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Impact of extracellular vesicles of *Staphylococcus aureus* N305 on the immune response of the host

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Bacterial extracellular vesicles and health: positive and negative effects



STLOpen Days
19-21 March 2019



Brenda LUZ – Doctorate
MicroBio - Eric GUEDON / Yves LE LOIR



Food quality & safety



Develop safe, healthy, sustainable and hedonic fermented foods



Food spoilage



Reduce health risks and food losses and waste



Bacterial extracellular vesicles and health: positive and negative effects



Animal health



Offer alternatives to antibiotic treatments (probiotics)

Health & wellbeing

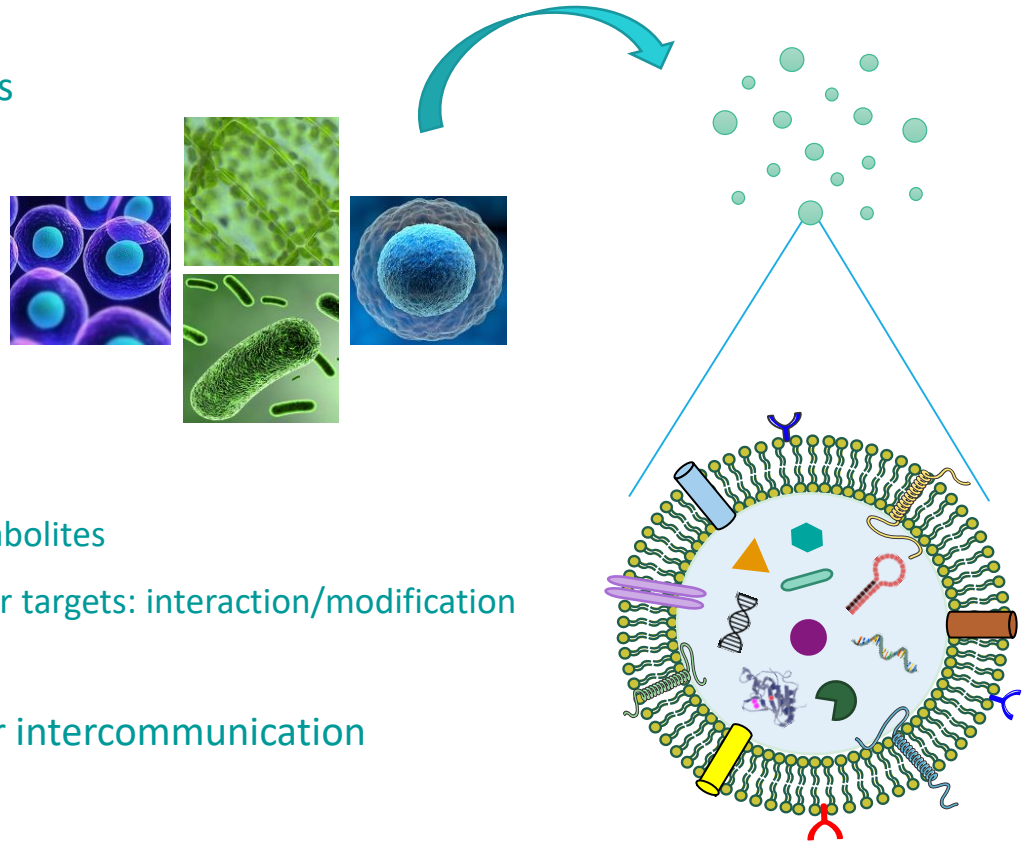


Develop functional and designer food against modern lifestyle diseases

Introduction

What are Extracellular Vesicles (EVs)?

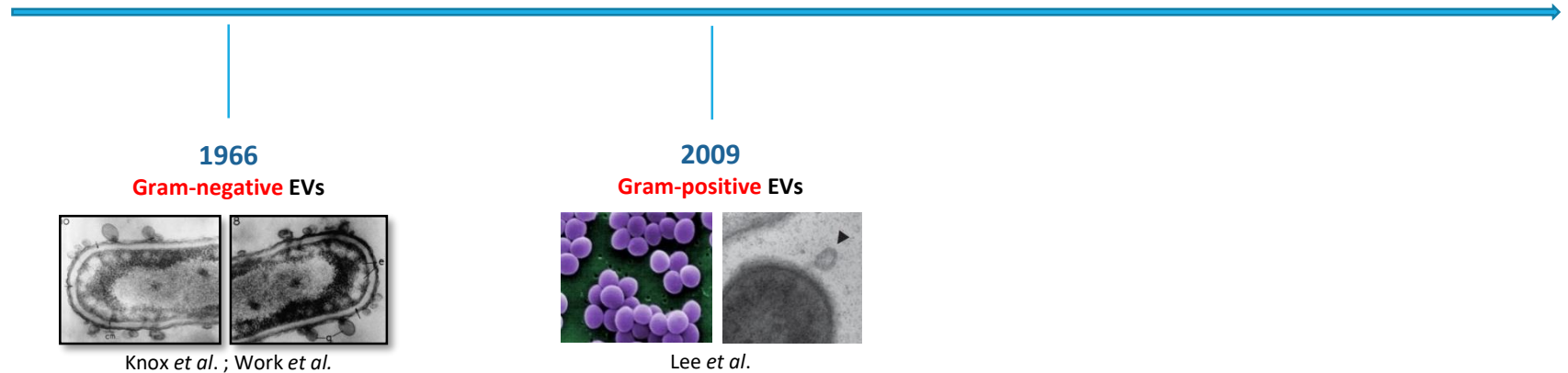
- ❖ Spherical, lipid bilayer nanoparticles (30 – 500 nm)
- ❖ Produced by any living cell
Archaea, Bacteria and Eukaryotes
- ❖ Carry various bioactive molecules
 - Proteins, nucleic acids, lipids, metabolites
 - Delivered to local or distant cellular targets: interaction/modification
- ❖ Considered a mechanism of cellular intercommunication



Introduction

Extracellular Vesicles (EVs)

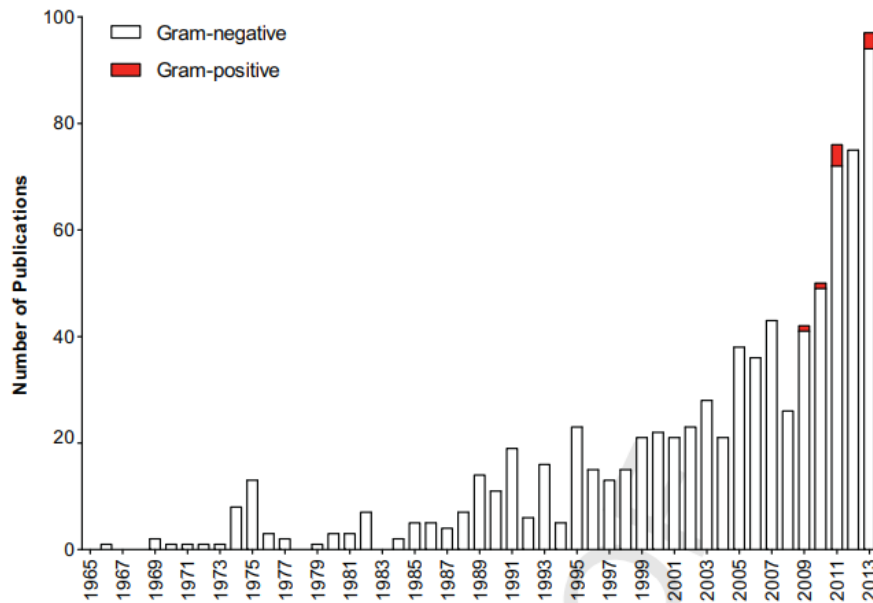
❖ Emerging field



Introduction

Extracellular Vesicles (EVs)

❖ Emerging field



2018
Staphylococcus aureus
NewBould305 EVs

Tartaglia *et al.*



2018
Propionibacterium
freudenreichii EVs

Vinicius *et al.*



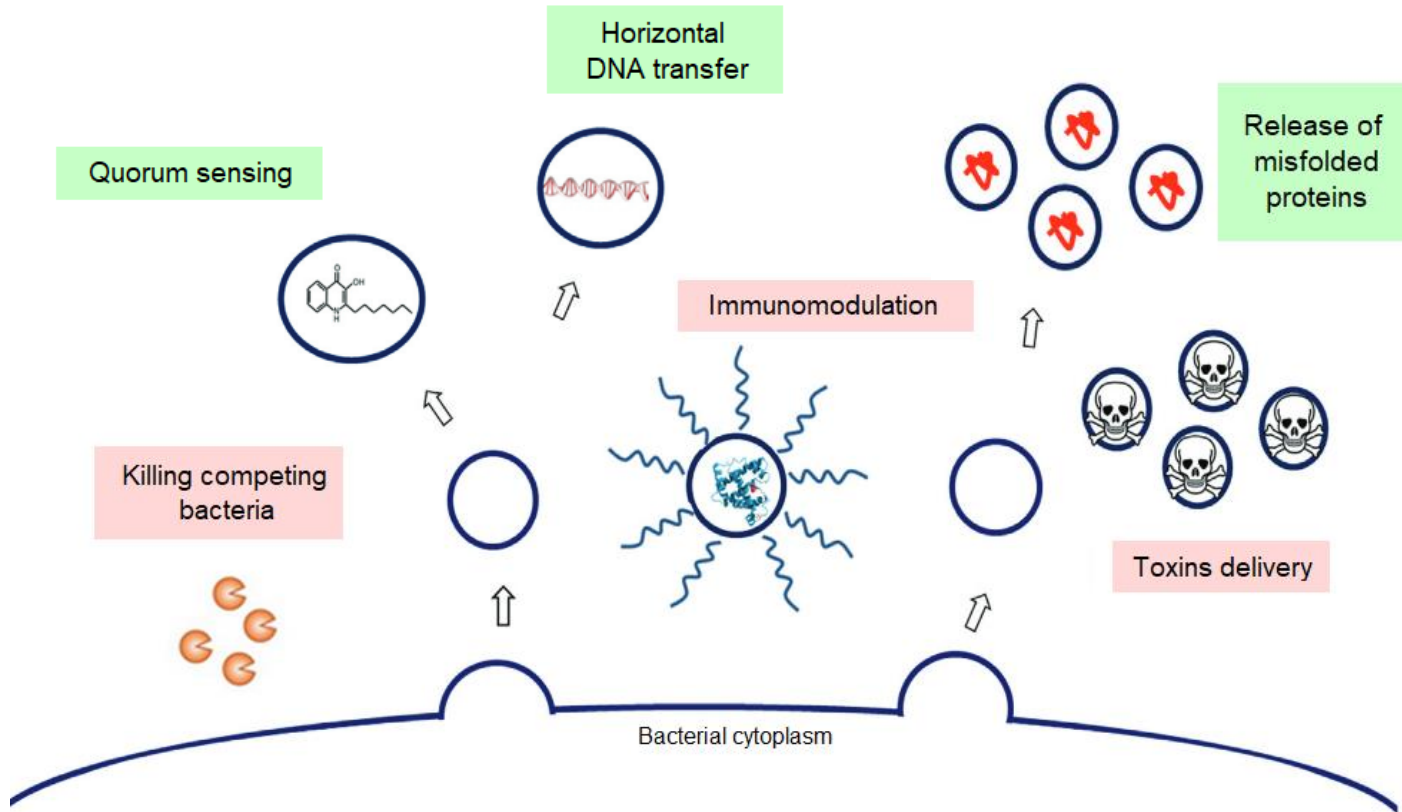
STLO

Introduction

What do bacterial EVs do?

Defense

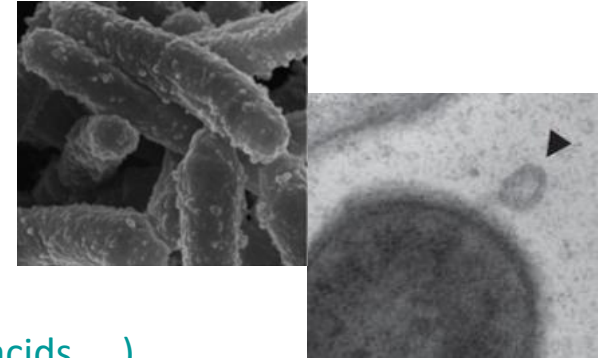
Offense



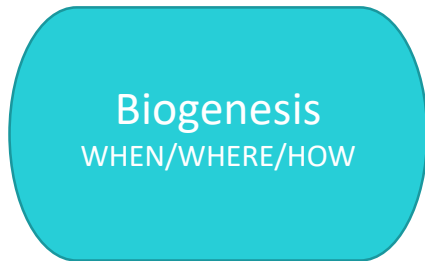
(Adapted - Haurat, Elhenawy, & Feldman, 2015)

Introduction

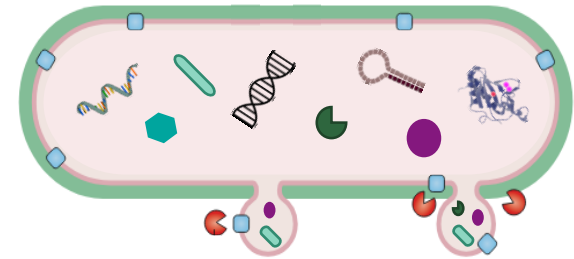
Our research aims:



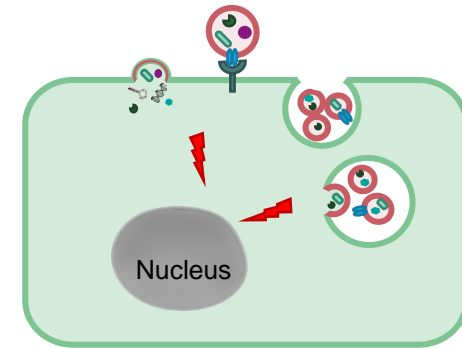
- Production (species, strains...)
- Compositions (proteins, nucleic acids, ...)



- Formation mechanisms
- Content selection mechanisms



- Communication intra- and inter-species
- Group behavior and community functioning
- Interactions with microbiota and host



(Prado-Rosales et al, 2014; Lee et al., 2009)

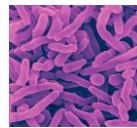
Introduction

Our research aims:

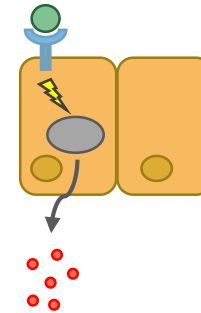
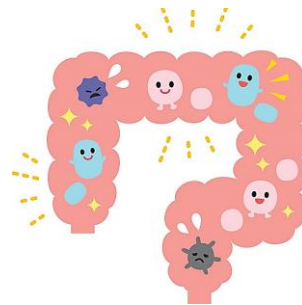
- Characterization
WHO/WHAT
- Biogenesis
WHEN/WHERE/HOW
- Biological Roles
WHY

Bacterial EVs and health

*Propionibacterium
freudenreichii*

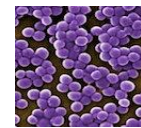


Probiotic
Properties

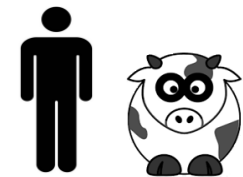


Immunomodulation

*Staphylococcus
aureus*



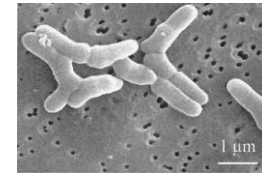
Virulence
Properties



Bacterial EVs and health: positive effects

Propionibacterium freudenreichii

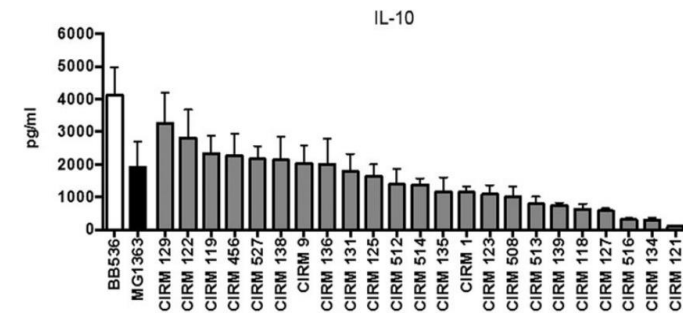
- ❖ Probiotic bacterium – role in cheese production
- ❖ Anti-inflammatory properties
 - ✓ SlpB surface protein being carried by EVs



Gram-positive



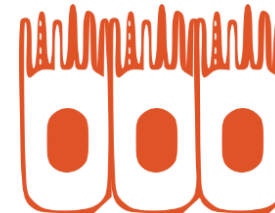
Swiss-type cheese



P. freudenreichii



EVs



Host-cell

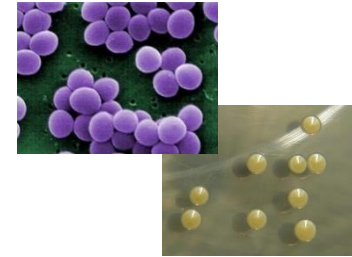
Role of EVs in the probiotic properties of *P. freudenreichii*?

(Deutsch et. al, 2017)

Bacterial EVs and health

Staphylococcus aureus

- ❖ Medical and veterinary importance
- ❖ It is one of the most important etiological agent of **mastitis**

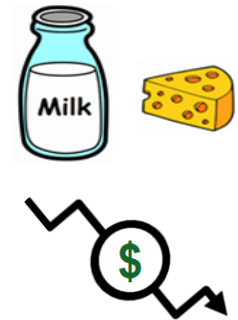


Gram-positive

Inflammation of the mammary gland



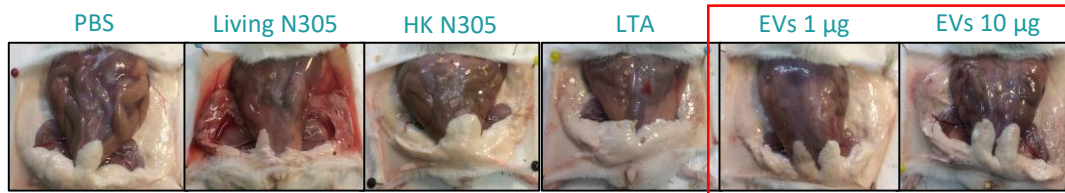
- Production disease in dairy herds
- Affects animal health and milk quality
- Treatment is still **ineffective**



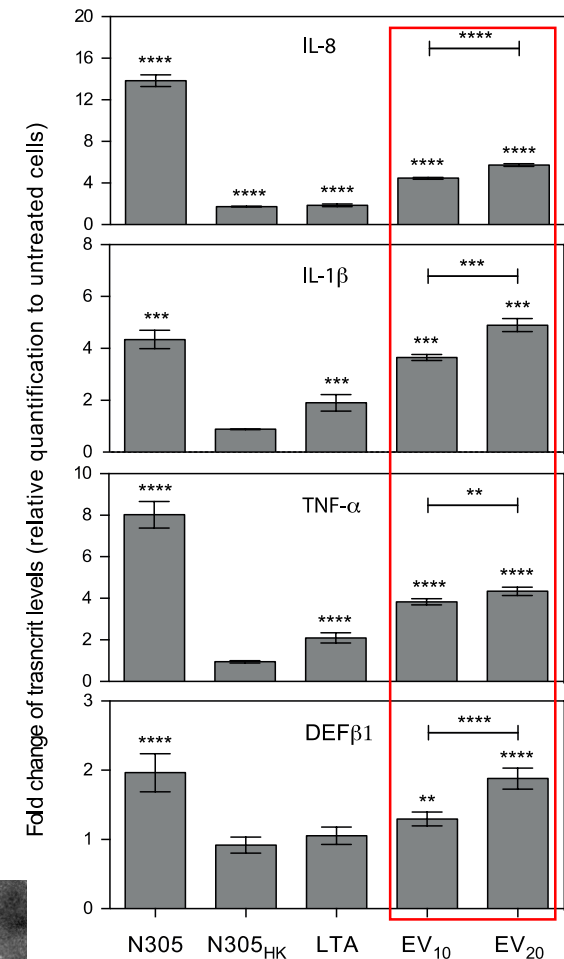
Bacterial EVs and health: negative effects

Staphylococcus aureus EVs

- ❖ Strain N305 – bovine mastitis isolate
 - Induce a pro-inflammatory response expression in vitro
 - Promote tissue inflammation in vivo



How do EVs from *S. aureus* N305 strain impact the immune response of the host?



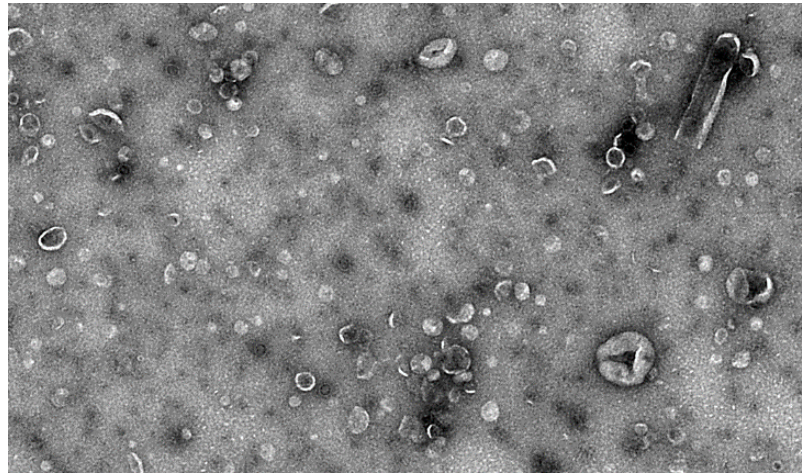
(Tartaglia *et al.*, Front Cell Infect Microbiol, 2018)

Perspectives

- ❖ Expand the knowledge about EVs produced by Gram-positive bacteria
- ❖ Improve the understanding of the interactions of EVs with host cells
- ❖ Provide molecular and functional data for the use of EVs as biotechnological agents
 - New vesicular systems for therapy
 - Development of vaccines or drugs for prevention of diseases
 - Delivery of bioactive molecule (immunomodulating compounds)



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THANK YOU