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# *Propionibacterium freudenreichii* Surface Protein SlpB Is Involved in Adhesion to Intestinal Cells

**Gwénaél JAN**

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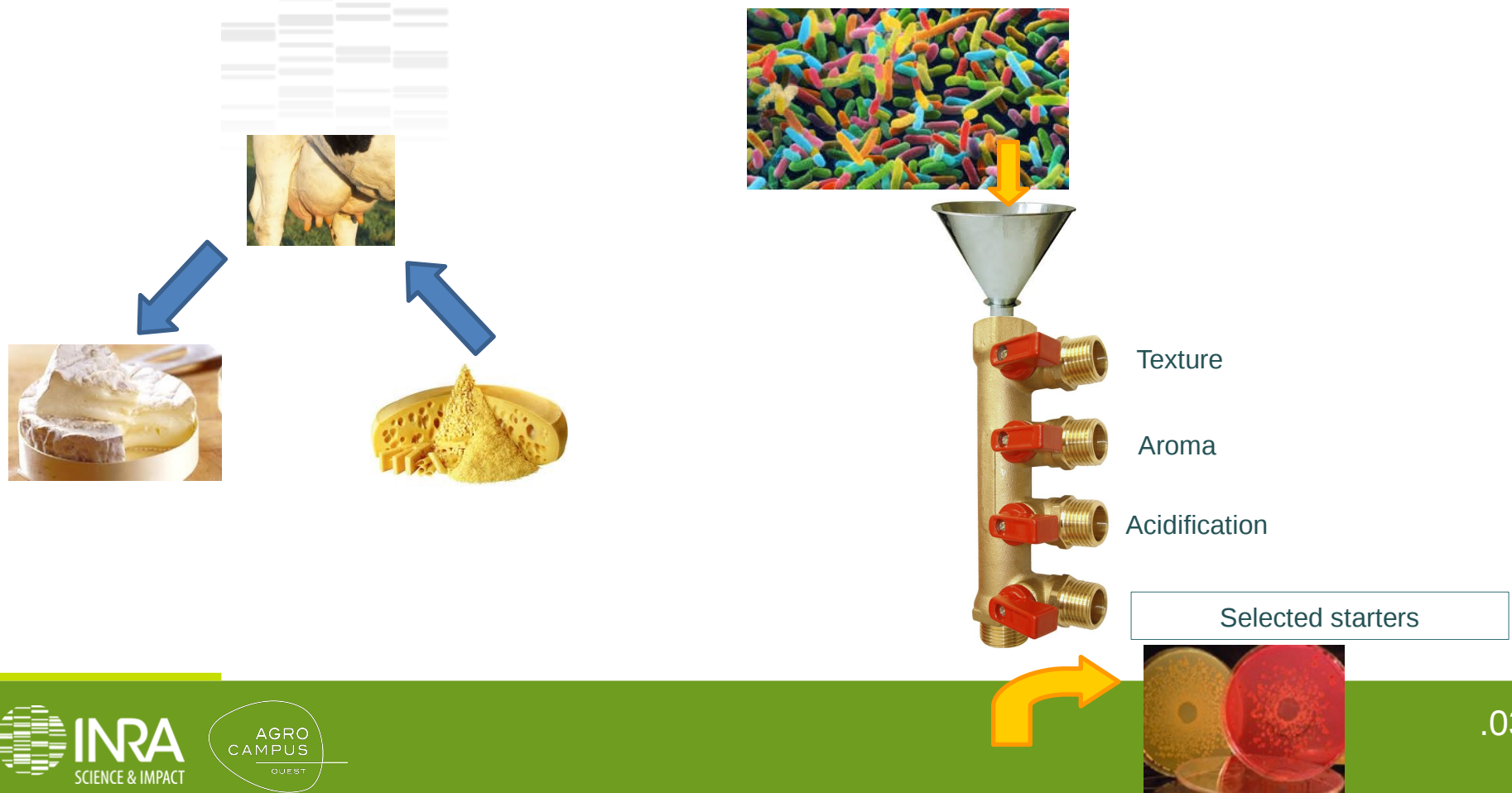




# The “2-in-1” bacteria ...

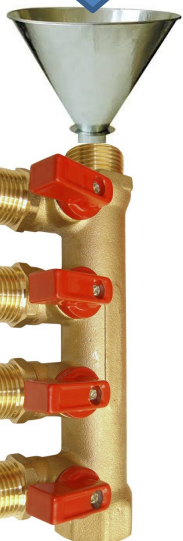


# Bacteria were first selected by the cheese-making process



# Other bacteria were selected for probiotic properties

IBS, IBD, atopie,  
intolérance ...

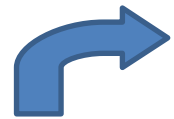


Immunomodulation

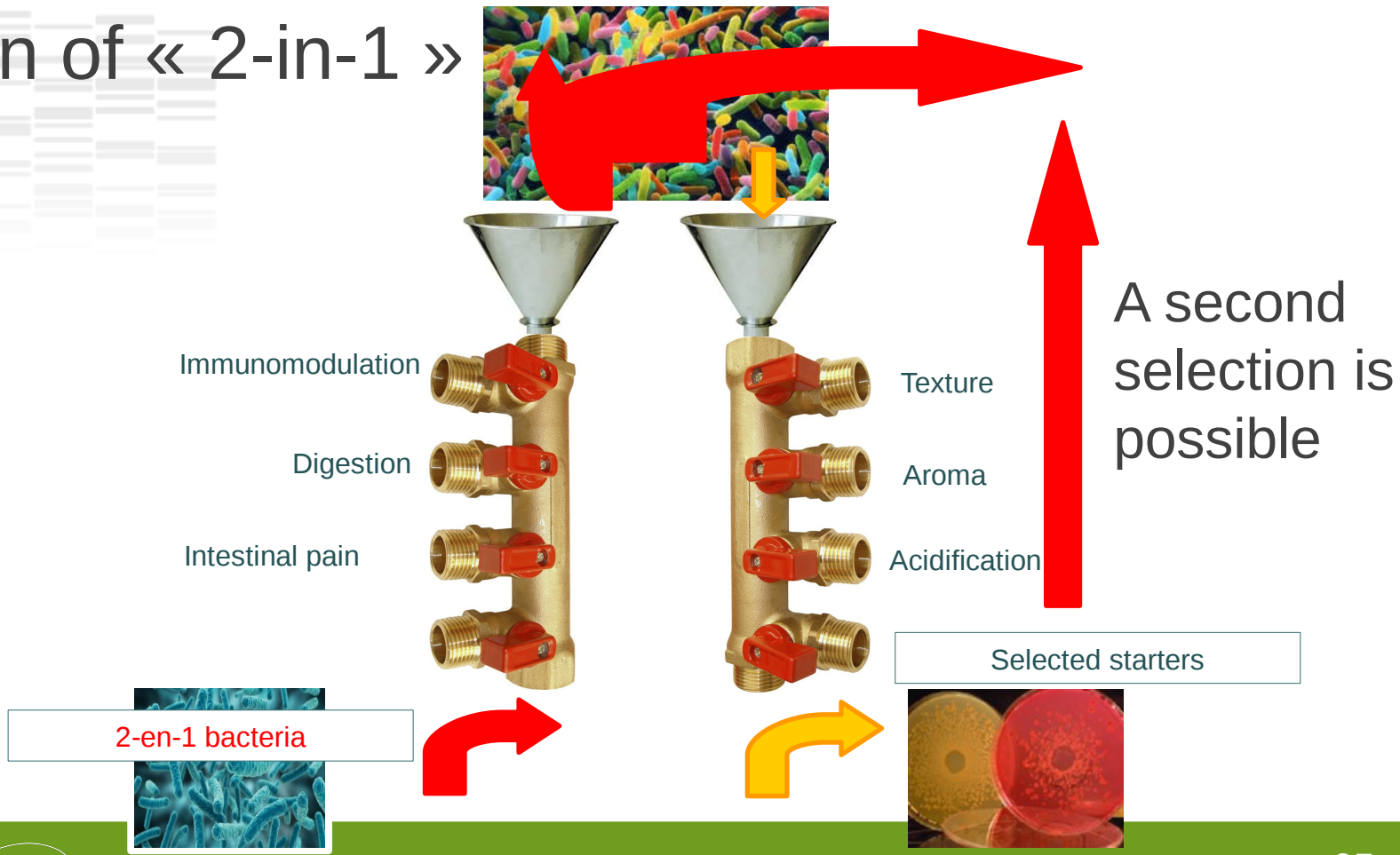
Digestion

Intestinal pain

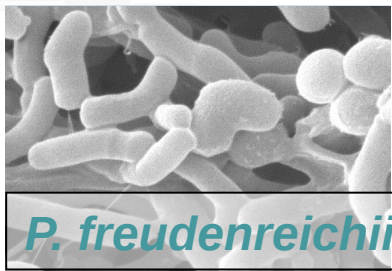
Selected probiotics



# Selection of « 2-in-1 » bacteria



# Examples of « 2-in-1 » bacteria: propionibacteria



*P. freudenreichii*

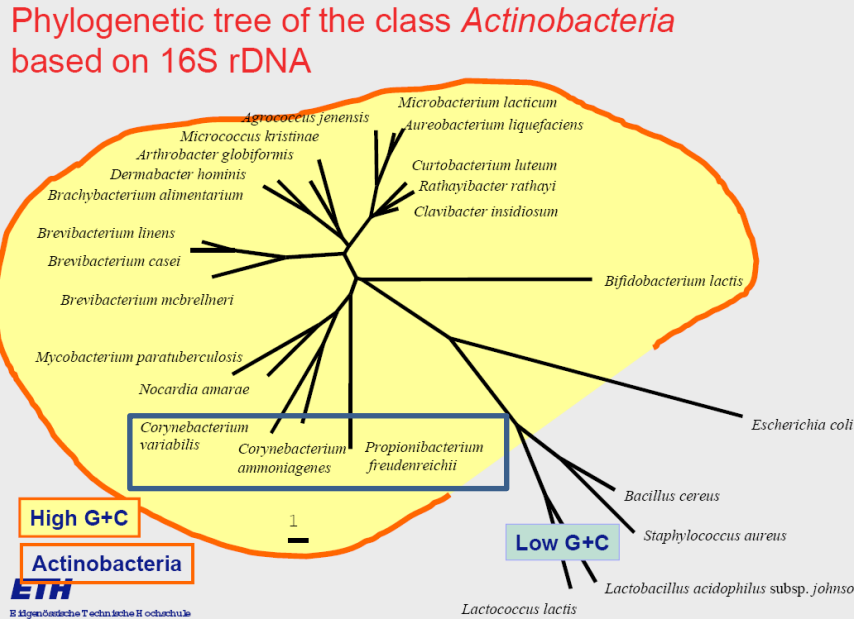
Gram +

pleiomorphic

anaerobic to microaérophilic

non motiles et non sporulated

GC Rich : 67%



« Dairy » :

*P. freudenreichii*

*P. jensensis* - *P. thoenii* - *P. acidipropionici*

# Examples of selected bacteria: propionibacteria

## Propionibacteria, a peculiar ecology

Soil

Fodder

Sewage plants

Silage

Rumen

Gut

Cheese

Milk

*Propionibacterium freudenreichii*

- Vitamin producer B9, B12
- Probiotics
- Food bio-preservative
- Ripening starter

Short Chain Fatty Acids (SCFA)  
Known effect on health



# Promising immunomodulators

APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Dec. 2010, p. 8259-8264  
 0099-2240/10/\$12.00 doi:10.1128/AEM.01976-10  
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Vol. 76, No. 24

## Promising Immunomodulatory Effects of Selected Strains of Dairy Propionibacteria as Evidenced *In Vitro* and *In Vivo*†

Benoit Foligné,<sup>1,2,3,4</sup> Stéphanie-Marie Deusch,<sup>5,6</sup> Jérôme Breton,<sup>1,2,3,4</sup> Fabien J. Cousin,<sup>5,6,7</sup>  
 Joëlle Dewulf,<sup>1,2,3,4</sup> Michel Samson,<sup>8</sup> Bruno Pot,<sup>1,2,3,4</sup> and Gwénaél Jan<sup>5,6,\*</sup>

*Institut Pasteur de Lille, Lactic Acid Bacteria & Mucosal Immunity, Center for Infection and Immunity of Lille, 1, Rue du Pr Calmette, BP 245, F-59019 Lille, France<sup>1</sup>; Université Lille Nord de France, F-59000 Lille, France<sup>2</sup>; CNRS, UMR 8204, F-59021 Lille, France<sup>3</sup>; Institut National de la Santé et de la Recherche Médicale, U1019, F-59019 Lille, France<sup>4</sup>; INRA, UMR1253 Science et Technologie du Lait et de l'Oeuf, F-35042 Rennes, France<sup>5</sup>; AGROCAMPUS OUEST, UMR1253 Science et Technologie du Lait et de l'Oeuf, F-35042 Rennes, France<sup>6</sup>; CNIEL/Synlaitrais, 42 Rue de Châteauidan, F-75314 Paris 09, France<sup>7</sup>; and EA 4427 SeRAIC, Faculty of Pharmacy, University of Rennes 1, IFR 140 GFAS, Rennes F-35043, France<sup>8</sup>*

Received 20 August 2010/Accepted 7 October 2010

Immunomodulatory properties of 10 dairy propionibacteria, analyzed on human peripheral blood mononuclear cells (PBMCs), revealed a highly strain-dependent induction of anti-inflammatory cytokine interleukin 10 (IL-10). Two selected strains of *Propionibacterium freudenreichii* showed a protective effect against two models of colitis in mice, suggesting a probiotic potential predicted by immune-based selection criteria for these cheese starter bacteria.

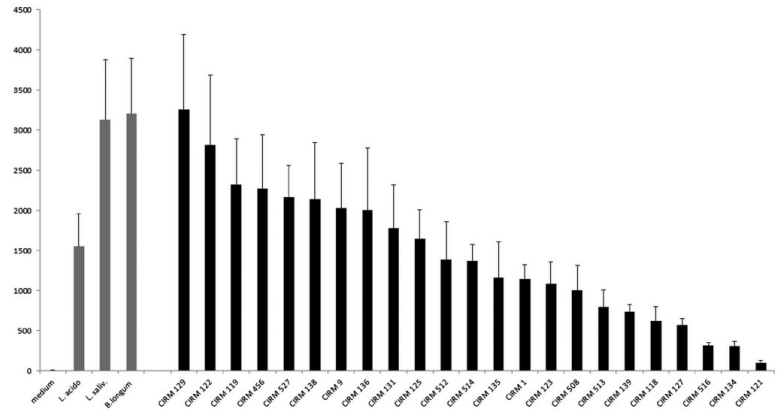
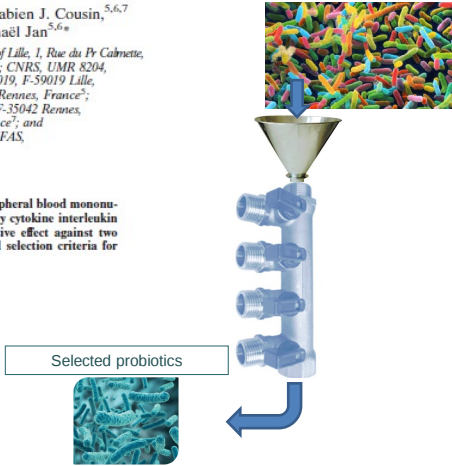


Figure 1 Anti-inflammatory profile of dairy *Propionibacterium freudenreichii* strains assessed on human peripheral blood mononuclear cells (PBMCs). Comparative IL-10 release (in pg/ml) of human PBMCs for 3 reference benchmark probiotic strains (*Lactobacillus acidophilus* NCFM, *L. salivarius* LS33 and *Bifidobacterium longum* BB536) and for 23 propionibacteria strains (CIRM-BIA, INRA, Rennes, France). Immunocompetent cells were stimulated at multiplicity of infection of 10 for 24 h and supernatants analysed by ELISA. Detailed methodology was previously published.<sup>7</sup>

### ➤ Highly strain-dependent



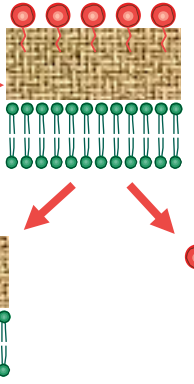
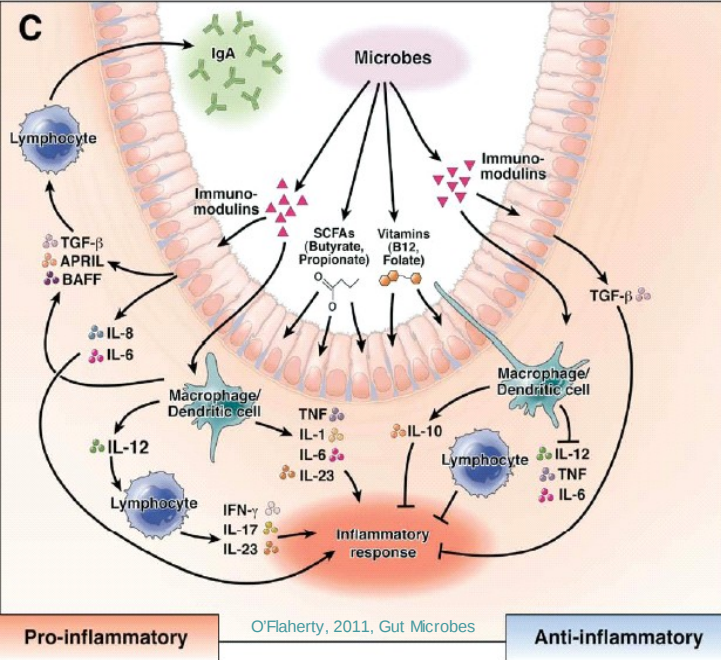
### Tracking the microbiome functionality: focus on *Propionibacterium* species

Benoit Foligné, Jérôme Breton, Denis Mater, et al.

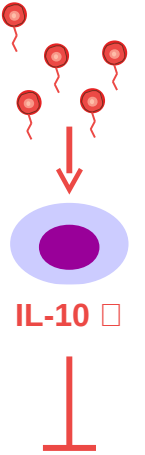
*Gut* 2013 62: 1227-1228 originally published online February 6, 2013  
 doi: 10.1136/gutjnl-2012-304393



# A key role of surface proteins



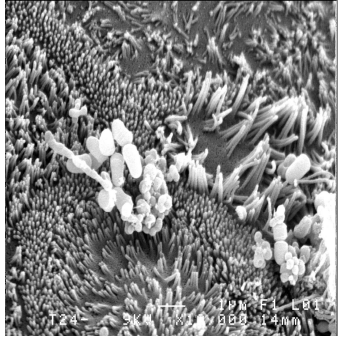
Surface layer proteins (SLP) Are immunomodulators



A close contact favors action of SCFAs and of immunomodulators

➤ What about adhesion ?

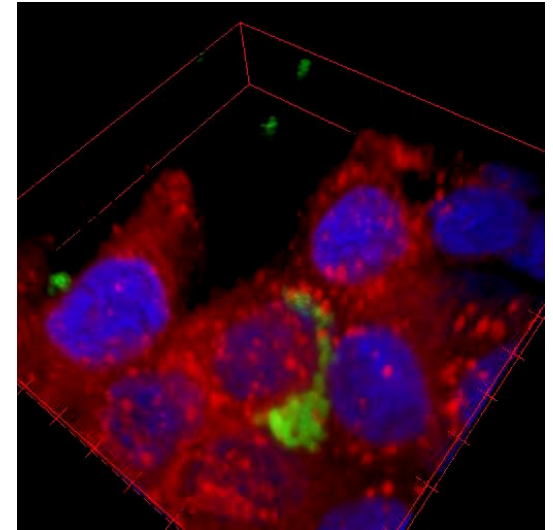
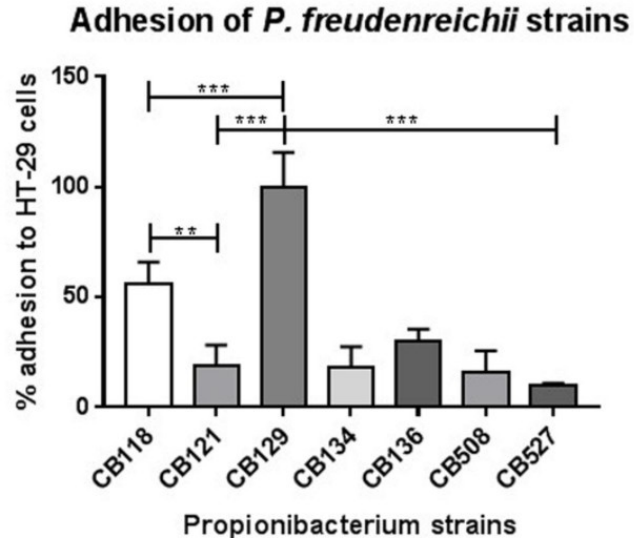
# Adhesion : strain-dependent



*P. freudenreichii* adhering to cultured HT-29



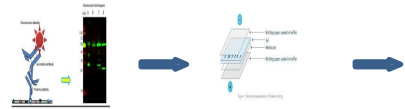
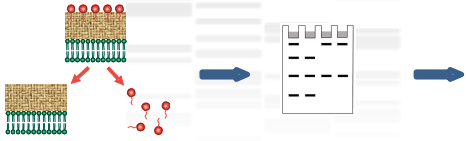
fillipelrc@gmail.com



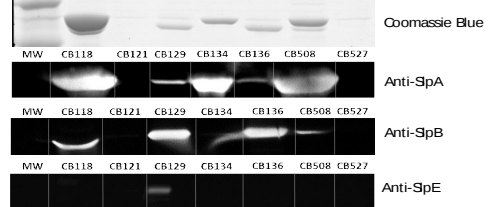
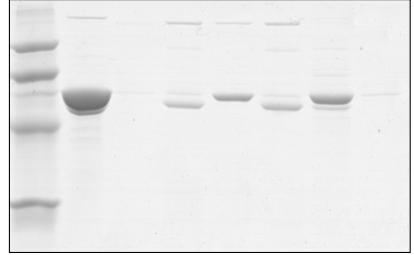
Blue : HT-29 nuclei  
Red : HT-29 membranes  
Green : *P. freudenreichii*  
(fed with fluorescein ester)

➤ Proteins involved ?

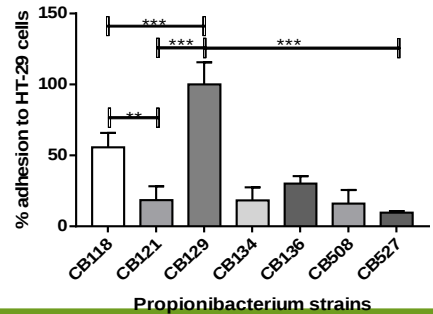
# S-layer proteins : strain-dependent



MW CB118 CB121 CB129 CB134 CB136 CB508 CB527



Adhesion of *P. freudenreichii* strains



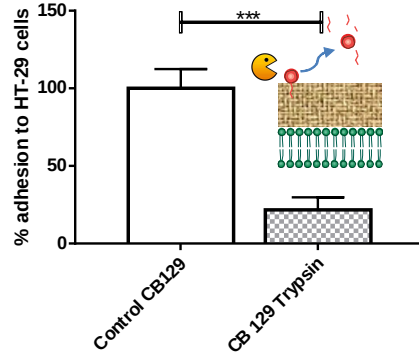
Houem.Rabah@inra.fr

➤ Slp involved ?

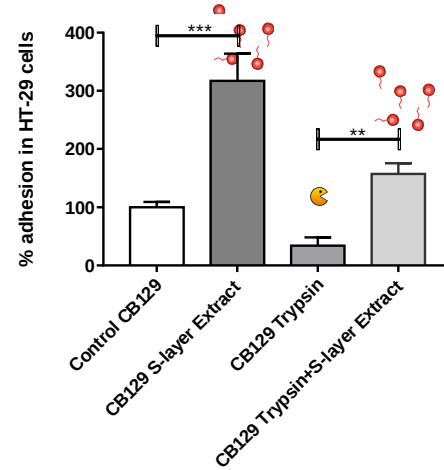
# S-layer proteins : involved in adhesion



Adhesion after enzymatic shaving

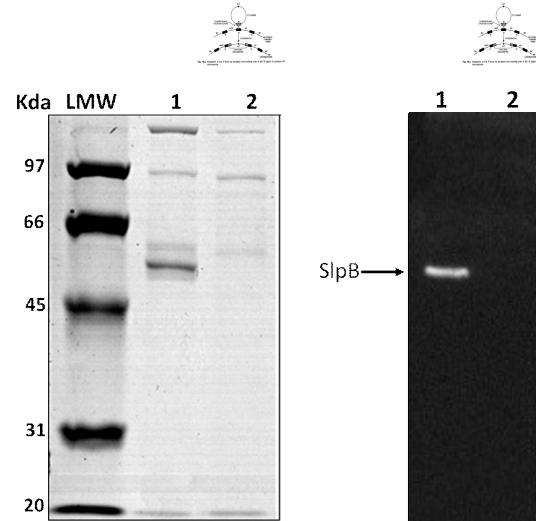
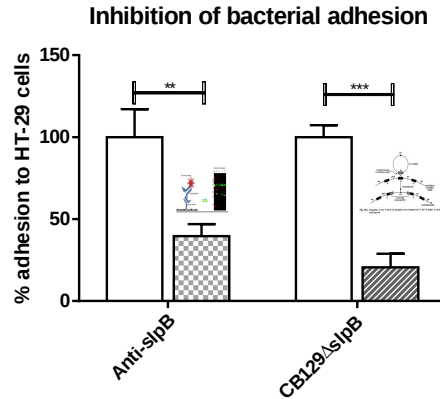


Adhesion with S-layer Extract



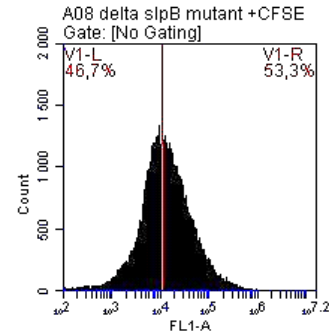
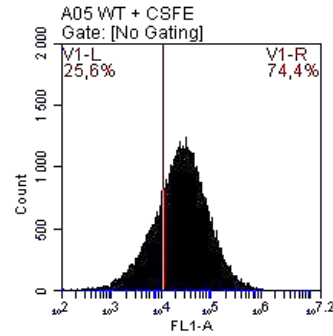
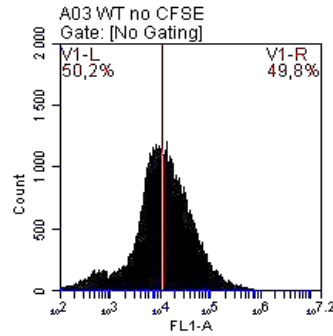
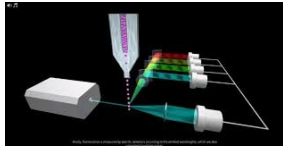
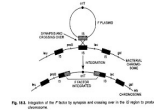
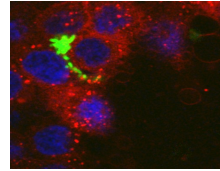
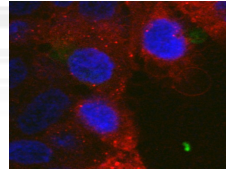
➤ Which SIp involved ?

# Surface layer protein SlpB involved in adhesion



- Mutation of SlpB suppresses adhesion

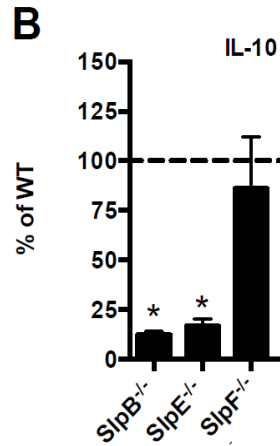
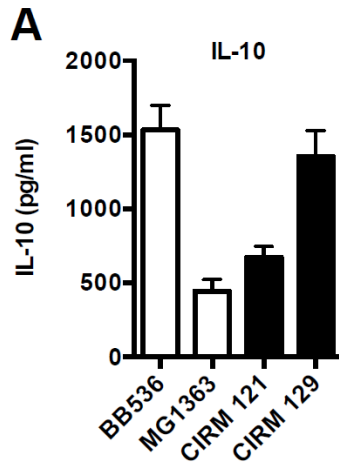
# Surface layer protein SlpB involved in adhesion



Green fluorescence : *P.freudenreichii* (fed with fluorescein ester) →

- Mutation of SlpB suppresses adhesion

# Surface layer protein SlpB involved in immune modulation



- Mutation of SlpB, or of SlpE, suppresses immune modulation



# Read more ...



Review

## Dairy Propionibacteria: Versatile Probiotics

Houem Rabah <sup>1,2</sup>, Fillipe Luiz Rosa do Carmo <sup>1,3</sup> and Gwénaél Jan <sup>1,\*</sup>

[Front Microbiol.](#) 2017; 8: 1033.

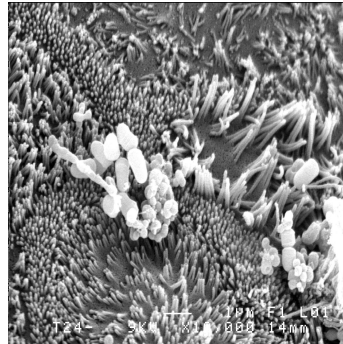
Published online 2017 Jun 8. doi: [10.3389/fmicb.2017.01033](https://doi.org/10.3389/fmicb.2017.01033)

PMCID: PMC5462946

PMID: [28642747](https://pubmed.ncbi.nlm.nih.gov/28642747/)

### *Propionibacterium freudenreichii* Surface Protein SlpB Is Involved in Adhesion to Intestinal HT-29 Cells

[Fillipe L. R. do Carmo](#),<sup>1,2</sup> [Houem Rabah](#),<sup>2,3</sup> [Song Huang](#),<sup>2,4</sup> [Floriane Gaucher](#),<sup>2</sup> [Martine Deplanche](#),<sup>2</sup> [Stéphanie Dutertre](#),<sup>5</sup> [Julien Jardin](#),<sup>2</sup> [Yves Le Loir](#),<sup>2</sup> [Vasco Azevedo](#),<sup>1,†</sup> and [Gwénaél Jan](#)<sup>2,\*†</sup>



REVIEW  
published: 04 April 2018  
doi: [10.3389/fmicb.2018.00645](https://doi.org/10.3389/fmicb.2018.00645)

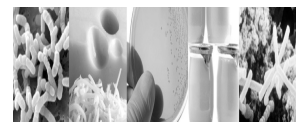
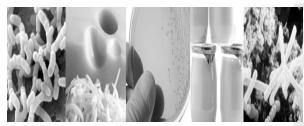


See also : Houem RABAH,  
oral communication,  
Wednesday, 16H00, Session  
4

### Extractable Bacterial Surface Proteins in Probiotic–Host Interaction

[Fillipe L. R. do Carmo](#)<sup>1,2†</sup>, [Houem Rabah](#)<sup>2,3†</sup>, [Rodrigo D. De Oliveira Carvalho](#)<sup>1</sup>, [Floriane Gaucher](#)<sup>2,4</sup>, [Barbara F. Cordeiro](#)<sup>1</sup>, [Sara H. da Silva](#)<sup>1</sup>, [Yves Le Loir](#)<sup>2</sup>, [Vasco Azevedo](#)<sup>1†</sup> and [Gwénaél Jan](#)<sup>2,\*</sup>

<sup>1</sup> Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil, <sup>2</sup> STLO, Agrocampus Ouest, INRA, Rennes, France, <sup>3</sup> Pôle Agronomique Ouest, Rennes, France, <sup>4</sup> Bioprox, Levallois-Perret, France



## Conclusion:

- ✓ Fermented foods: a source of bioactive bacteria
- ✓ Molecules and mechanisms involved are being identified

## Perspectives :

- ✓ Preclinical and clinical studies with fermented products
- ✓ Fermented food for specific populations

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Fermented foods : 30% of our diet

A major source of bacteria : 1010 per day!

A huge variety of bacteria



Thank  
you for  
your  
attention

Don't ask  
tough  
questions

[Houem.Rabah@inra.fr](mailto:Houem.Rabah@inra.fr)

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**Valorial**  
OSONS L'ALIMENT PLUS INTELLIGENT