



HAL
open science

Crucial role of milk proteins on adhesion of intestinal microbes

Sarah Barrau, C. Gaiani, Claire Retourney, C. Mangavel, Yves Le Roux,
Claire Soligot-Hognon, Matthieu Delannoy, Joël Scher, J. Burgain

► To cite this version:

Sarah Barrau, C. Gaiani, Claire Retourney, C. Mangavel, Yves Le Roux, et al.. Crucial role of milk proteins on adhesion of intestinal microbes. *Biomolecules: Research & Development, Markets and Acceptability*, Oct 2019, Palma de Majorque, Spain. hal-02504336

HAL Id: hal-02504336

<https://hal.univ-lorraine.fr/hal-02504336v1>

Submitted on 10 Mar 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Crucial role of milk proteins on adhesion of intestinal microbes

S. Barrau¹, C. Gaiani¹, C. Retourney¹, C. Mangavel¹, Y. Le Roux², C. Soligot-Hognon², M. Delannoy², J. Scher¹, J. Burgain¹

¹ Université de Lorraine, LIBio, F-54000 Nancy, France

² Université de Lorraine, Inra, URAFPA, F-54000 Nancy, France

jennifer.burgain@univ-lorraine.fr ; sarah.barrau@univ-lorraine.fr

Introduction

Milk

Main source of nutrition and immunological protection for the neonate
Contain glycoproteins (GPs)

Potentially bind bacteria' pili to adhesion site of model intestinal cells

Use of probiotic bacteria

Beneficial for health and intestinal diseases

"Generally Recognized as Safe" (GRAS)

Glycoproteins

What are the different existing interactions ?

Aim of the study

- ❖ Identification SpaCBA pili role in interaction with intestinal cells and GPs
- ❖ Establishment of interactions and benefits of GPs on bacteria adhesion
- ❖ Improved understanding of the role of milk in the adhesion of bacteria to epithelial intestinal cells

Use of differentiated cell monolayer obtained after 22 culture days

Materials and Methods

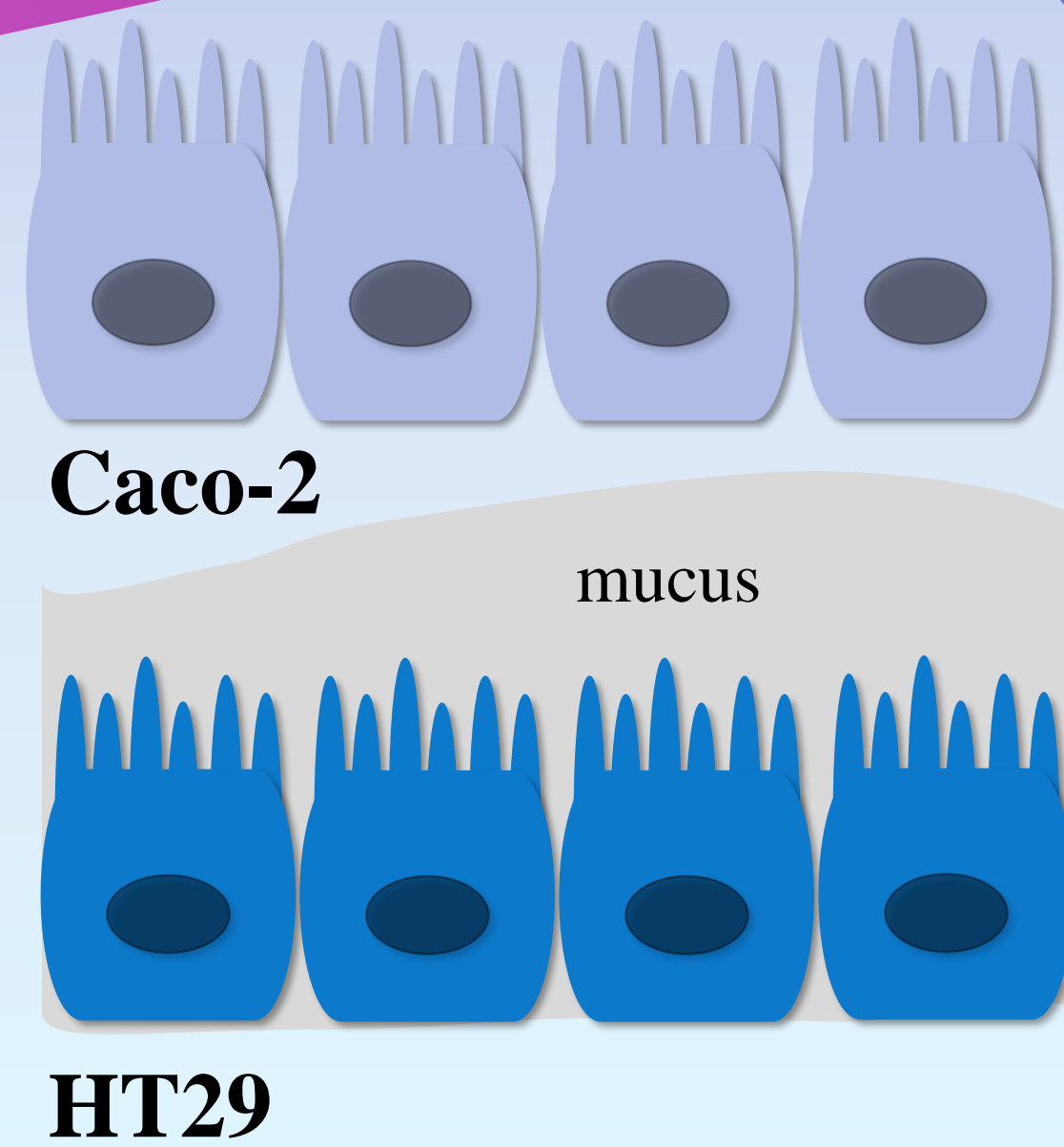
Materials used

Milk GPs
Osteopontin
Lactoferrin
OPN
Lf

Intestinal epithelial cells
Caco-2 TC7 cells
HT29-CL16E cells (producing mucus)

Probiotic bacteria
L. rhamnosus GG (LGG) WT
LGG pili depleted (spaCBA)

LGG WT LGG spaCBA



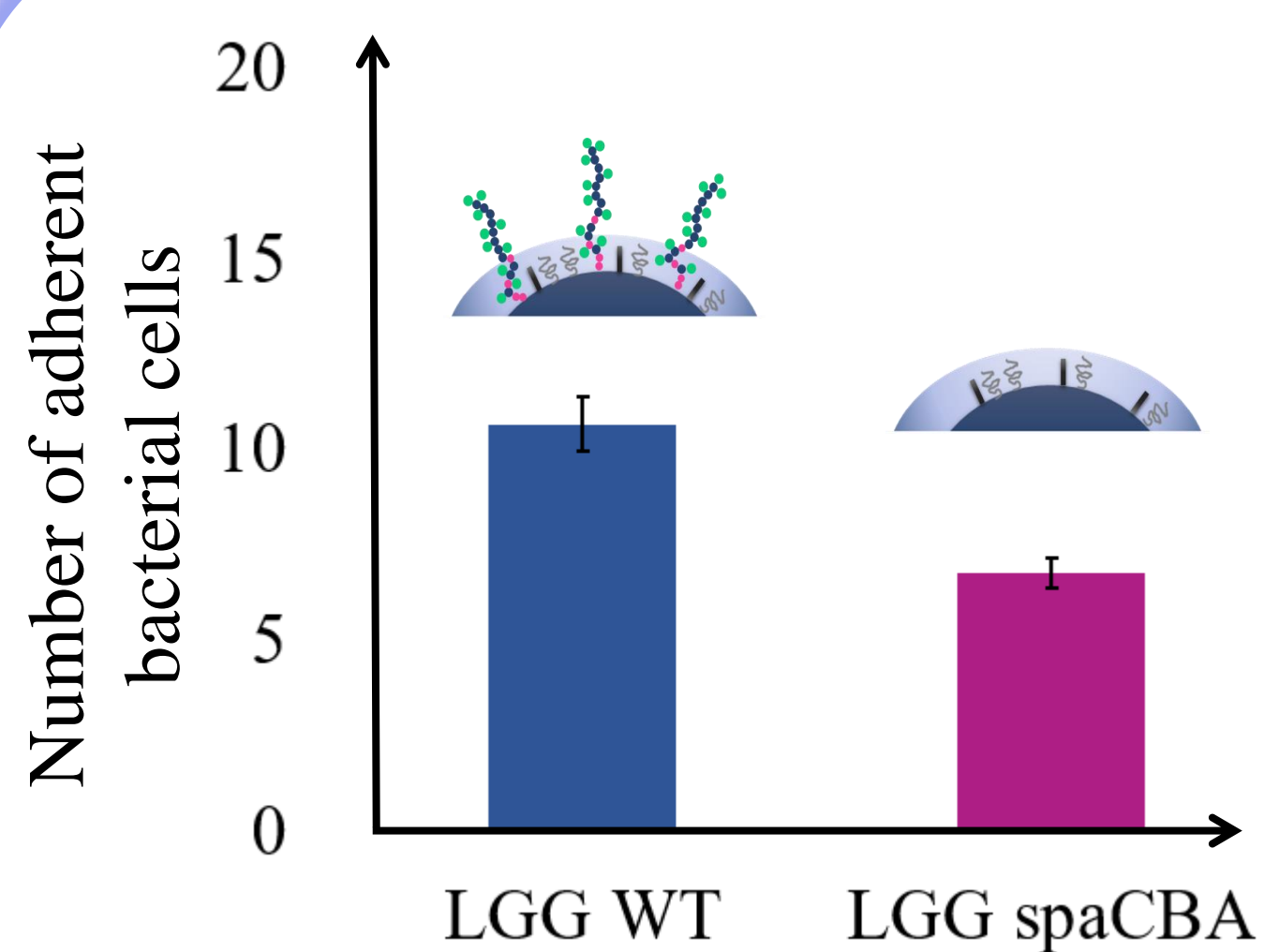
Mucus layer: potentially impact the bacterial adhesion

Cell plate with Caco-2 TC7 or HT29-CL16E

- ① Bacterial culture on fresh MRS broth: end of exponential phase (12h)
- ② Epithelial monolayer incubated for 2h with a) Bacteria suspension or b) Bacteria + GPs
- ③ Sequential washing of intestinal cells
- ④ Counting of bacteria attached to epithelial cells

Results and Discussion

Caco-2 TC7 cells



* Percentage increase in cell adhesion compared to results obtained without GPs

Addition of GPs

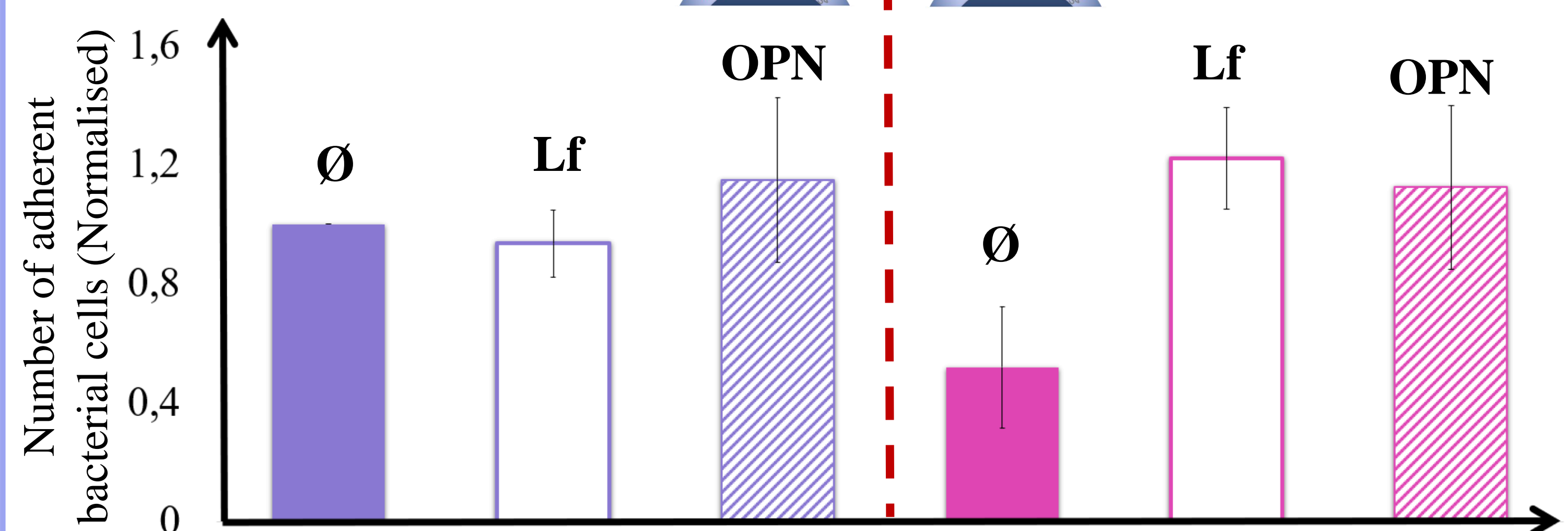
Lf + 23.4 %*
OPN + 51.4 %*

Lf + 14.7 %*
OPN + 70.6 %*

Key role of SpaCBA pilus in adhesion of LGG to Caco-2 cells

- ❖ GPs improve LGG adhesion
- ❖ OPN: major impact on bacterial adhesion

HT29-CL16E cells

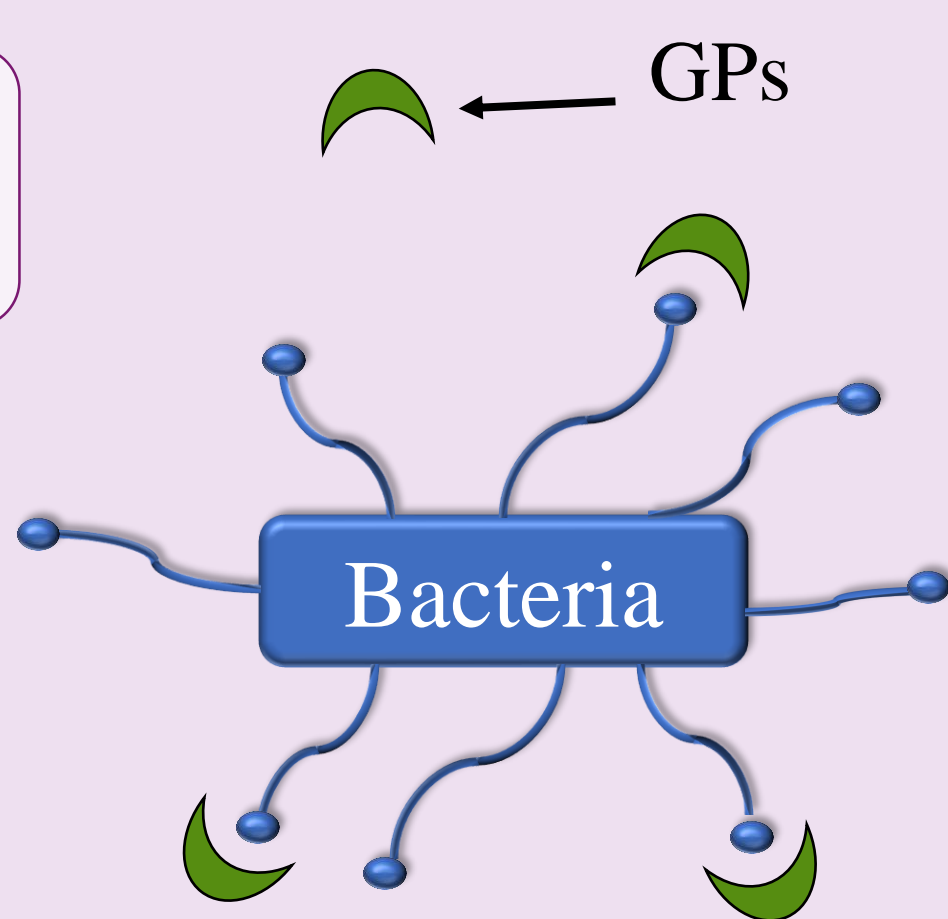
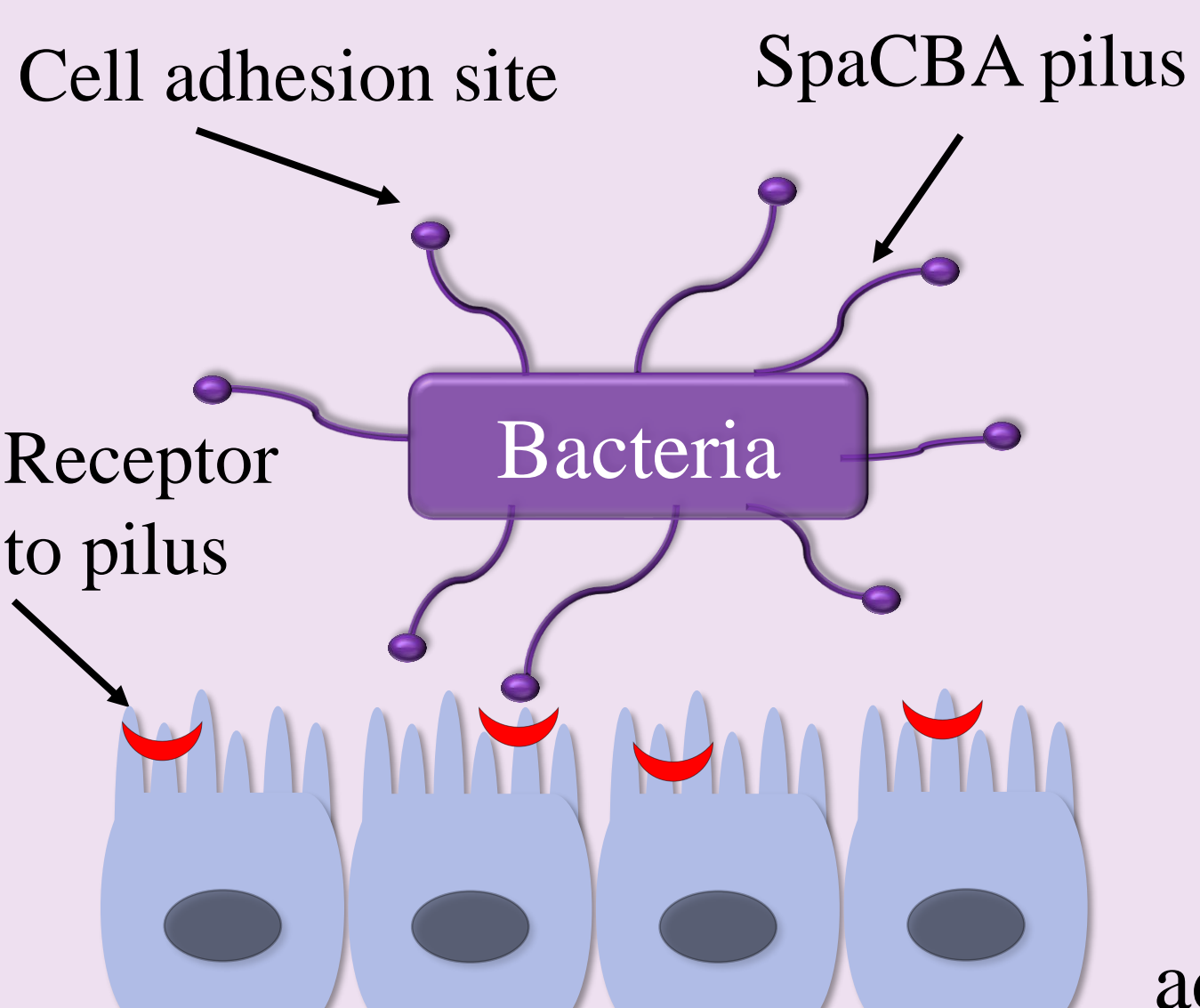


- ❖ Impact of mucus on bacterial adhesion (compared to Caco-2 cells)
- ❖ SpaCBA and WT: almost similar adhesion with GPs
- ❖ OPN: best adhesion results of both cell types in all present cases

Conclusion / Perspectives

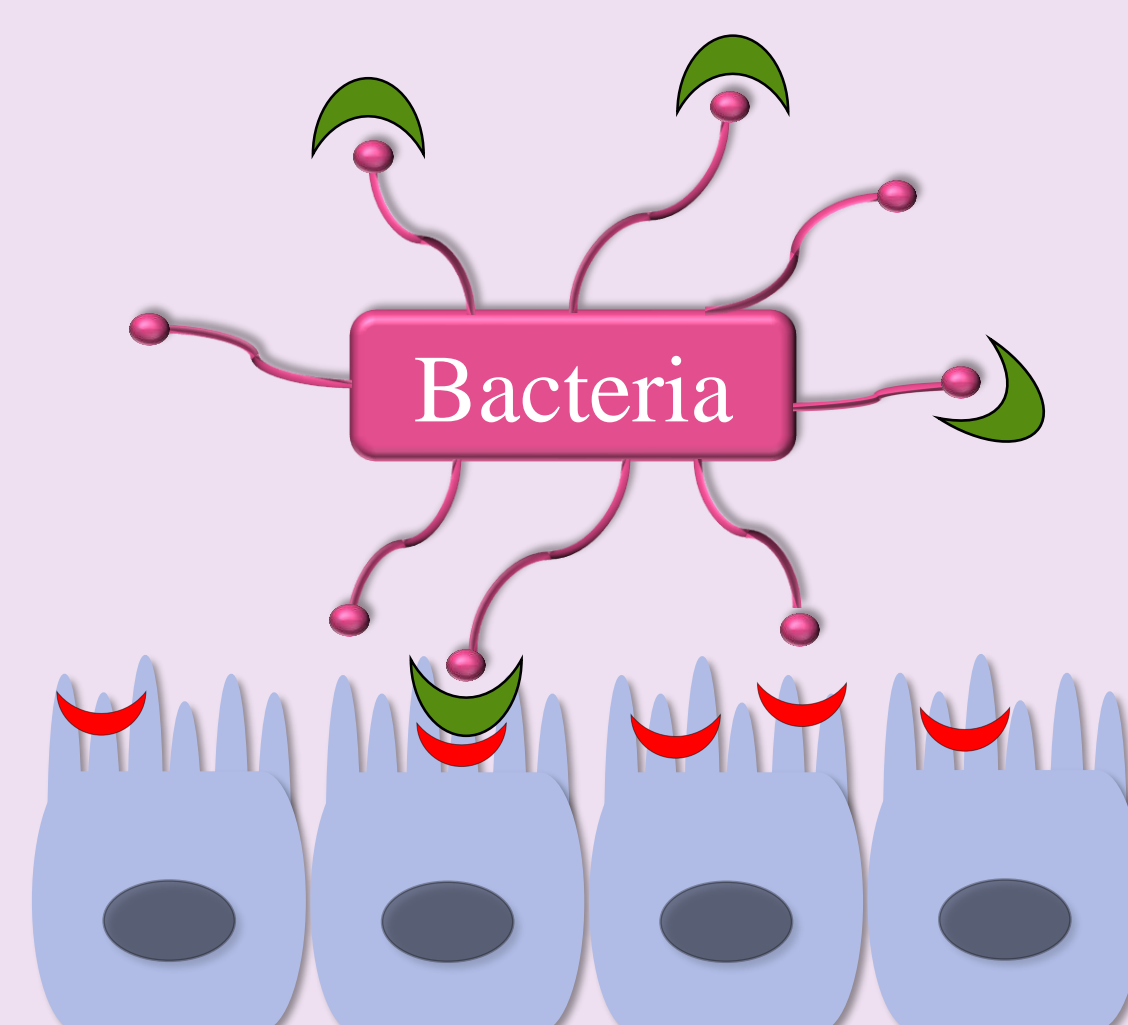
- ❖ Identification of all interactions

(1) Without GPs: bacteria adhesion with epithelial cells



(2) Bacterial adhesion with GPs

(3) With GPs: increase of bacteria adhesion to epithelial cells



Future works: Identification of molecules engaged in adhesion like Peptins (adhesins, GPs, surface molecules...)

Acknowledgments

Thanks to:

- ❖ Arla Foods and Glanbia for providing milk GPs
- ❖ LUE Impact Biomolécules for funding COMPET project.

References

- [1] Bron *et al.* Emerging molecular insights into the interaction between probiotics and the host intestinal mucosa. *Nat. Rev. Microbiol.*, 10 (2012), 66-78.
- [2] Lebeer *et al.* Host interactions of probiotic bacterial surface molecules: comparison with commensals and pathogens. *Nat. Rev. Microbiol.*, 8 (2010), 171-184.
- [3] Burgain *et al.* Significance of bacterial surface molecules interactions with milk proteins to enhance microencapsulation of *Lactobacillus rhamnosus* GG. *Food Hydrocoll.* 41 (2014), 60-70.
- [4] Christensen and Sørensen, Structure, Function and Nutritional Potential of Milk Osteopontin, *International Dairy Journal*, 57 (2016), 1-6
- [5] Guerin *et al.* Adhesive interactions between milk fat globule membrane and *Lactobacillus rhamnosus* GG inhibit bacterial attachment to Caco-2 TC7 intestinal cell, *Colloids and Surfaces B: Biointerfaces*, 167 (2018), 44-53.
- [6] Tarazanova *et al.* Cell Surface Properties of *Lactococcus lactis* Reveal Milk Protein Binding Specifically Evolved in Dairy Isolates. *Front. Microbiol.* 8 (2017), 1691.
- [7] Guerin *et al.* Pili of *Lactobacillus rhamnosus* GG mediate interaction with β -lactoglobulin. *Food Hydrocoll.* 58 (2016), 35-41.
- [8] Liu *et al.* Protective effects of Lactoferrin on injured intestinal epithelial cells, *Journal of Pediatric Surgery* (2019)