Approche hybride de modélisation explicable du métabolisme des écosystèmes microbiens

Hybrid approach for explainable metabolic modelling of microbial ecosystems'

Présenté par Maxime LECOMTE

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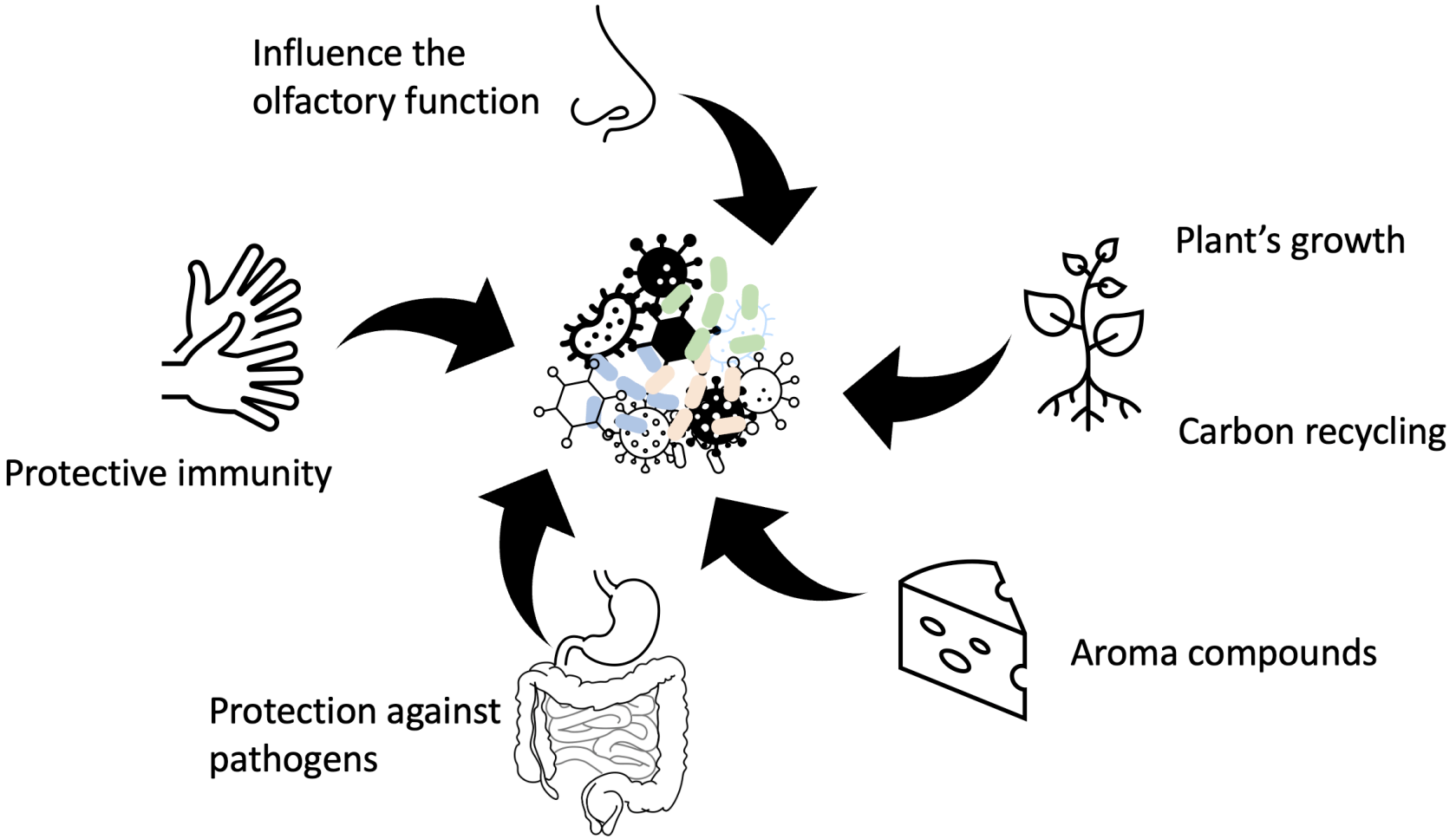
Why the study of microorganisms is relevant ?



- High diversity of microorganisms
- Microorganisms roles specific to the environment (Royet and Plailly, 2004; Belkaid and Hand, 2014; Zhang et al., 2015; Hoorman, 2011; McSweeney and Sousa, 2000)

What underlying mechanisms are responsible of the observed activity ?

Metabolism

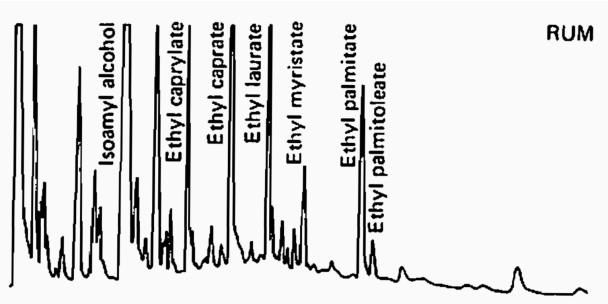


Figure 1: Gas chromatograms of the major aroma compounds isolated from rum (from Suomalainen and Lehtonen, 1978)

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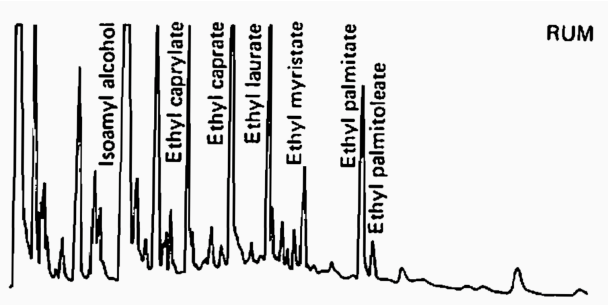

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What is metabolism ?

Set of all biochemical reactions occurring in the cell of an organism that permit the production of energy and metabolic goods. (Sánchez López de Nava A, 2023)

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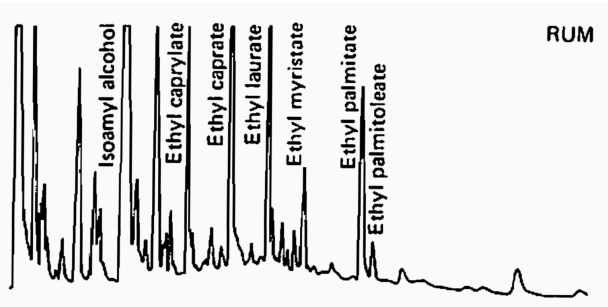
Metabolism and Bacterial interactions



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- Metabolism of an organism explain observable phenotype

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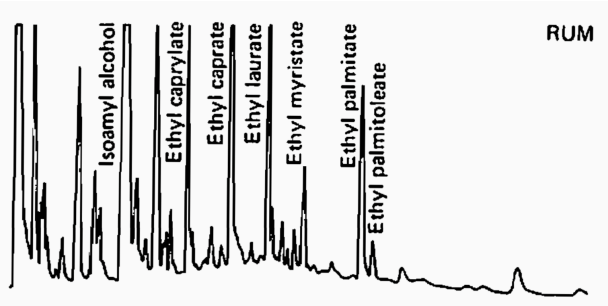

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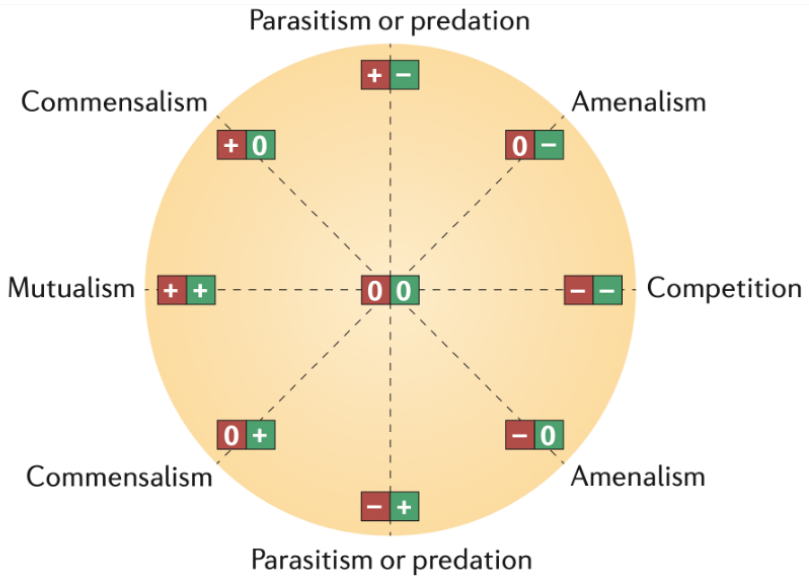

Figure 2: List of different types of bacterial interactions (Faust and Raes, 2012)

- Bacterial interaction can affect positively / negatively other organisms

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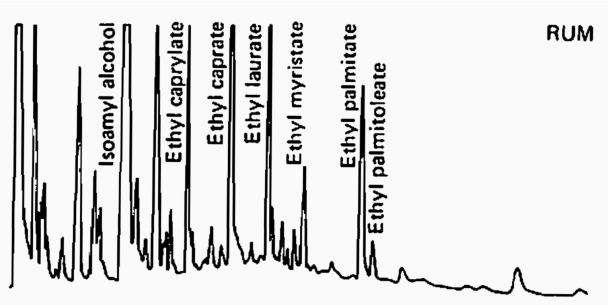

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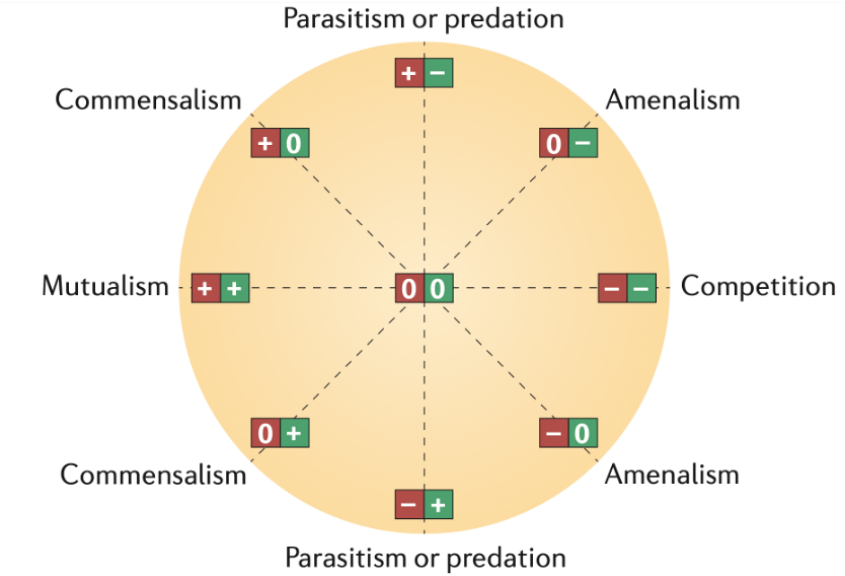

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Bacterial interactions can modulate metabolic goods

How can we study this impact through metabolism?

Genome-scale metabolic network (GEMs) reconstruction

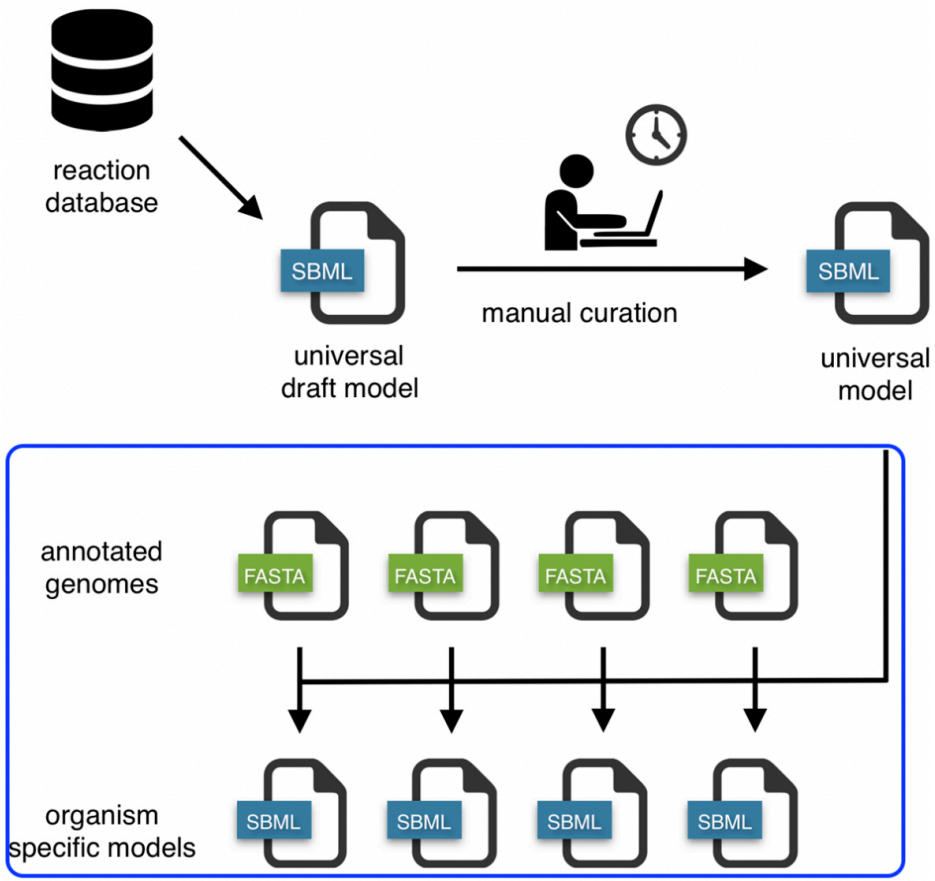

Figure 3: Top down genome-scale metabolic network reconstruction approach (modified from Machado et al., 2018)

- For bacteria: average of 1500 reactions, 1000 genes, 800 metabolites
- Informatic can help to resolve combinatorial problem

How can we study this impact through metabolism?

Systems biology

System biology

Associate an organism to a system and study the all system (Kitano, 2002)

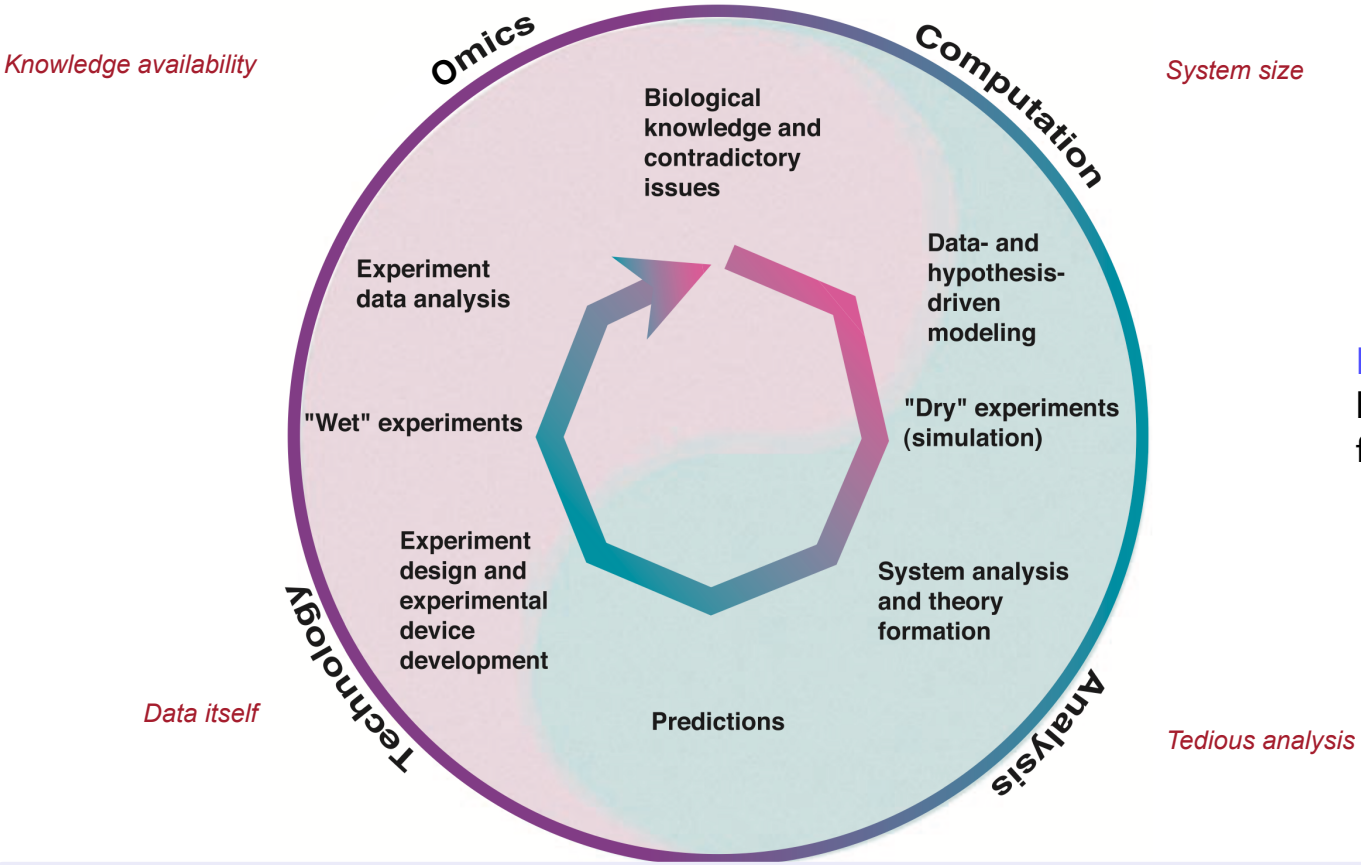

Figure 4: System biology modified from Kitano, 2002

- System biology combines biology and informatic analysis for studying bacterial behavior

Objectifs de la thèse

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