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La microbiologie du lait et de sa transformation

Gwénaél Jan

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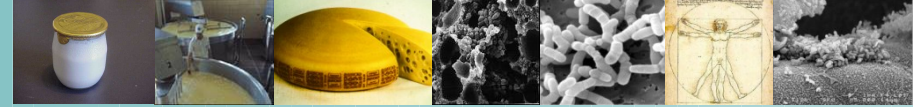
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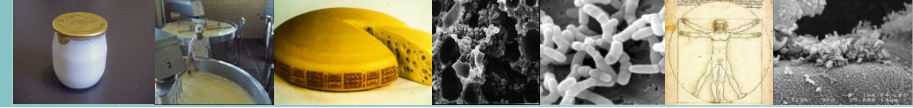
Gwénaél JAN

La microbiologie du lait et de sa transformation

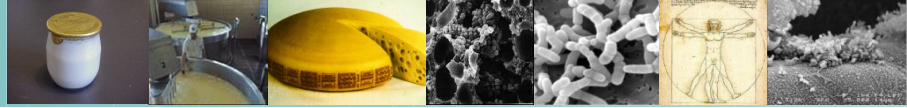
Introduction générale

Science & Technologie du Lait et de L'Œuf
<http://www6.rennes.inra.fr/stlo>





Les aliments fermentés, une histoire ancienne.....



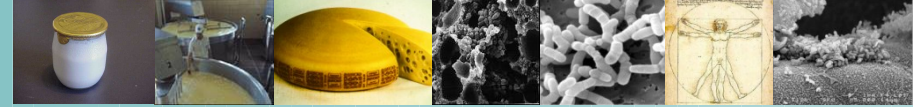
Qui débute avec la domestication d'animaux source de lait
- néolithique, 6000 avant JC



"les premières espèces domestiquées furent la chèvre, le mouton, le porc et le boeuf... elles l'ont toutes été à peu près en même temps, vers 8 500 avant J.-C., au Proche-Orient."

Moule à fromage de la grotte de la Pileta, Malaga

→ le fromage est le plus ancien aliment façonné par l'homme, avant le pain et le vin!

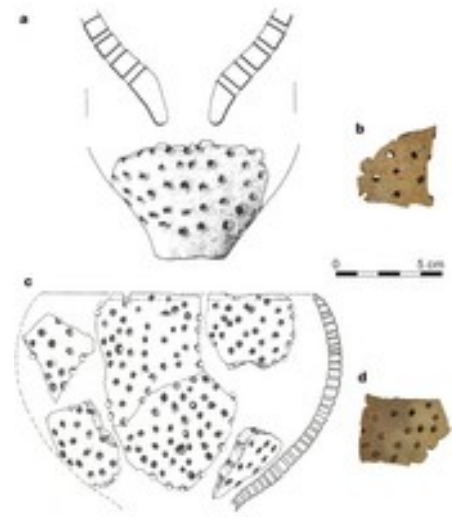


Earliest evidence for cheese making in the sixth millennium bc in northern Europe

Salque M1, Bogucki PI, Pyzel J, Sobkowiak-Tabaka I, Grygiel R, Szmyt M, Evershed RP.

Salque et al., 2013.
Nature

Pottery vessel
Lipids analysis



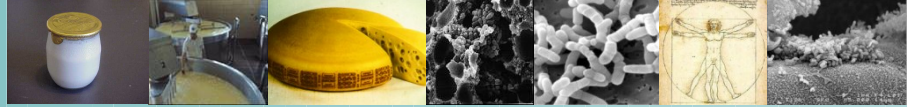
Critical step in making milk less perishable, and more digestible for early prehistoric farmers

- 8000 years

nature

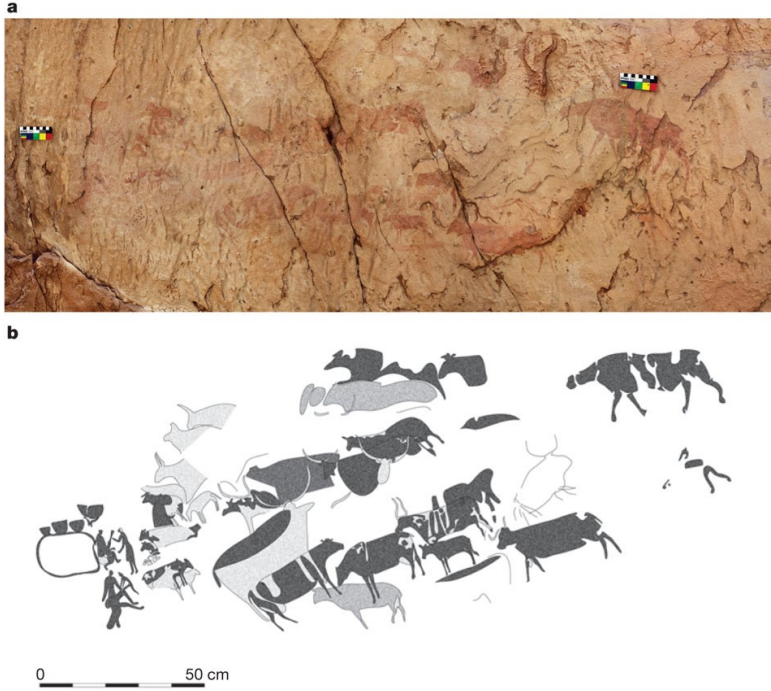
Des traces de lipides laitiers montrent que ces poteries ont servie à égoutter du lait....

Rendre le lait moins périssable et plus digeste.....



First dairying in green Saharan Africa in the fifth millennium bc

J Dunne et al. Nature **486**, 390-394 (2012) doi:10.1038/nature11186



nature

Représentation ancienne d'élevage, de traite de ruminants et de manipulation du lait.....

Proteomics evidence for kefir dairy in Early Bronze Age China

Yimin Yang^{a,b,1}, Anna Shevchenko^{c,1}, Andrea Knaust^c, Idelisi Abuduresule^d, Wenying

Journal of Archaeological Science 45 (2014) 178–186

Ils ont trouvé une femme momifiée

Une offrande précieuse pour une personne de rang



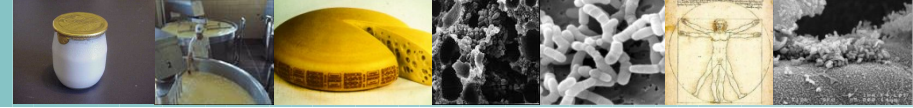
Analyse biochimique de cette offrande....

C'est un fromage !!

Table 3
The number of proteins identified in the proteomic analysis of Xiaohe foods.

Protein name	Gene identifier ^a	Organism ^b	M11	M13a	M22a	M22b
LAB proteins						
Glyceraldehyde-3-phosphate dehydrogenase	gi7c336054463	<i>L. kefiranofaciens</i>	7	4	6	5
Surface layer protein	gi7c336055311	<i>L. kefiranofaciens</i>	3			
Surface layer protein	gi7c1054802	<i>L. helveticus</i>				
Phosphopyruvate hydratase	gi7c227893416	<i>Lactobacillus ultunensis</i>	2			
Pyruvate kinase	gi7c336054221	<i>Lactobacillus sp.</i>	2		3	2
D-lactate dehydrogenase	gi7c104773324	<i>Lactobacillus sp.</i>				
Fructose-bisphosphate aldolase	gi7c104774377	<i>Lactobacillus sp.</i>				
ATP-dependent protease	gi7c161508175	<i>Lactobacillus sp.</i>				
Conserved hypothetical protein	gi7c260101505	<i>L. helveticus</i>				
Elongation factor Tu	gi7c124377108	<i>L. kefiranofaciens</i>				
Glutamine synthetase	gi7c336053793	<i>L. kefiranofaciens</i>				
Yeasts proteins						
Glyceraldehyde-3-phosphate dehydrogenase 2	gi7c1245703	<i>K. marxianus</i>	10			6
Glyceraldehyde-3-phosphate dehydrogenase 1	gi7c116247787	<i>K. marxianus</i>	7	2	5	7
Pyruvate decarboxylase	gi7c416888	<i>K. marxianus</i>	7			
Enolase 2	gi7c6321968	<i>S. cerevisiae</i>	7		2	3
Alcohol dehydrogenase 2	gi7c12229579	<i>K. marxianus</i>	5			3
70 kDa heat shock protein	gi7c172713	<i>Yeast sp.</i>	4			
Hypothetical protein	gi7c50312181	<i>K. lactis</i>	3		5	3
Unnamed protein	gi7c2867	<i>K. lactis</i>	3			
Hypothetical protein	gi7c365984825	<i>Naumovozya sp.</i>			2	
Enolase 1	gi7c260944716	<i>Candida lusitanae</i>				

**Le
fromage
le plus
affiné au
monde!!**



Une remarquable diversité

Pediococcus acidilactici

Lactocobacillus casei

Leuconostoc mesenteroides

Lactococcus lactis

Enterococcus faecium

Lactocobacillus paracasei

Lactocobacillus viridescens



Streptococcus thermophilus

Streptococcus macedonicus

Lactocobacillus plantarum



Lactobacillus bulgaricus

Lactobacillus helveticus



Lactobacillus sakei



L. lactis diacetylactis



Propionibacterium freudenreichii

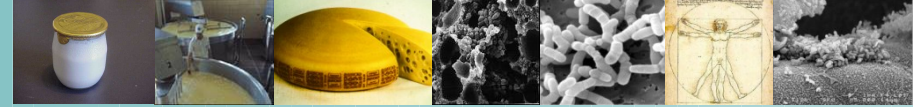
Staphylococcus xylosus

Staphylococcus carnosus

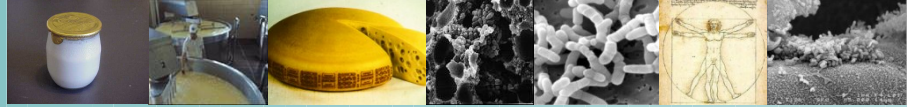
Oenococcus oeni



L. lactis cremoris



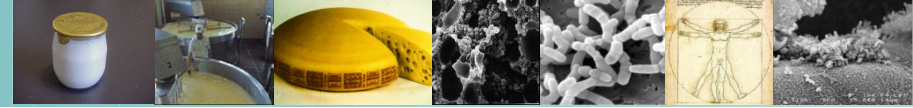
Le lait, un vecteur de bactéries



Emmental



UMR STLO



Propionibacterium freudenreichii antiinflammatoire

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*[†]

Benoît 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 Gwénaél Jan^{5,6*}

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, France¹; Université Lille Nord de France, F-59000 Lille, France²; CNRS, UMR 8204, F-59021 Lille, France³; Institut National de la Santé et de la Recherche Médicale, U1019, F-59019 Lille, France⁴; INRA, UMR1253 Science et Technologie du Lait et de l'Oeuf, F-35042 Rennes, France⁵; AGROCAMPUS OUEST, UMR1253 Science et Technologie du Lait et de l'Oeuf, F-35042 Rennes, France⁶; CNIEL/Syndifrais, 42 Rue de Châteaudun, F-75314 Paris 09, France⁷; and EA 4427 SeRAIC, Faculty of Pharmacy, University of Rennes 1, IFR 140 GFAS, Rennes F-35043, France⁸

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 from these cheese starter bacteria.

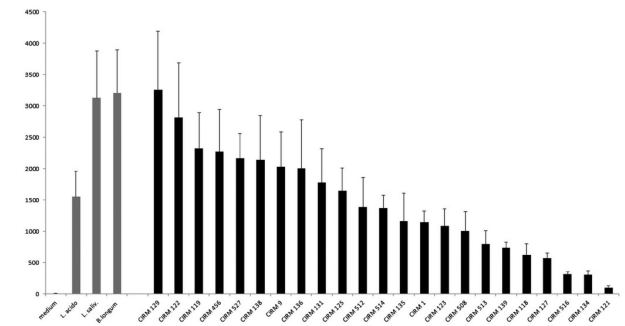
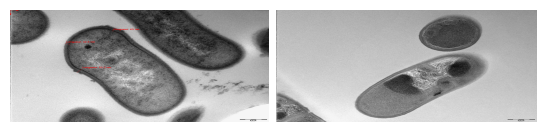


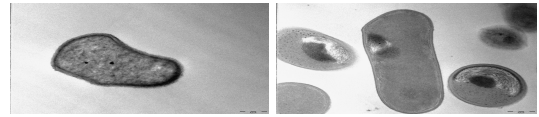
Figure 1 Anti-inflammatory profile of dairy *Propionibacterium freudenreichii* strains assessed on human peripheral blood mononuclear cells (PBMCs). Comparative IL-10 release (in pg/ml) of human PBMCs for 3 reference benchmark probiotic strains (*Lactobacillus acidophilus* NCFM, *L. salivarius* LS33 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.⁷

CIRM-BIA118



Untreated

S48



Guanidium extracted

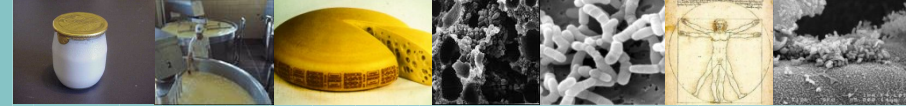


Tracking the microbiome functionality: focus on *Propionibacterium* species

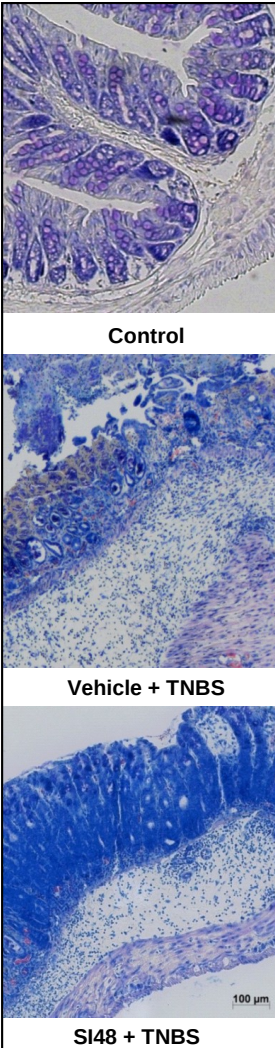
Benoit Foligné, Jérôme Breton, Denis Mater, et al.

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





Un fromage qui soigne ?



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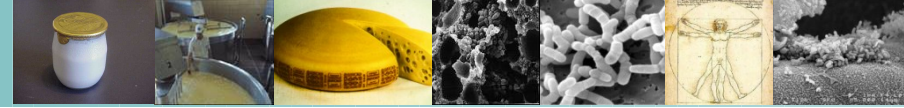


Single-strain starter experimental cheese reveals anti-inflammatory effect of *Propionibacterium freudenreichii* CIRM BIA 129 in TNBS-colitis model



Coline Plé ^a, Romain Richoux ^b, Julien Jardin ^{c,d}, Marine Nurdin ^b,
 Valérie Briard-Bion ^{c,d}, Sandrine Parayre ^{c,d}, Stéphanie Ferreira ^e,
 Bruno Pot ^a, Guillaume Bouguen ^{f,g}, Stéphanie-Marie Deutsch ^{c,d},
 Hélène Falentin ^{c,d}, Benoit Foligné ^{a,1}, Gwénaél Jan ^{c,d,*},¹





Le lait source de bactéries bénéfiques pour le nourrisson



APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Feb. 2009, p. 965–969
0099-2240/09/\$08.00+0 doi:10.1128/AEM.02063-08
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Isolation of Bifidobacteria from Breast Milk and Assessment of the Bifidobacterial Population by PCR-Denaturing Gradient Gel Electrophoresis and Quantitative Real-Time PCR[∇]

Rocío Martín,¹ Esther Jiménez,² Hans Heilig,¹ Leonides Fernández,² María L. Marín,²
Erwin G. Zoetendal,¹ and Juan M. Rodríguez^{2*}

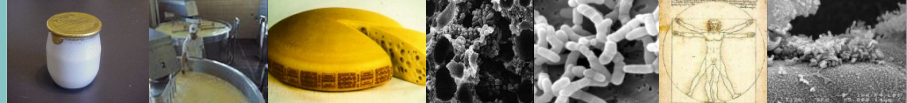
Laboratory of Microbiology, Wageningen University, Wageningen, The Netherlands,¹ and Departamento de Nutrición, Bromatología y Tecnología de los Alimentos, Universidad Complutense de Madrid, 28040 Madrid, Spain²

Received 5 September 2008/Accepted 10 December 2008

The objective of this work was to elucidate if breast milk contains bifidobacteria and whether they can be transmitted to the infant gut through breastfeeding. Twenty-three women and their respective infants provided samples of breast milk and feces, respectively, at days 4 to 7 after birth. Gram-positive and catalase-negative isolates from specific media with typical bifidobacterial shapes were identified to the genus level by F6PPK (fructose-6-phosphate phosphoketolase) assays and to the species level by 16S rRNA gene sequencing. Bifidobacterial communities in breast milk were assessed by PCR-denaturing gradient gel electrophoresis (PCR-DGGE), and their levels were estimated by quantitative real-time PCR (qRTi-PCR). Bifidobacteria were present in 8 milk samples and 21 fecal samples. *Bifidobacterium breve*, *B. adolescentis*, and *B. bifidum* were isolated from milk samples, while infant feces also contained *B. longum* and *B. pseudocatenulatum*. PCR-DGGE revealed the presence of one to four dominant bifidobacterial bands in 22 milk samples. Sequences with similarities above 98% were identified as *Bifidobacterium breve*, *B. adolescentis*, *B. longum*, *B. bifidum*, and *B. dentium*. Bifidobacterial DNA was detected by qRTi-PCR in the same 22 milk samples at a range between 40 and 10,000 16S rRNA gene copies per ml. In conclusion, human milk seems to be a source of living bifidobacteria for the infant gut.

Downloaded from <http://aem.asm.org/>





Demandez le programme !

- **Bifidobactéries du lait maternel et de l'intestin du jeune enfant**
Anne-Judith Waligora
- **Réservoirs du microbiote du lait et sa dynamique en fromage**
Isabelle Verdier-metz
- **Diversité des microorganismes du lait**
Florence Valence
- **Les levains du yaourt dans le tube digestif**
Muriel Thomas
- **Déjeuner**