticides that are currently used as the primary method for mosquito control;

The pathogenic bacteria can be extensively used due to its ability to selectively kill mosquito, may be effective in future control programs;

Eco-friendly, safe, and sustainable methods should be developed that can target a range of different mosquito species.

THANK YOU

RBM Partnership To End Malaria

Institut de Recherche en Sciences de la Santé IRSS BURKINA FASO

Centre MURAZ Recherche - Formation - Expertise

SIC SYA INNOVATION CENTER