



Smart design of functional fermented dairy foods

Gwénaël Jan

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Smart design of functional fermented dairy foods



STLOpen Days
19-21 March 2019



Gwénaël JAN - Microbio



Food quality & safety



Develop safe, healthy, sustainable and hedonic fermented foods

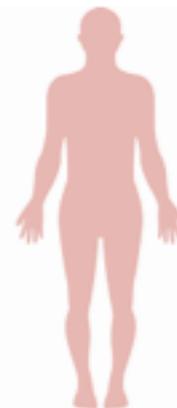


Animal health



Offer alternatives to antibiotic treatments (probiotics)

The cheese matrix as a delivery vehicle for probiotics bacteria



Food spoilage



Reduce health risks and food losses and waste

Health & wellbeing



Develop functional and designer food against modern lifestyle diseases

Driving functionality

→ through matrices



→ this talk

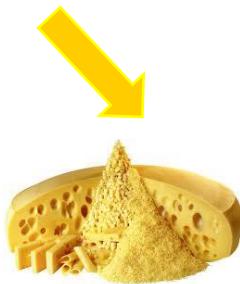
→ through processes



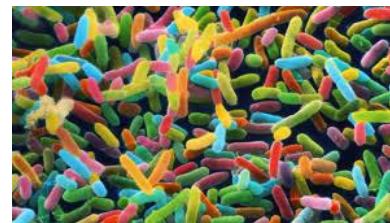
→ earlier

The concept of « 2-in-1 » bacteria

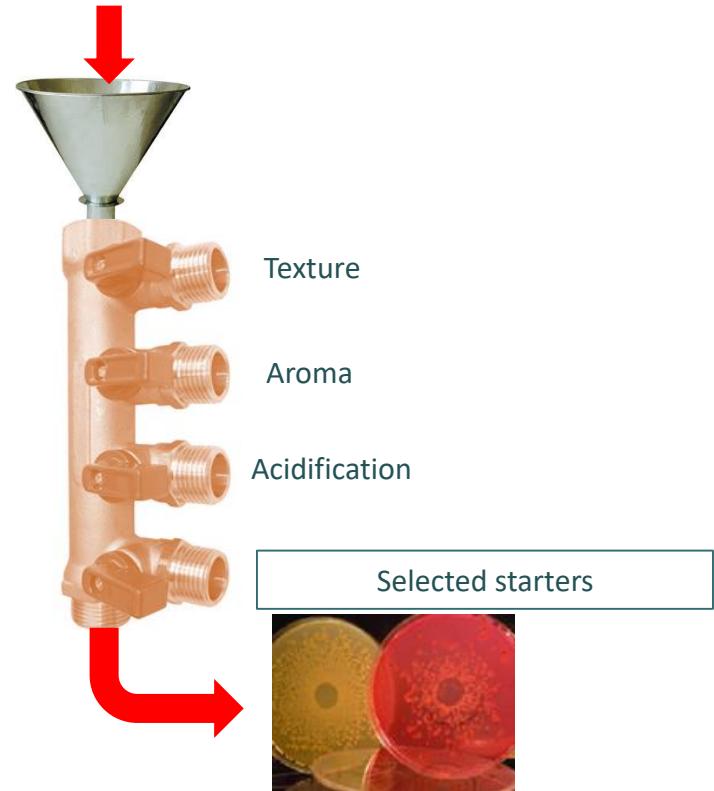
The technological pathway used to select the bacteria



Historically without added starter!!!!



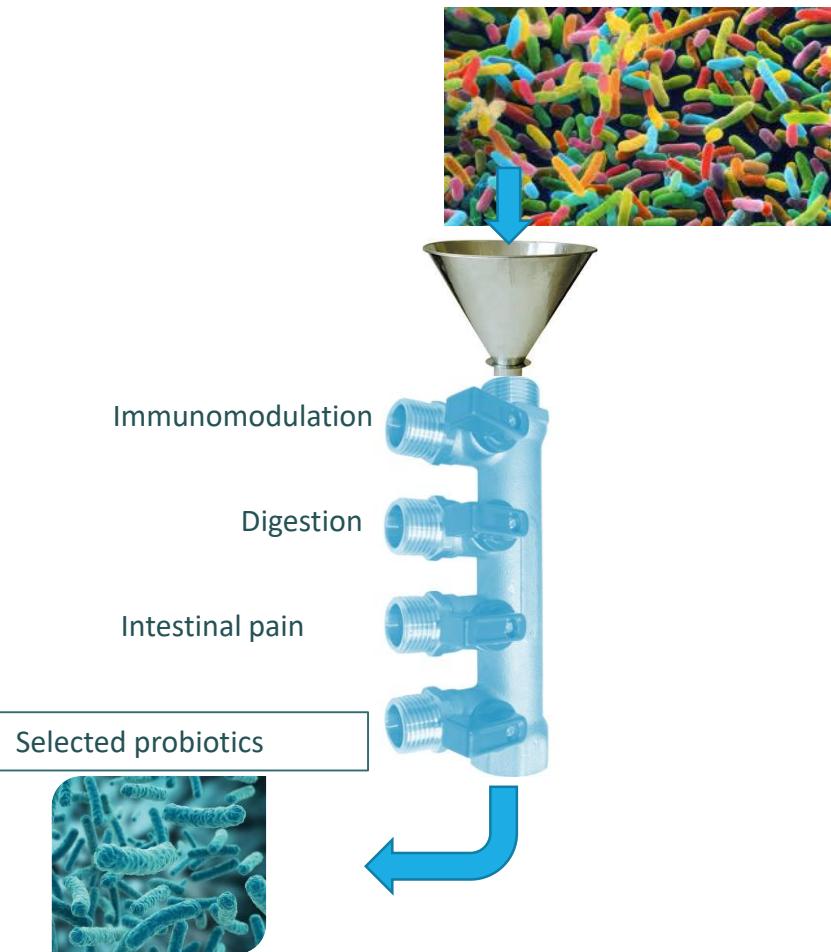
And now we select the bacteria



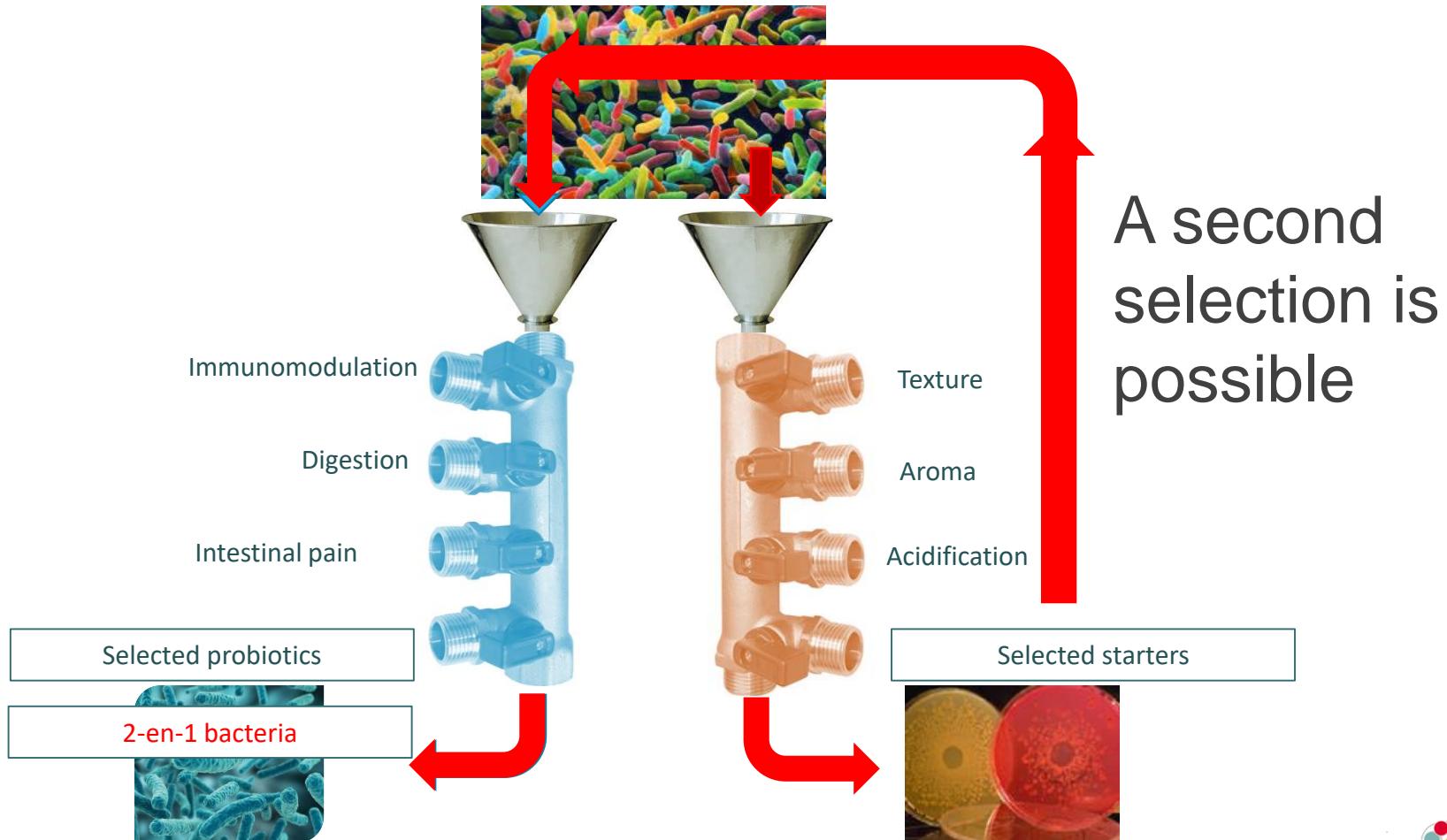
The concept of « 2-in-1 » bacteria

Other bacteria are selected for probiotic properties

IBS, IBD, atopy, intolerance ...



The concept of « 2-in-1 » bacteria



Biological Resource Centre

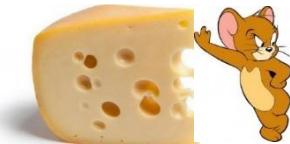


Bacteria of Food Interest



« 2-in-1 » propionibacteria

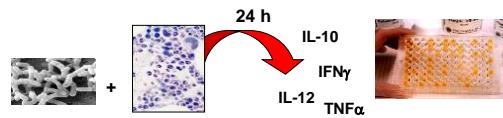
Anti-inflammatory properties



Propionibacterium freudenreichii



♦ *In vitro*

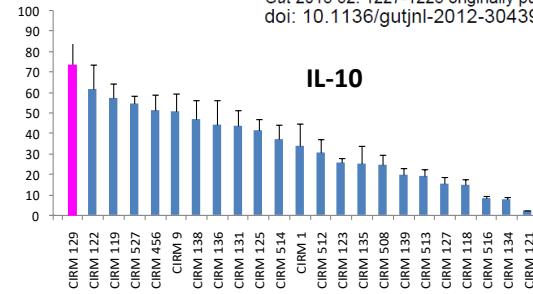


Tracking the microbiome functionality: focus on *Propionibacterium* species

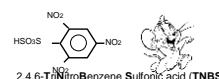
Benoit Foligné, Jérôme Breton, Denis Mater, et al.

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

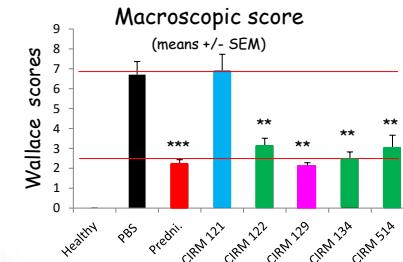
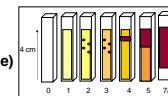
IL-10



♦ *In vivo*



Macroscopic score (Wallace)



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,^{1,2,3,4} Stéphanie-Marie Deutsch,^{5,6} Jérôme Breton,^{1,2,3,4} Fabien J. Cousin,^{5,6,7} Joëlle Dewulf,^{1,2,3,4} Michel Samson,⁸ Bruno Pot,^{1,2,3,4} and Gwénaël Jan^{5,6*}



Biological Resource Centre



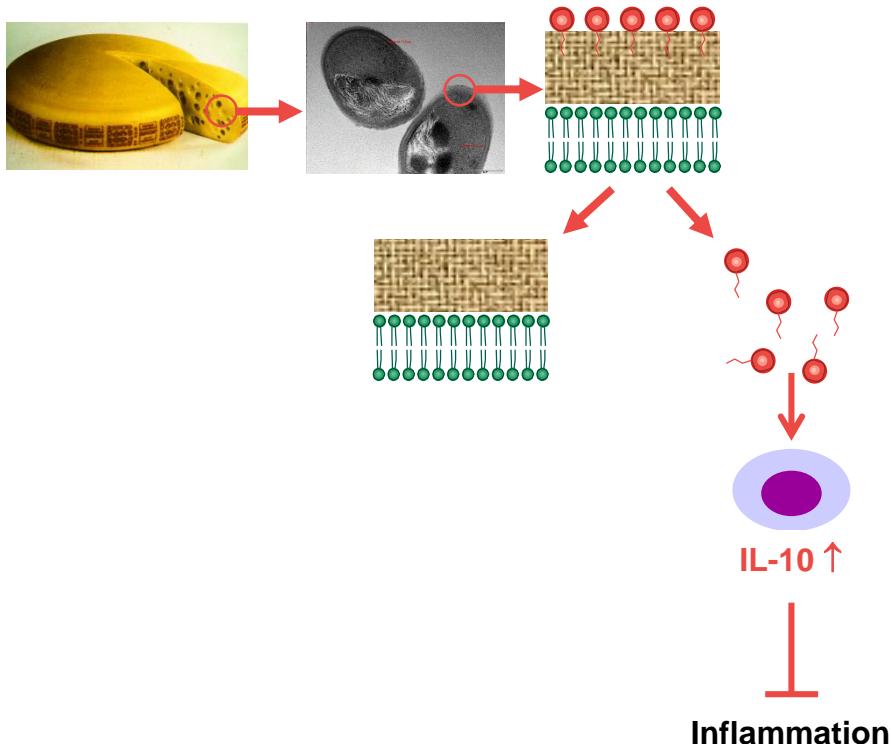
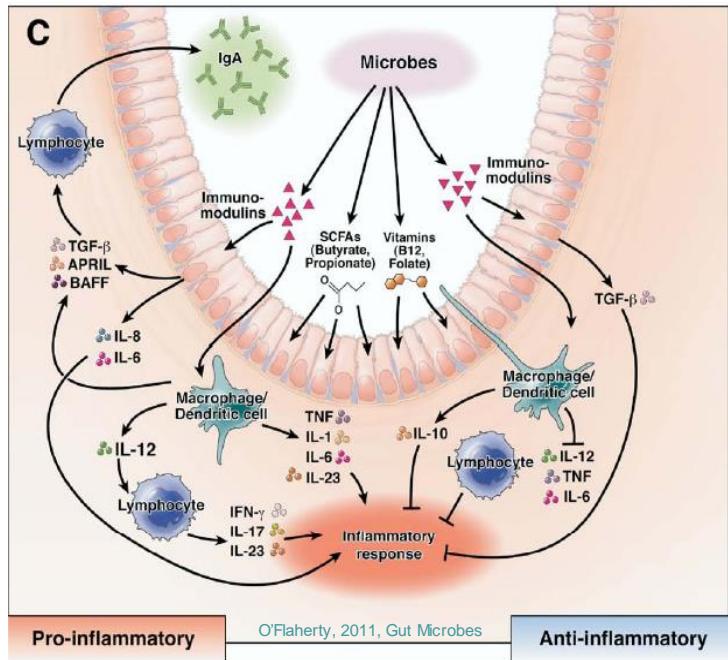
Biological
Resource Centre



STOpen Days
19-21 March 2019

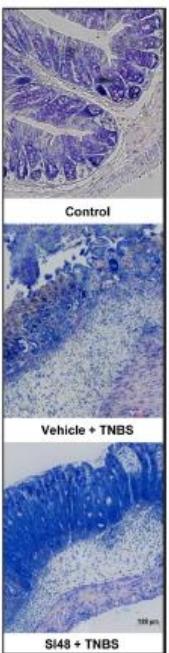


A key role of propionibacteria surface proteins



Other « 2-in-1 » bacteria

F



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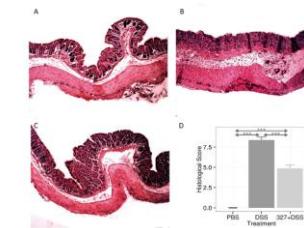
Let's make probiotic cheese!!!

OPEN ACCESS Freely available online

PLOS ONE

Local and Systemic Immune Mechanisms Underlying the Anti-Colitis Effects of the Dairy Bacterium *Lactobacillus delbrueckii*

Clarissa Santos Rocha^{1,3,4}, Ana Cristina Gomes-Santos², Thais Garcias Moreira², Marcela de Azevedo¹, Tessalia Diniz Luerce¹, Mahendra Mariadassou⁵, Ana Paula Longaray Delamare⁶, Philippe Langella^{3,4}, Emmanuelle Maguin^{3,4}, Vasco Azevedo¹, Ana Maria Caetano de Faria², Anderson Miyoshi^{1,9}, Maarten van de Guchte^{3,4,8}



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STOpen Days
19-21 March 2019



A reverse-engineered 2-strains cheese



Microfiltr. Milk



Powder 100 g/L



Cream 150 g/L



Sterilisation



Culture *P. freudenreichii*
30°C, 72 h



Pre-cheese

UHT Milk



Culture *L. delbrueckii*
42°C, 4 h



Fermented Milk



UF MG
UNIVERSIDADE FEDERAL
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Clotting, stirring, cooking, moulding,
pressing, wrapping, ripening



Mol. Nutr. Food Res. 2016, 60, 935–948

Molecular Nutrition
Food Research

935

RESEARCH ARTICLE

Combining selected immunomodulatory
Propionibacterium freudenreichii and *Lactobacillus delbrueckii* strains: Reverse engineering development
of an anti-inflammatory cheese

Coline Plé¹, Jérôme Breton¹, Romain Richoux², Marine Nurdin², Stéphanie-Marie Deutsch^{3,4},
Hélène Falentin^{3,4}, Christophe Hervé⁵, Victoria Chua^{3,4,6}, Riwanon Lemée⁶,
In^{3,4}, Maarten Van de Guchte^{7,8} and Benoît Foligné¹



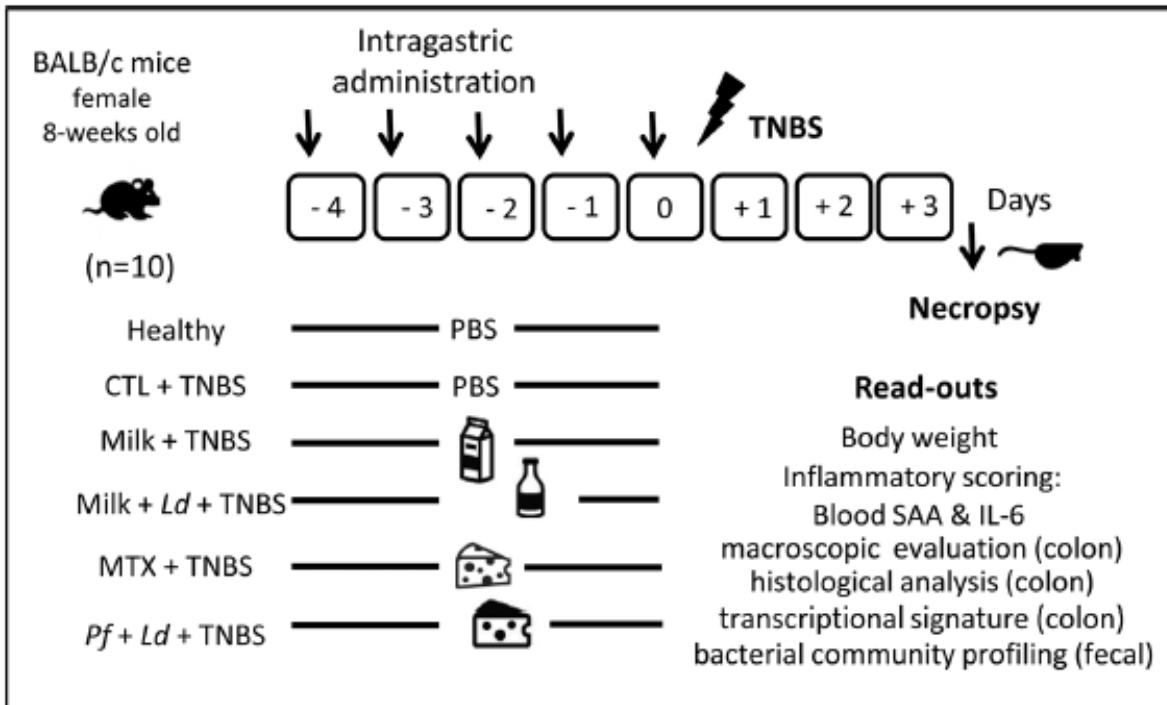
Dairy Platform



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A reverse-engineered 2-strains cheese challenged *in vivo*

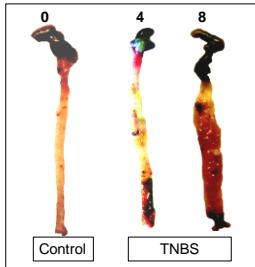


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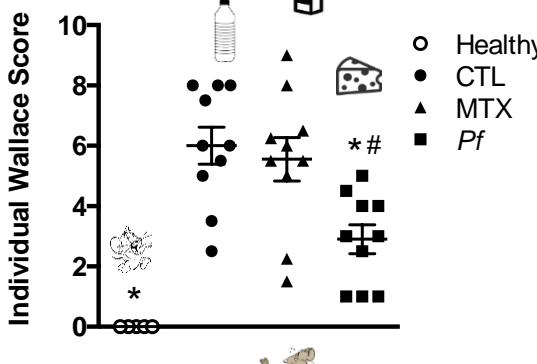
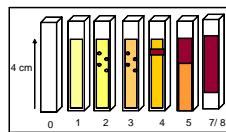


A reverse-engineered 2-strains cheese protects from colitis

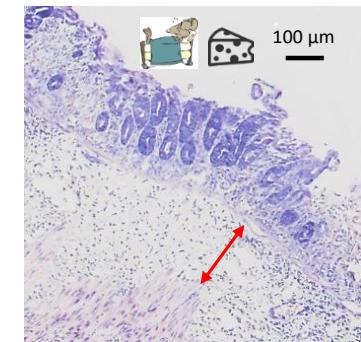
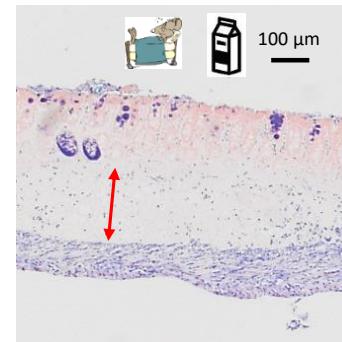
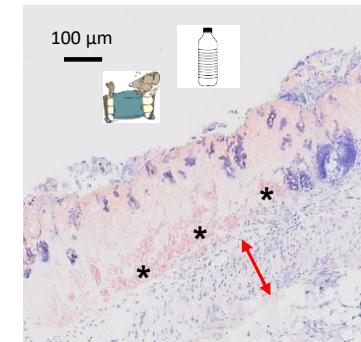
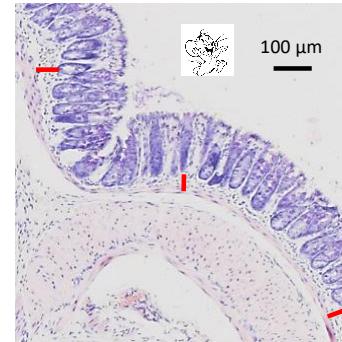
Macroscopic level



Macroscopic score (Wallace)



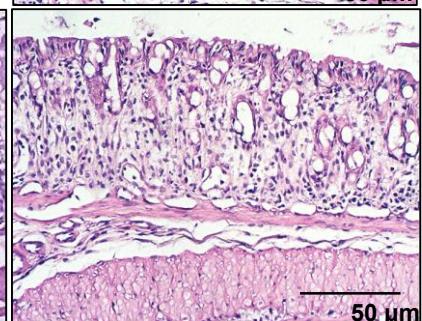
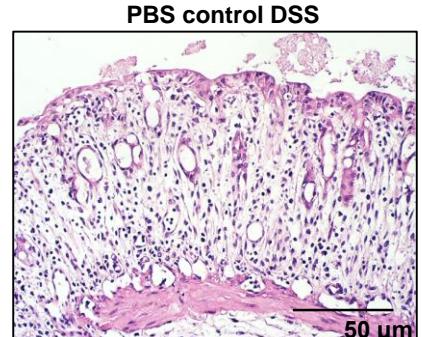
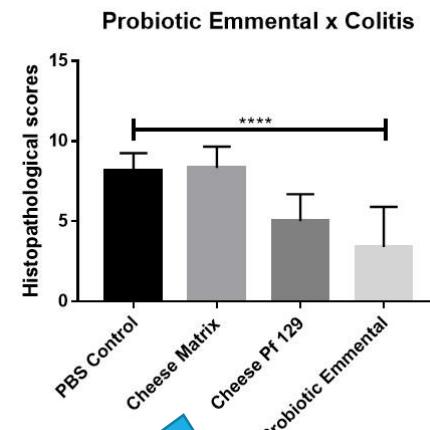
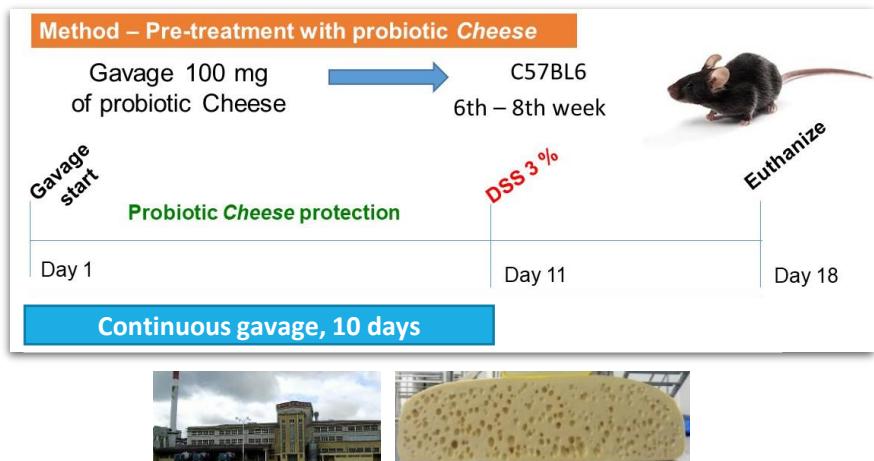
Microscopic level



But it is still a lab cheese!



This Emmental cheese protects from colitis



Another example of application: fighting mucositis

GI inflammatory diseases

IBD

- GIT Chronic inflammation

Ulcerative
Colitis



Mucositis



GI Mucositis



Oral mucositis



5-Fluoracil (5-FU)

- Head, neck and colon cancer.

(Chang et al., 2012; Falvey et al., 2015)

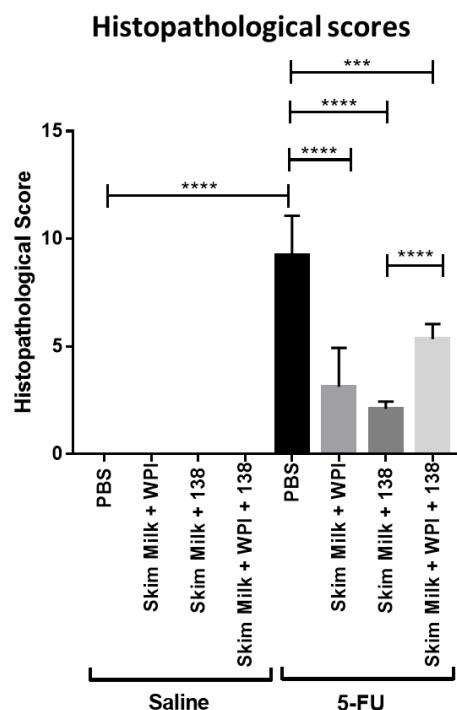
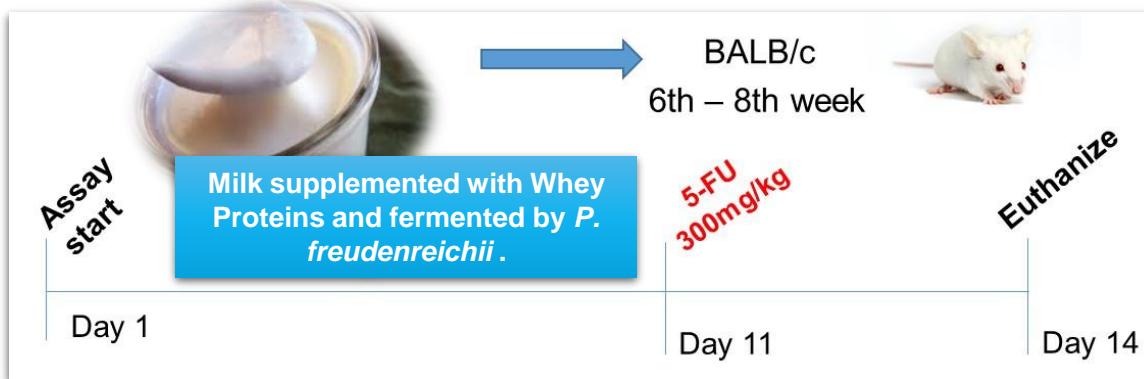
Another example of application: fighting mucositis

→ NO CURE AVAILABLE

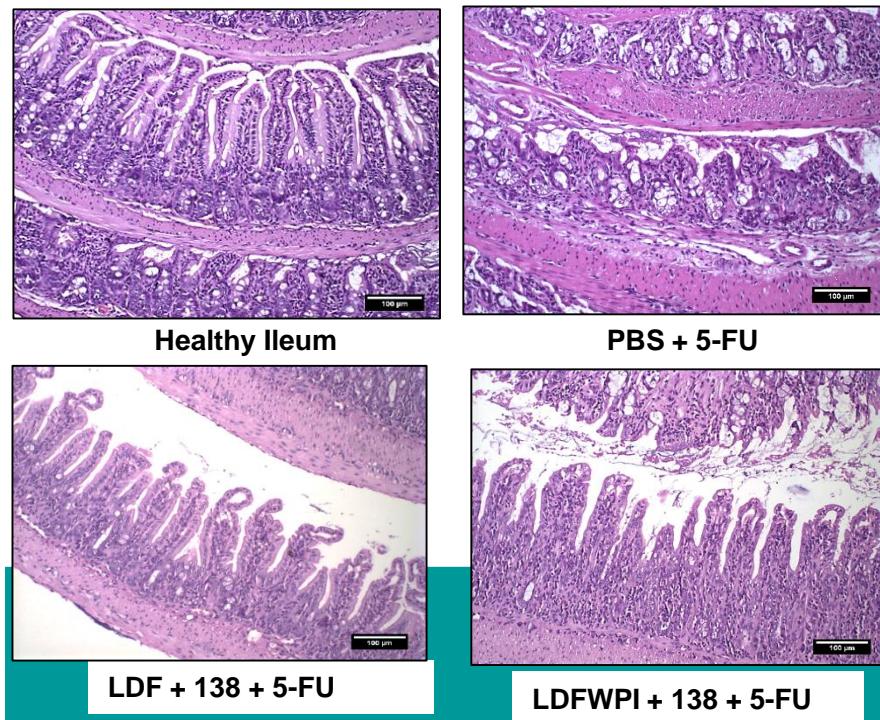
IBD available treatment	Mucositis available treatment
<ul style="list-style-type: none">→ Treatment for mucositis and IBD are limited;→ Development of new therapies is necessary.	
Strong side effects!!!	Temporary benefit!!!



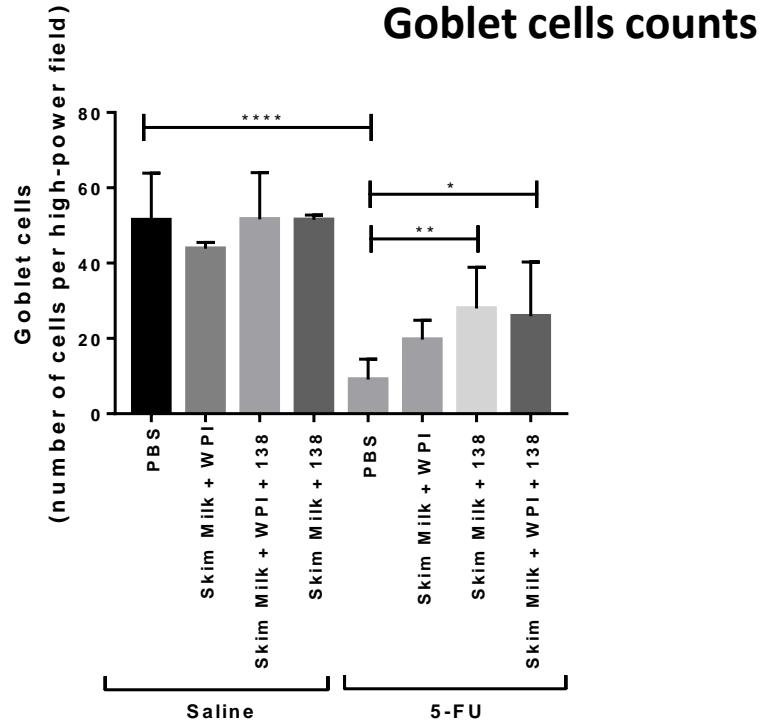
Fermented milk protects from mucositis



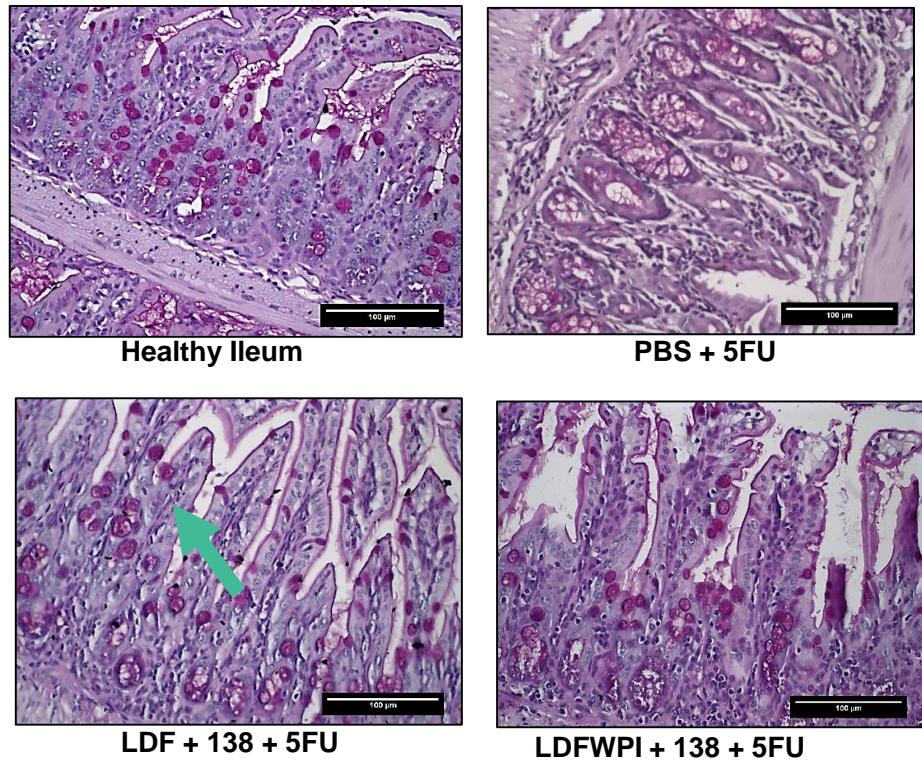
Representative images from mucosal histopathology (H&E)

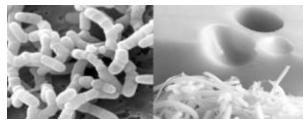


Fermented milk preserves mucus



Representative images of stained goblet cells (PAS)





Conclusion:

- ✓ Fermented foods: a source of immunomodulatory bacteria
- ✓ Molecules and strains involved are being identified

Perspectives :

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



Benoit Foligné



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Vasco Azevedo



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