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Controlling Vector-borne Diseases Through Paratransgenesis

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Abstract

The high incidence of Vector-borne diseases (VBDs) and the inefficiency of current methods in preventing and treating them have been driving research for alternative solutions. Here, we present an approach called paratransgenesis that could help in such challenge. In paratransgenesis, genetic modification in vectors' symbionts can be used to block the transmission of various pathogens and help preventing or even eradicate insect-transmitted diseases.

Introduction

Vector-borne diseases (VBDs) affect millions of people worldwide and the strategies to suppress such diseases are still insufficient[1]. VBDs are caused by several pathogens and are transmitted to humans by different species of hematophagous arthropods[1]. Moreover, most of theses diseases still do not have vaccines or even efficient and safe treatments[1]. Here, we will introduce paratransgenesis as an innovative strategy to prevent VBDs transmission[2,3].

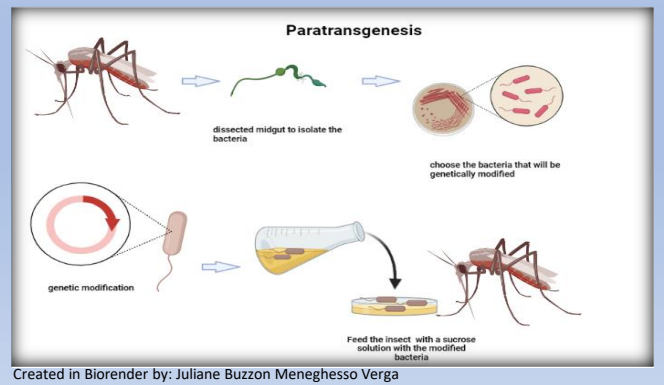
Vector-Borne diseases
- Malária
- Leishmaniasis
- Sleeping sickness
- Lyme diseases
- Chagas

- All together causing 700 000 deaths annually.
- Account for more than 17% of all infectious diseases

Current control and treatment are not good enough

How to use paratransgenesis

- Choose and test a molecule able to kill the pathogen: protein, polypeptide, lipase or even antibodies
- Find a suitable bacteria (able to be transmitted and resistant to the chosen molecule) within the insect gut to genetically modify it
- Transform the chosen bacteria and make them "factories" of the molecule that kill the parasite.
- Feed the insects with the modified bacteria



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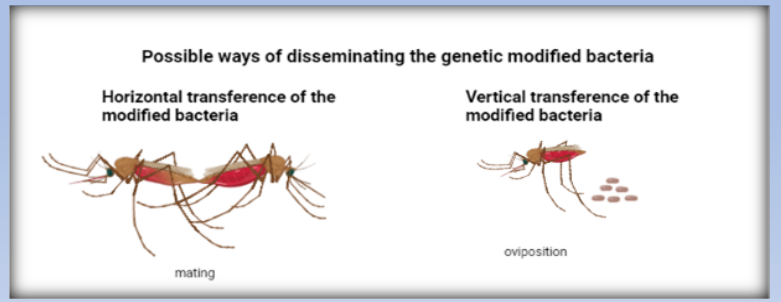

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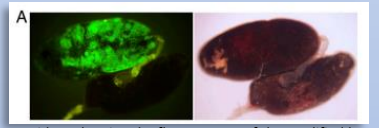
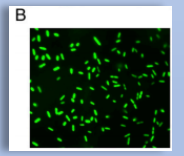
Conclusion

- Paratransgenesis can be a powerful tool in our fight against VBDs.
- Some research papers have shown the ability of paratransgenesis in reducing the Plasmodium load in the Anopheles by up to 98 %[4].
- Several criteria have to be fulfilled to guarantee that this strategy is efficient and transferable [2,4].

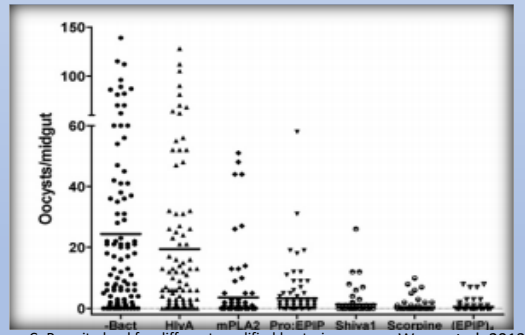


A- Midgut showing the fluorescence of the modified bacteria



B- The genetically modified bacteria

Wang et al. 2012



C- Parasite load for different modified bacteria

Wang et al. 2012

Reference

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2. Beard CB, Durvasula RV, Richards FF. Bacterial symbiosis in arthropods and the control of disease transmission. Emerging infectious diseases. 1998;4(4):581-91.
3. Coutinho-Abreu IV, Zhu KY, Ramalho-Ortigao M. Transgenesis and paratransgenesis to control insect-borne diseases: current status and future challenges. Parasitol Int. 2010;59(1):1-8.
4. cteWang S, Ghosh AK, Bongio N, Stebbings KA, Lampe DJ, Jacobs-Lorena M. Fighting malaria with engineered symbiotic baria from vector mosquitoes. Proc Natl Acad Sci U S A. 2012;109(31):12734-9.