

Functional Foods Research in Ireland

Research Programmes : Gut Health





Food intelligence

Contains wide range of
bioactive components
which positively affect
human health

Can use these as a basis for
Functional Foods with
Associated health claims

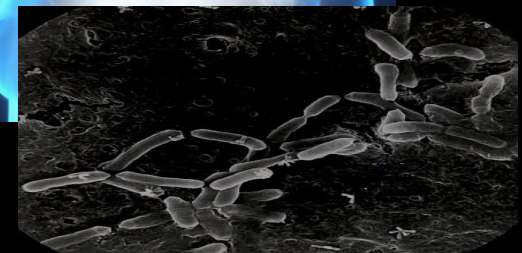
Functional Foods Research in Ireland

Research Programmes : Gut Health

Research Infrastructure and Programme

1. **Mining Food** for Potential Functional Food Ingredients
e.g. antimicrobial peptides
2. **Gut Health:** gut microbes and how they affect health
3. **Mechanisms:** the basis for health claims

Conclusions



Strategy/ Research Positioning



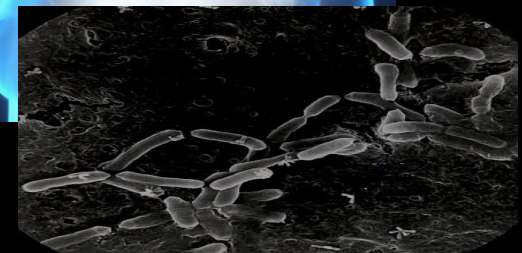
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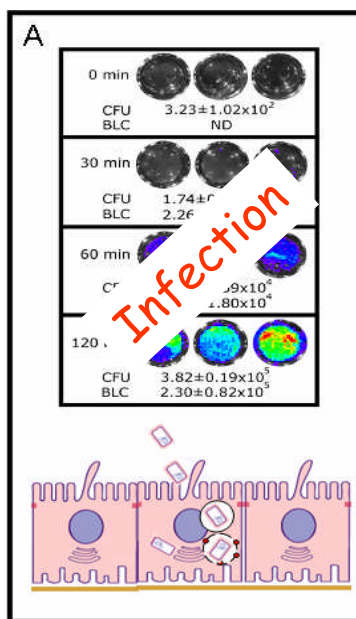
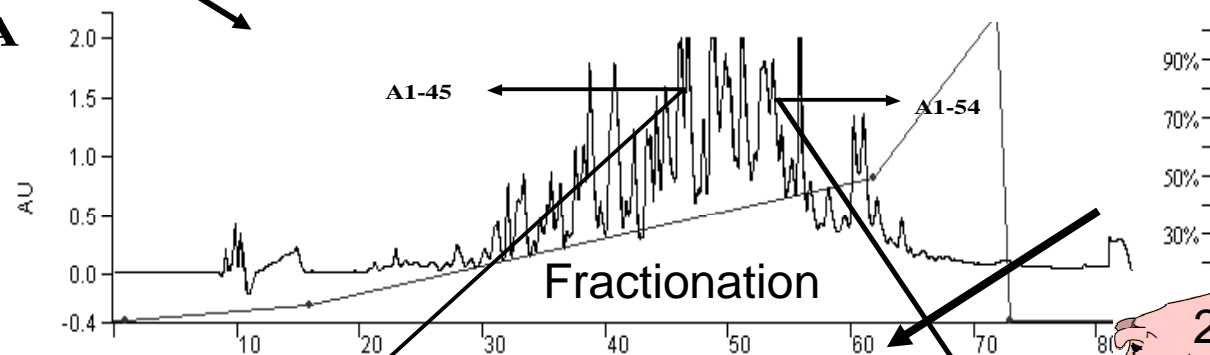
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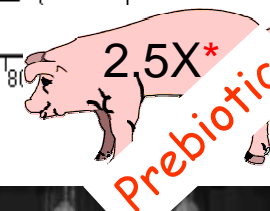
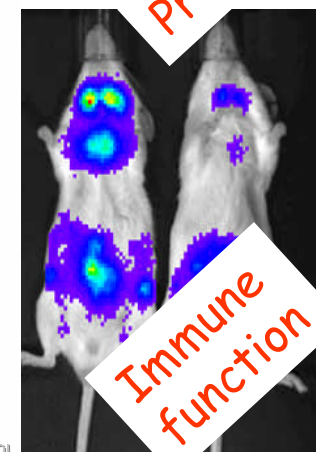
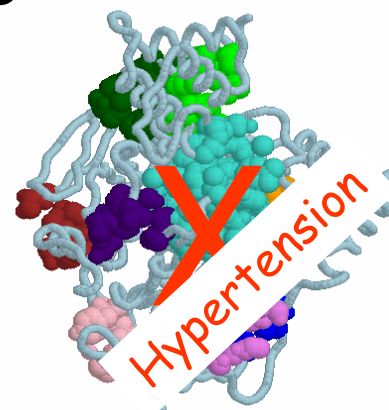


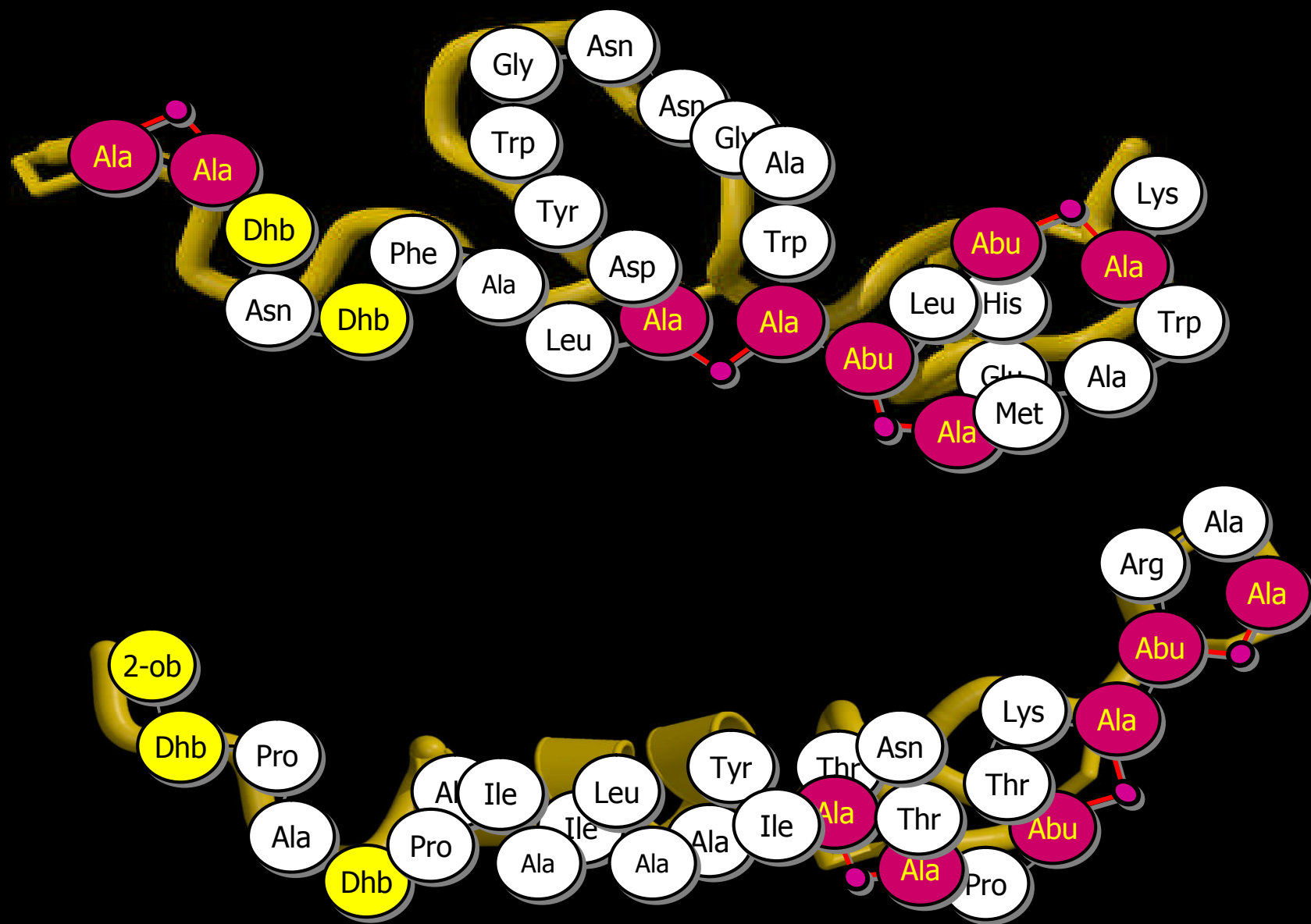


Mining for bioactives Δ fermentation/hydrolysis
Modification/deconstruction



BIOASSAYS





Martin et al., 2004 Biochemistry
Cotter et al., 2004 PNAS

ORIGINAL ARTICLE

A lacticin 3147 enriched food ingredient reduces *Streptococcus mutans* isolated from the human oral cavity in saliva

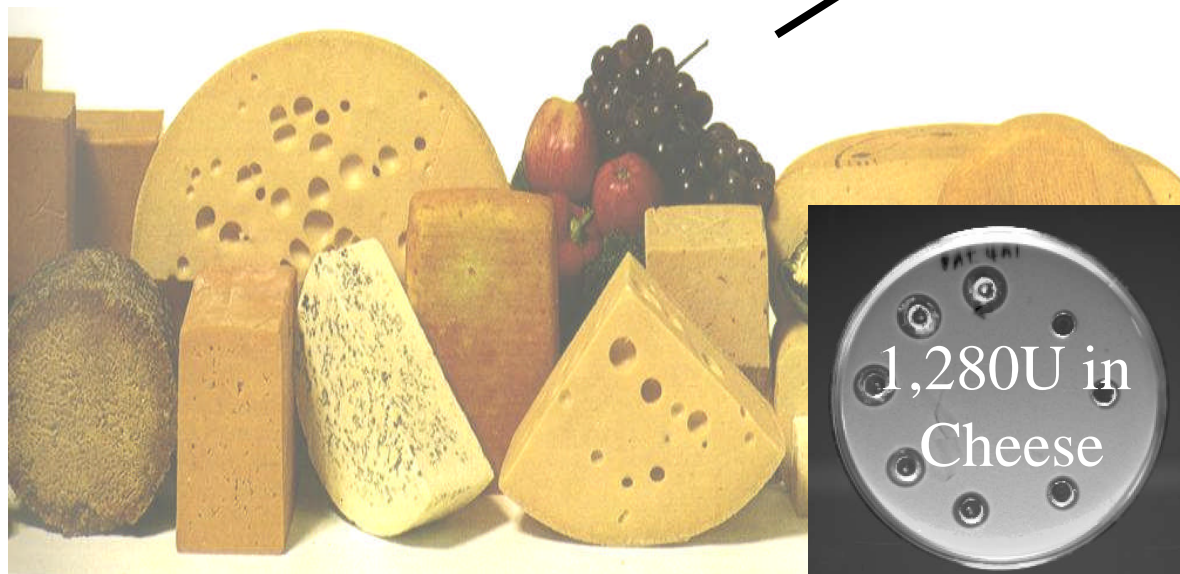
E.B. O'Connor^{1,2,3}, B. O'Riordan¹, S.M. Morgan^{1,3}, H. Whelton⁴, D.M. O'Mullane⁴, R.P. Ross^{1,3} and C. Hill^{2,3}

1 Dairy Products Research Centre, Moorepark, Fermoy Co., Cork, Ireland

2 Department of Microbiology, University College, Cork, Ireland

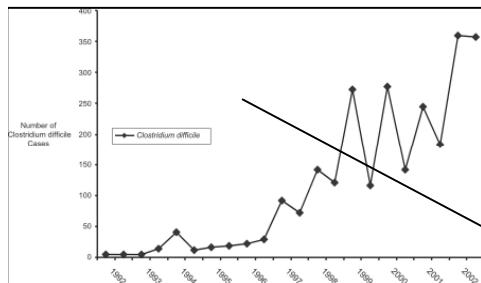
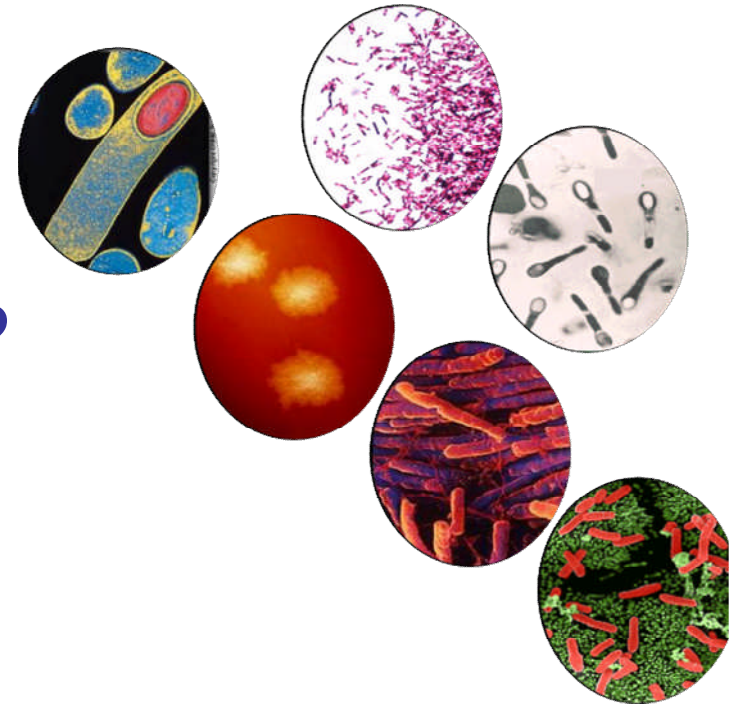
3 Alimentary Pharmabiotic Centre, Cork, Ireland

4 Dental Hospital, Cork University Hospital, Cork, Ireland

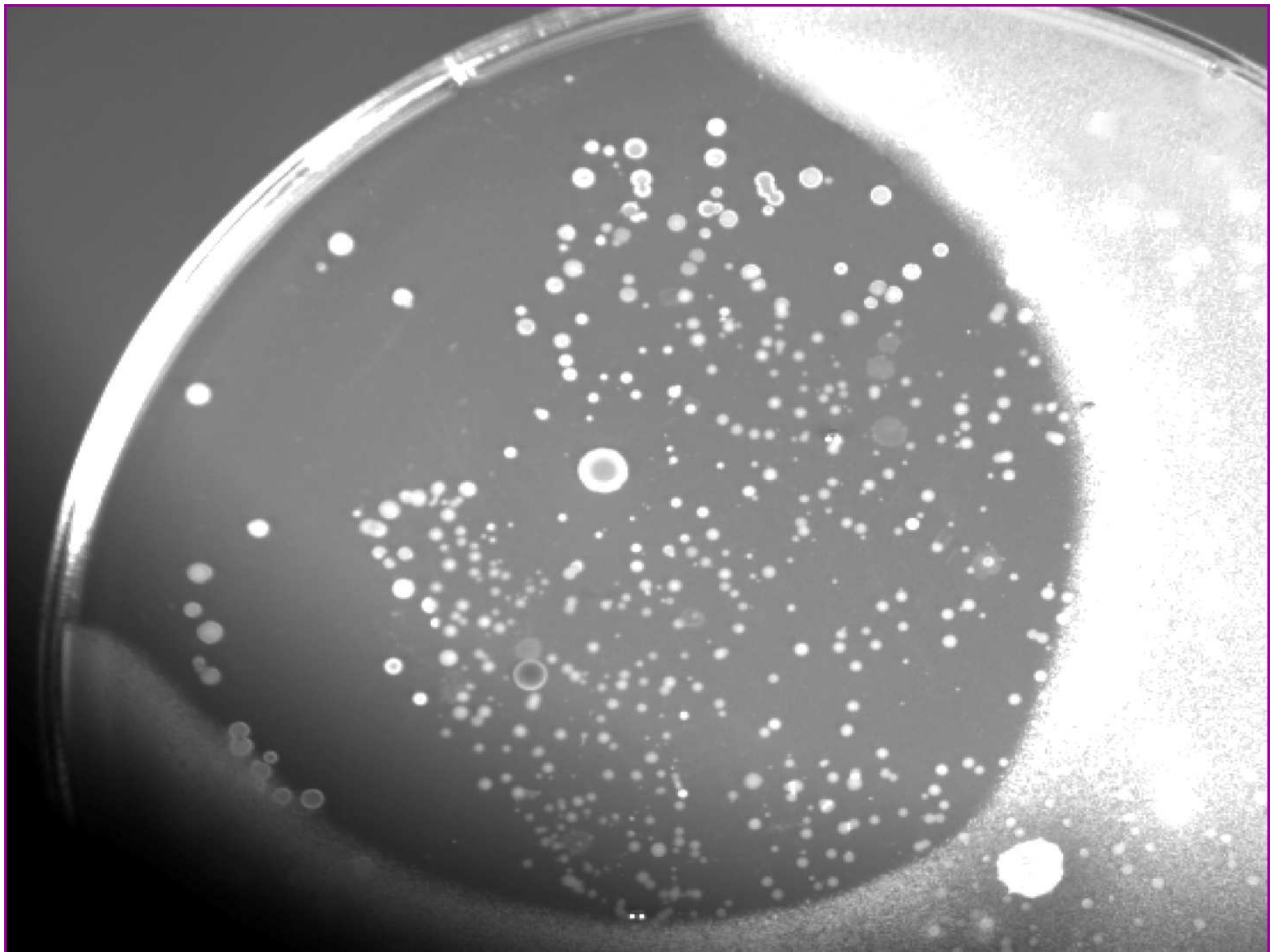


O'Connor et al. *J. Appl. Microbiol.*, 2006

Why *C. difficile* as target?



- Major GI infectious agent
- Sensitive to only two antibiotics, metronidazole and vancomycin.
- Increasingly associated with GI disorders
- Causes 15-25% of all antibiotic associated diarrhoea
- Toxin producer which can be fatal in the elderly
- Incidence is on the increase

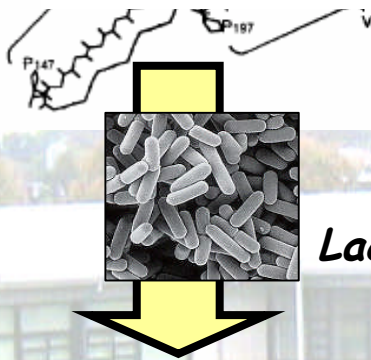


Casein-Derived Antimicrobial Peptides Generated by *Lactobacillus acidophilus* DPC6026

M. Hayes,^{1,2} R. P. Ross,^{1,3} G. F. Fitzgerald,^{2,3} C. Hill,^{2,3} and C. Stanton^{1,3*}

Teagasc, Moorepark Food Research Centre, Fermoy, Cork, Ireland¹; Department of Microbiology, University College, Cork, Ireland²; and Alimentary Pharmabiotic Centre, Cork, Ireland³

Received 15 September 2005/Accepted 24 December 2005



Lactobacillus acidophilus DPC6026

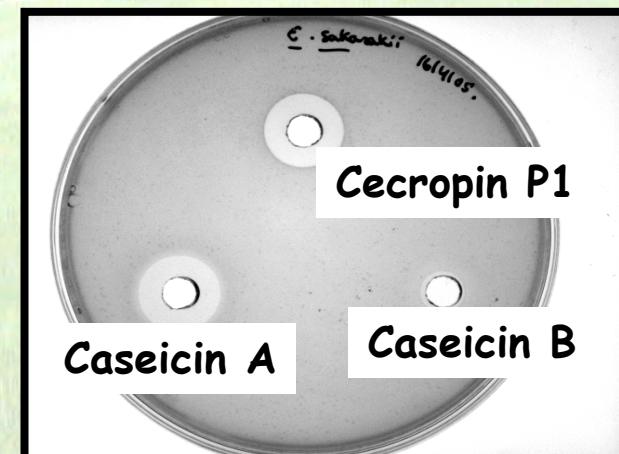
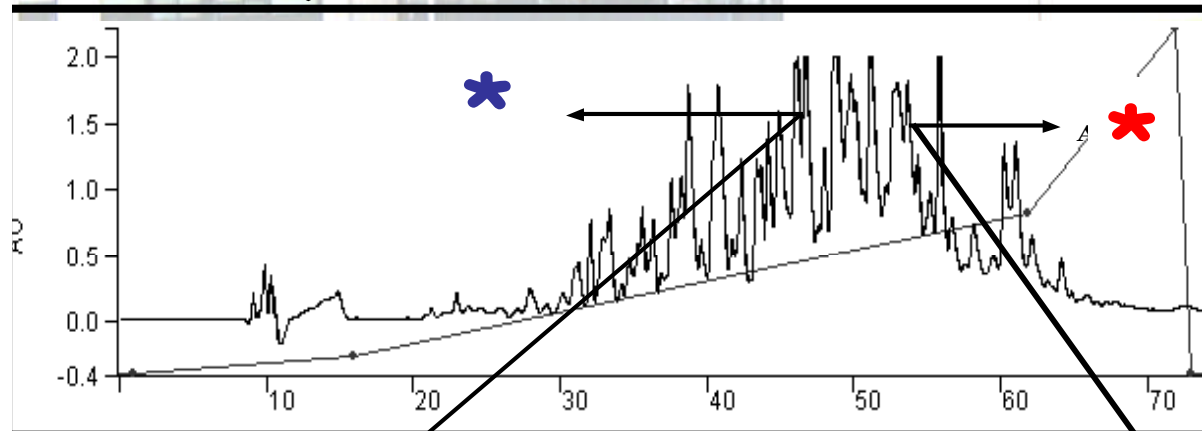
Sequence, synthesise and confirm

*IKHQGLPQE

(9 aa peptide)

*VLNENLLR

(8 aa peptide)



Control of *Enterobacter sakazakii* in Infant Formula

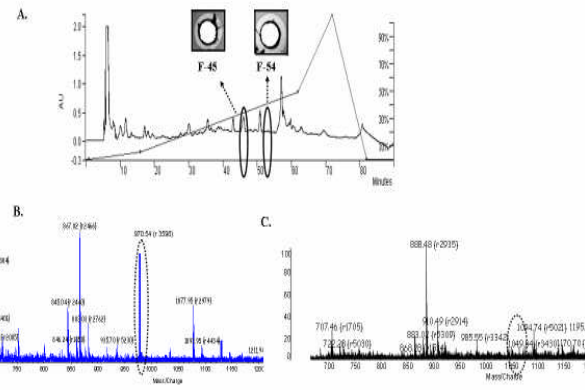
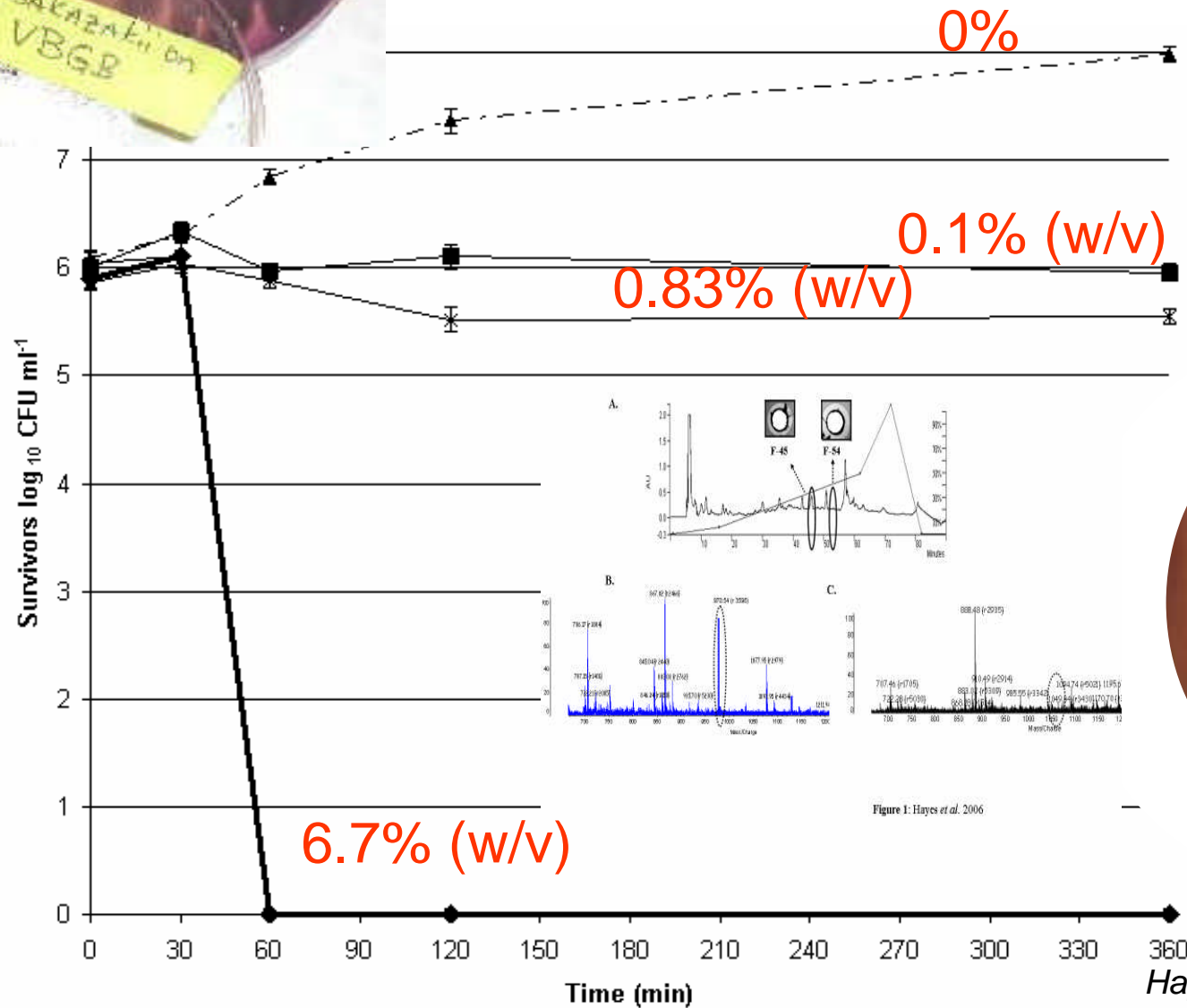


Figure 1: Hayes et al. 2006



Hayes et al., unpublished

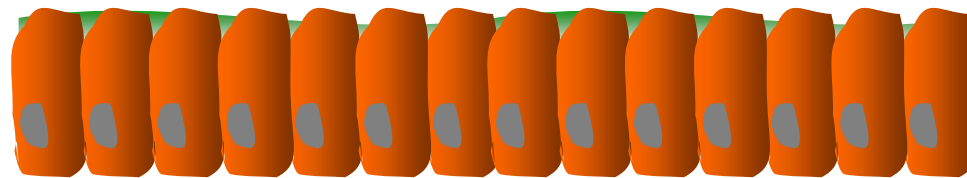
Colostrum-derived anti-infective peptide



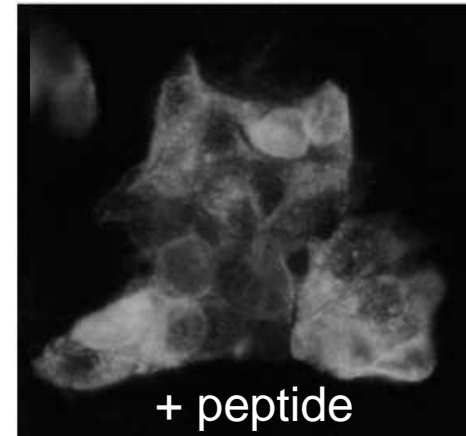
Milk Peptides

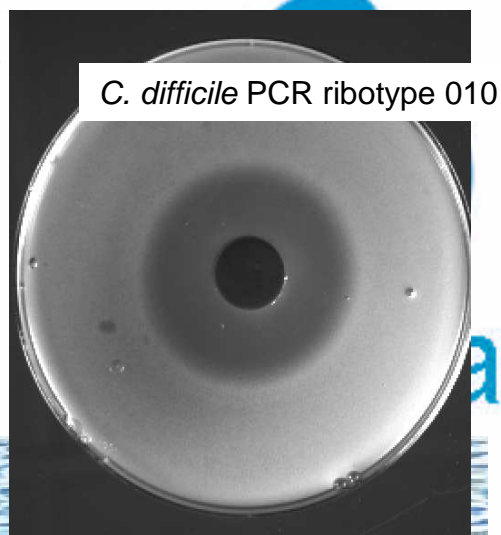
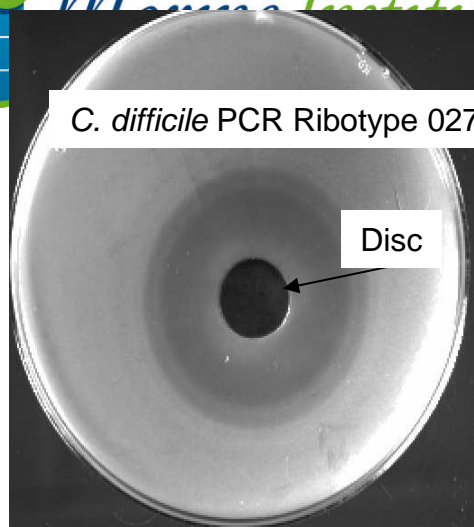
M-SAA310-mer
GWL**TFL**KAAG-NH₂

Human 42-mer:
QGWL**TFL**KAAGQG**T**KDMWKAYSDF

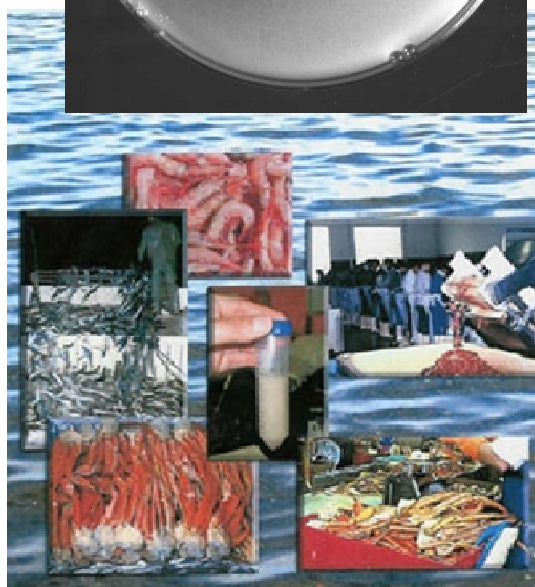


Gut epithelial cell line





Algae



Marine Discard



Aquaculture Industry

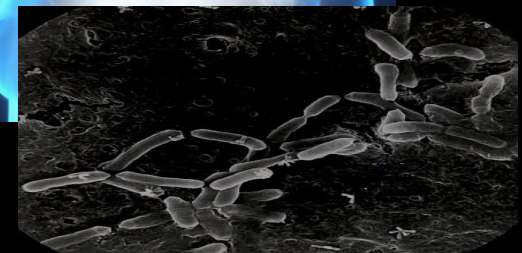
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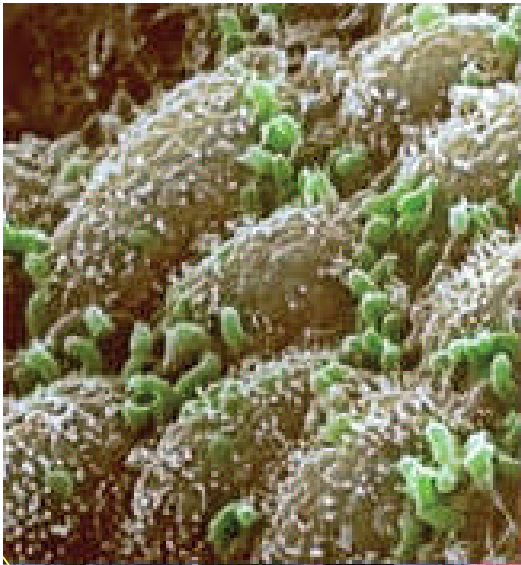
Research Programmes : Gut Health

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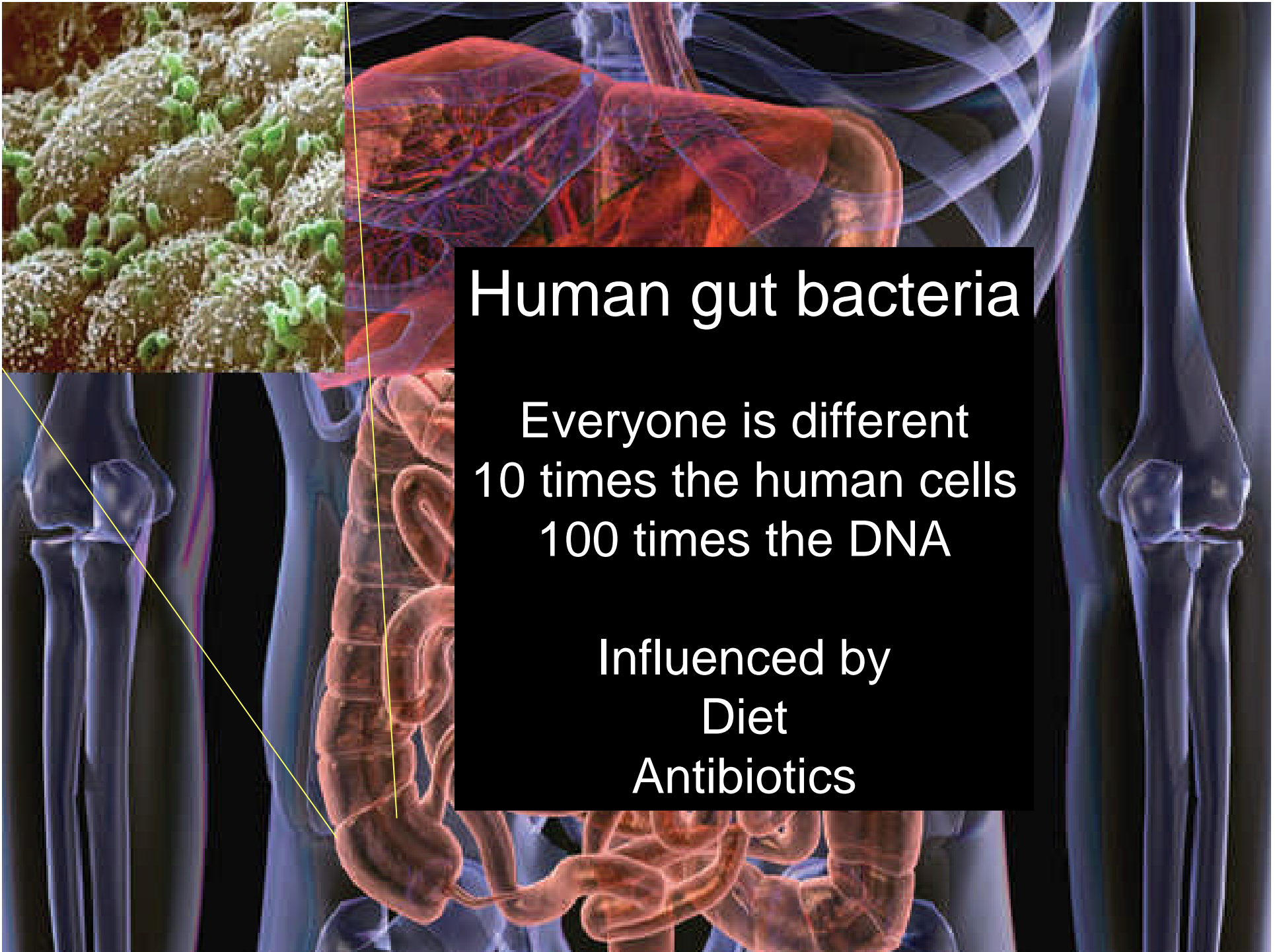




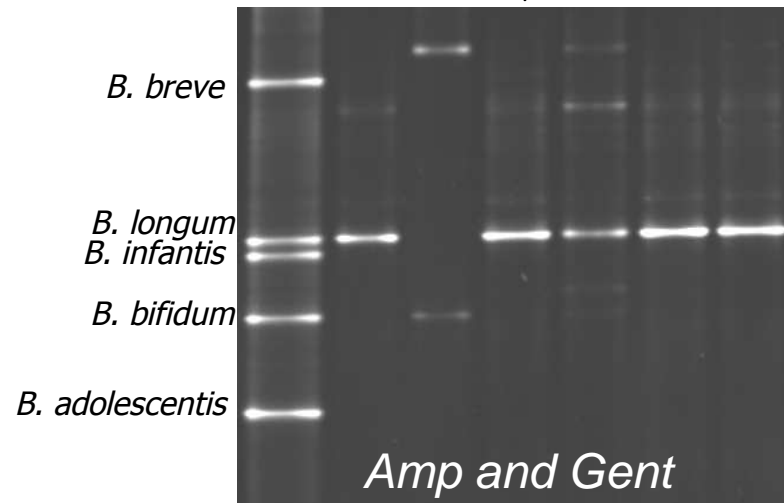
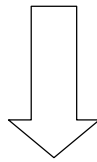
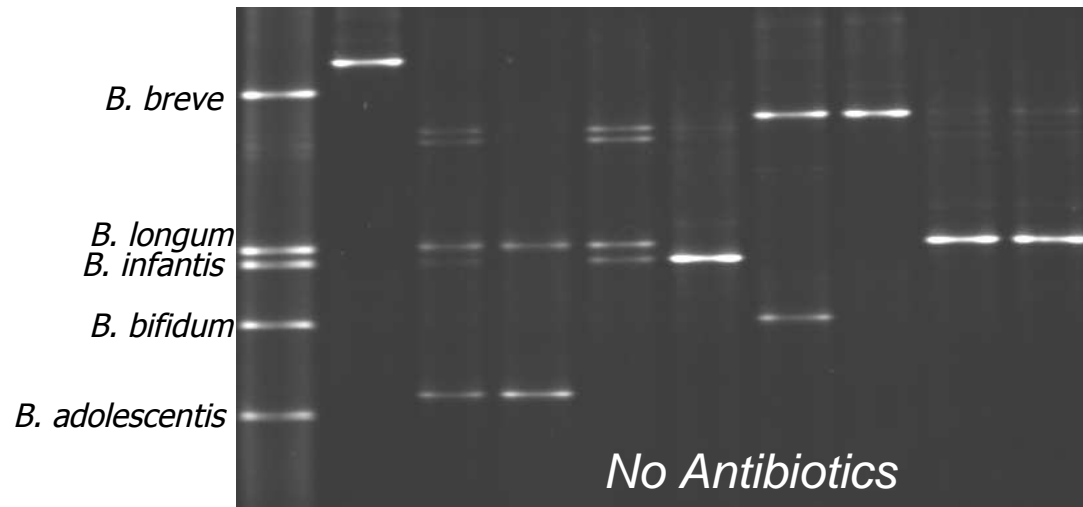
Human gut bacteria

Everyone is different
10 times the human cells
100 times the DNA

Influenced by
Diet
Antibiotics



Antibiotic Treatment Affects *Bifidobacterium* Diversity



4 week babies

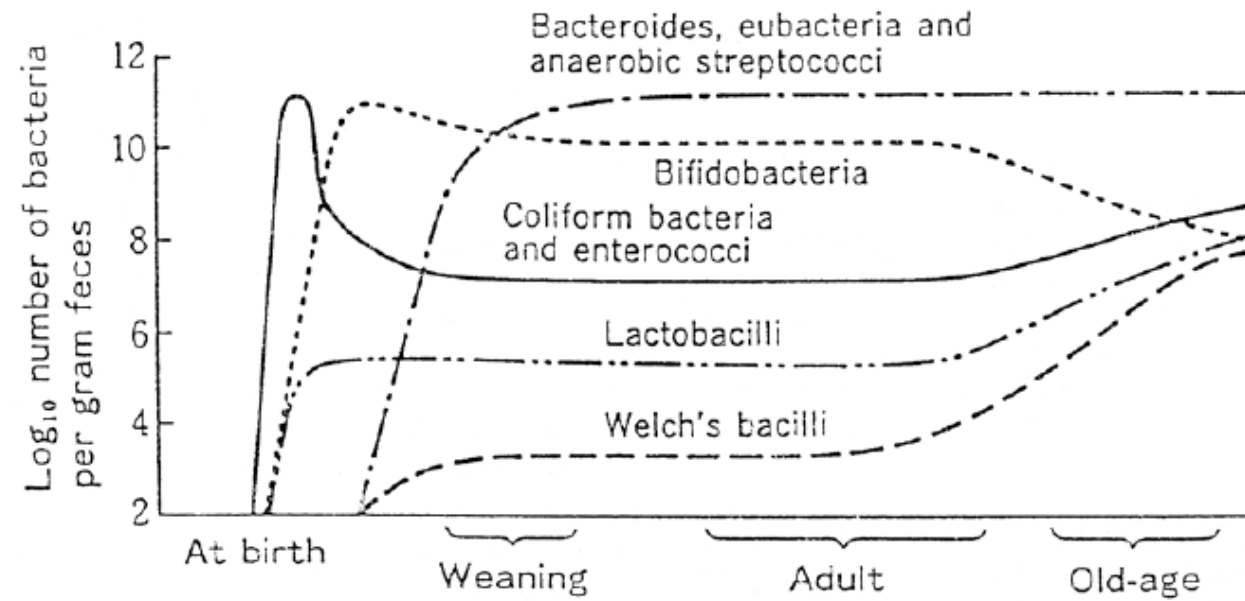


Figure 1. Change of intestinal flora with age (Mitsuoka 1978)

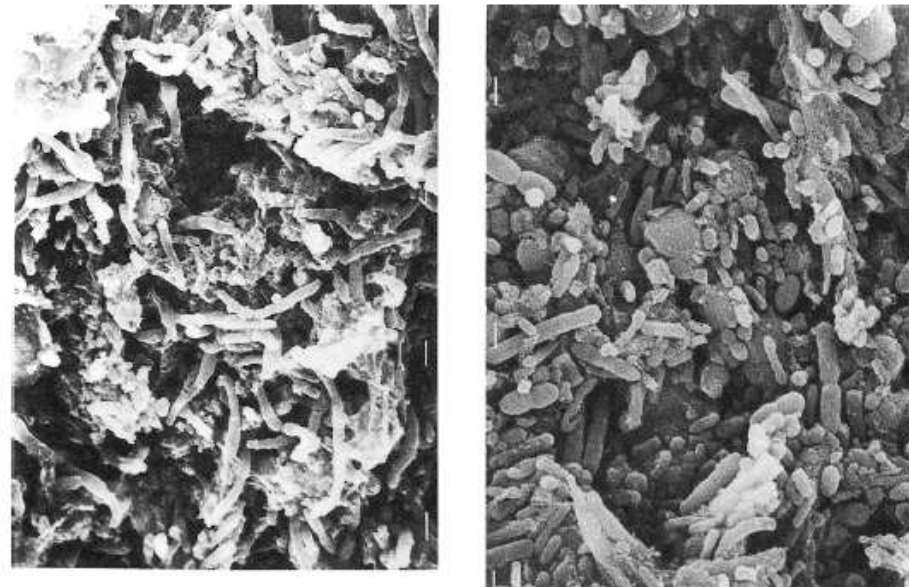
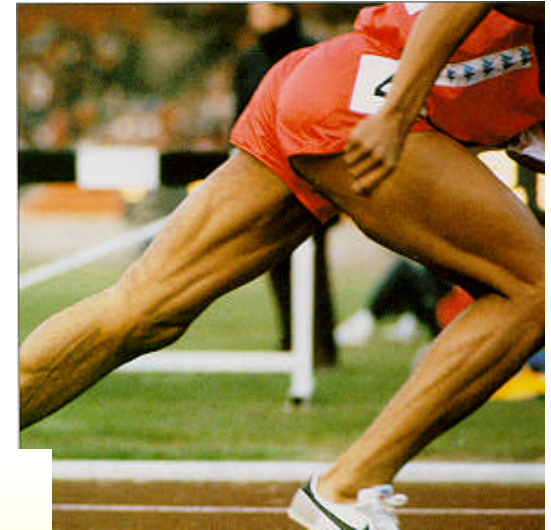
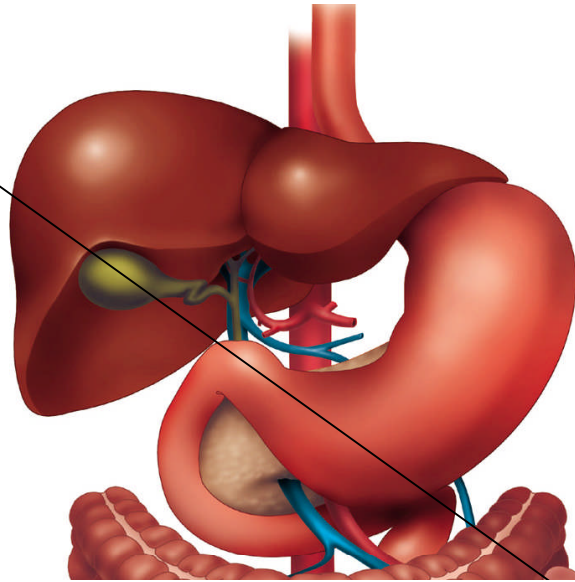
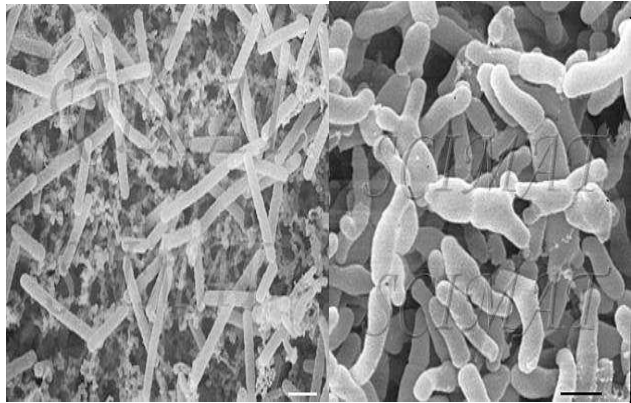


Figure 2. Electron micrographs of infant (A) and adult (B) faeces

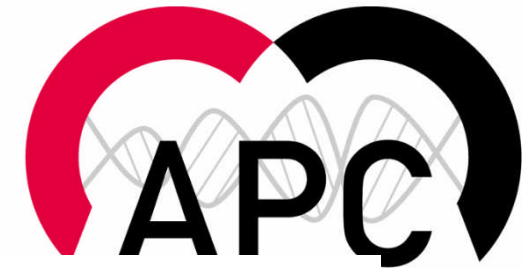
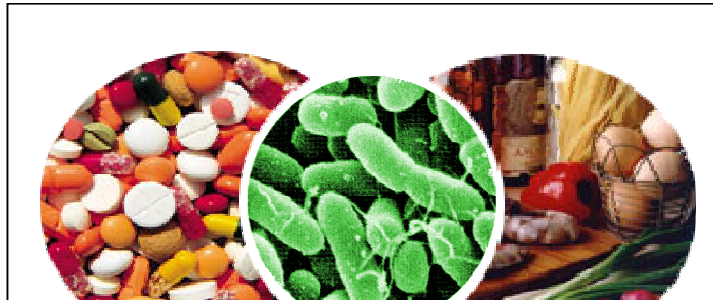
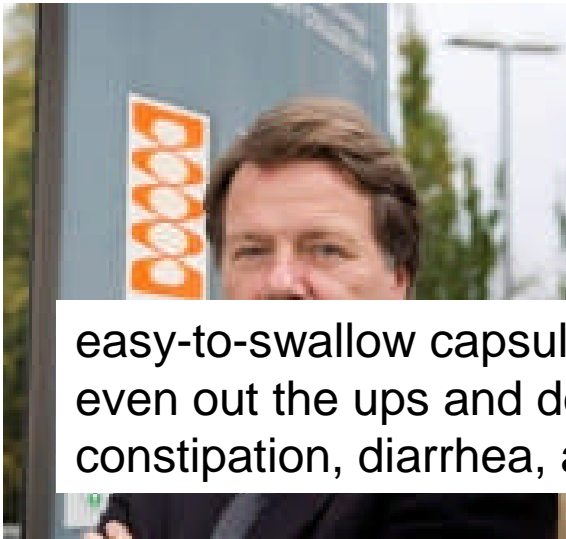


Definition

“live microorganisms which when consumed in adequate numbers confer a health benefit on the host”

FAO/WHO Expert Consultation 2001



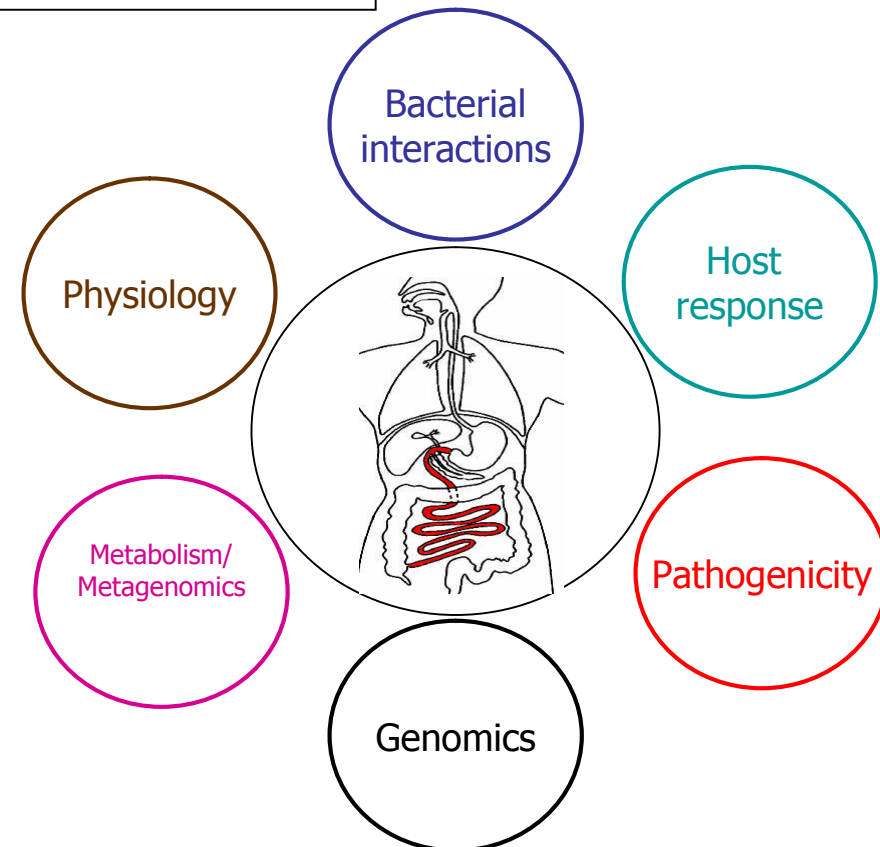


ic Centre
Medicine

easy-to-swallow capsule that you take just once a day, every day to help even out the ups and downs of common digestive upsets such as constipation, diarrhea, abdominal discomfort, urgency, gas, and bloating.



Align containing Bifantis™ is a daily probiotic supplement that helps build and maintain a healthy, balanced digestive system when taken daily. T





THE DEPARTMENT OF
AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

ELDERMET: Gut health for the elderly

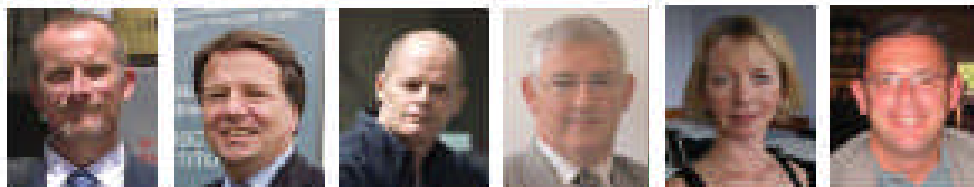


Gut microbiota as an indicator and agent of nutritional health in elderly Irish subjects

Microbiome composition in 500 subjects at one time point, and in 250 of these subjects at two subsequent time-points.

To make a logical link with the microbial conversion of diet, the production of effector molecules and bioactives, or microbial effect upon host metabolism, we will perform metabolomics on fecal water and plasma lipids

Prof. Dennis O'Mahony, Finbarrs

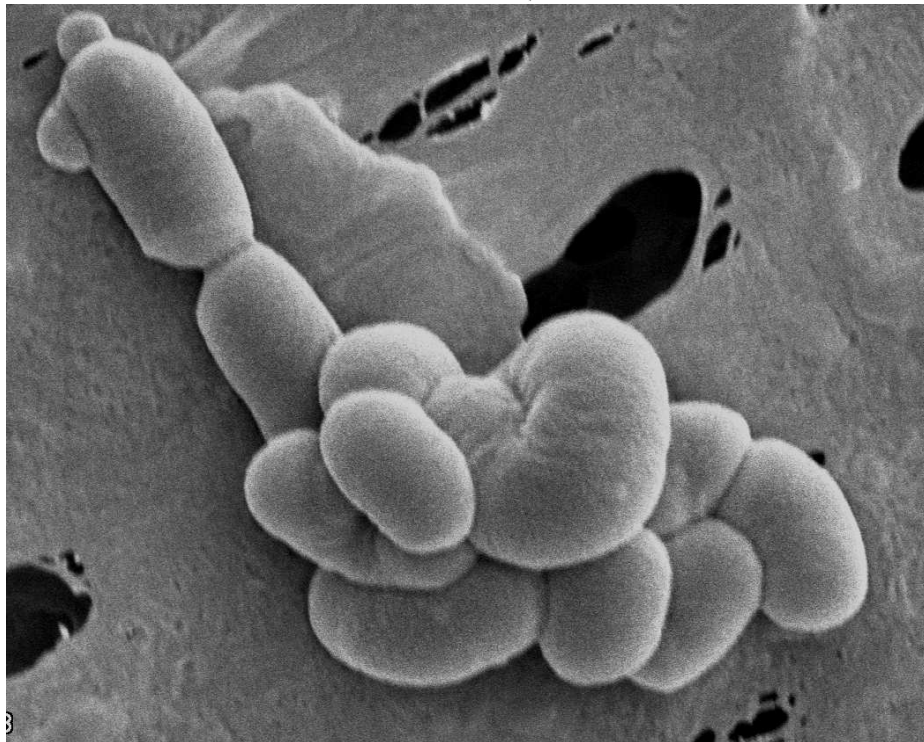




Vision Programme



Discovery of Bioactives for Incorporation
Into Functional Foods



PHARMACEUTICALS

MEDIUM
PROBIOTIC CHEDDAR



Pilgrims
Choice®

Helps maintain
a healthy
digestive
system



A SMOOTH RICH AND
MELLOW TASTING CHEDDAR

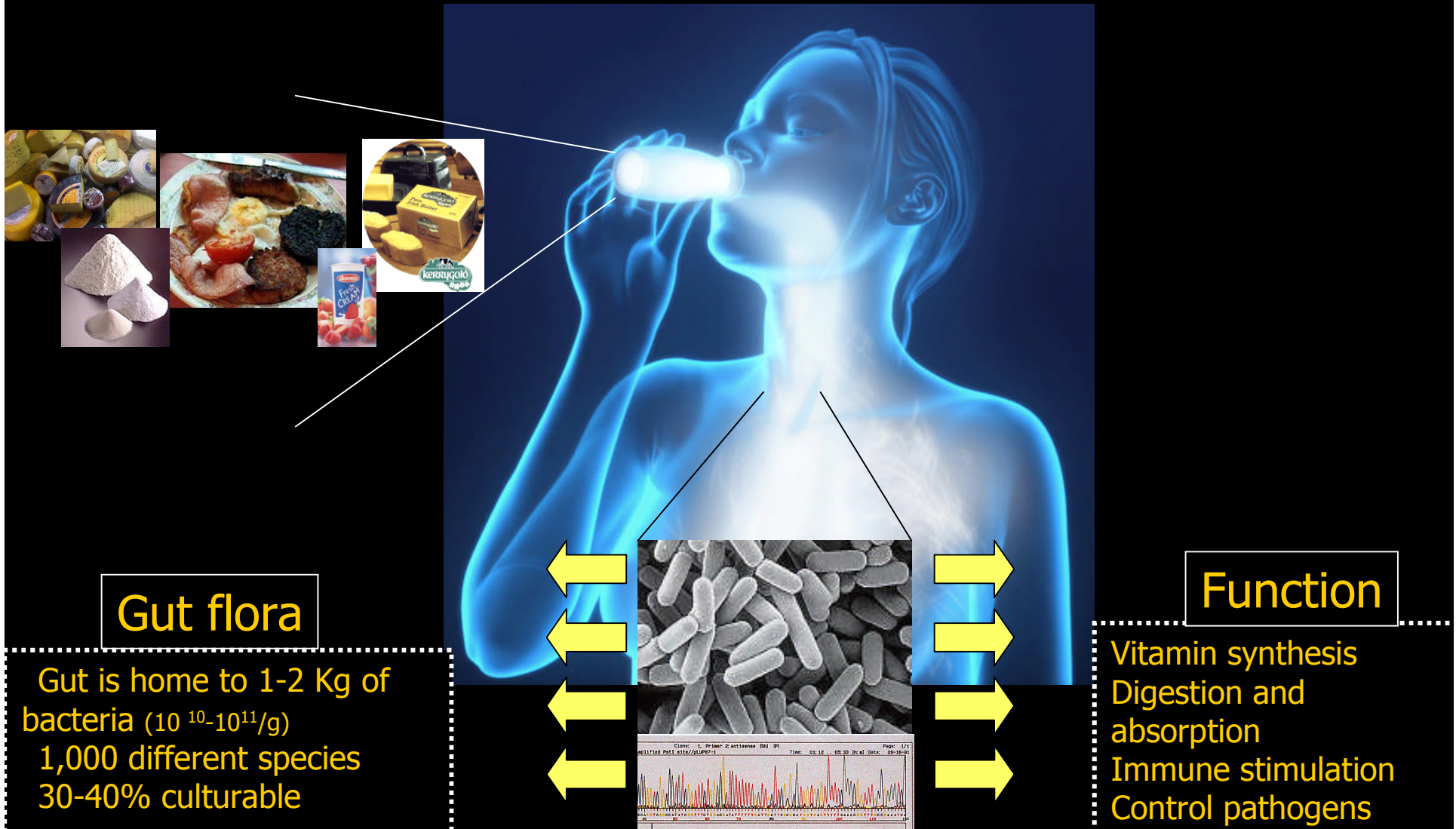
FLAVOUR

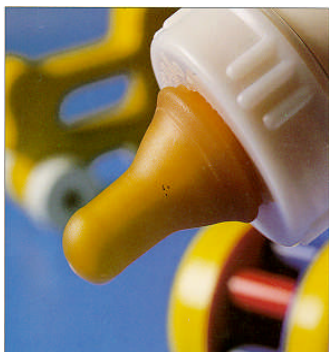
3

STRENGTH

Connect food-product in
To obesity pander

Food can programme resident flora and thereby affect health





N = 8

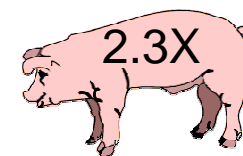
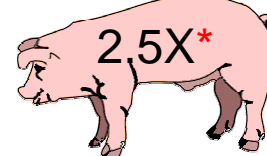
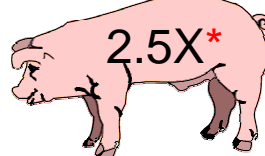
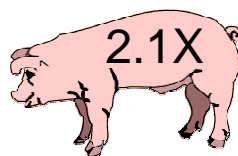


Control

Formula 1

Formula 2

Formula 3



Log cfu/g
faeces
Days

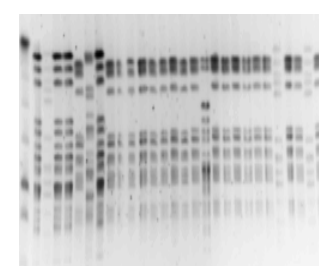
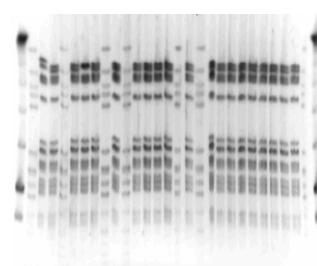
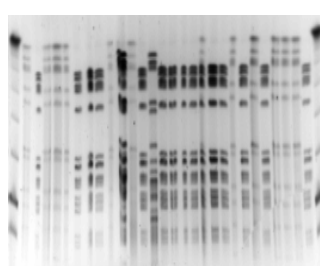
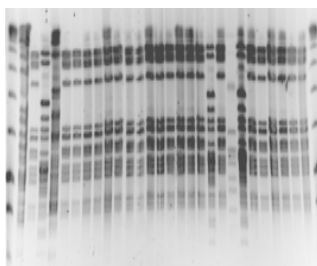
0 7 21 28

0 7 21 28

0 7 21 28

0 7 21 28

PFGE
21 days



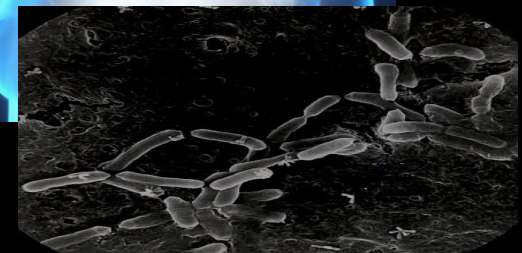
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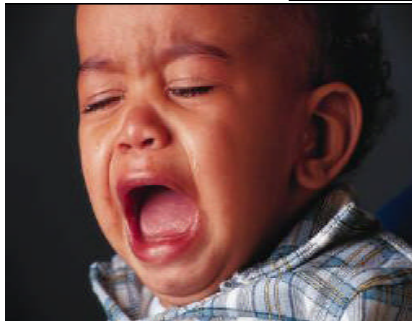
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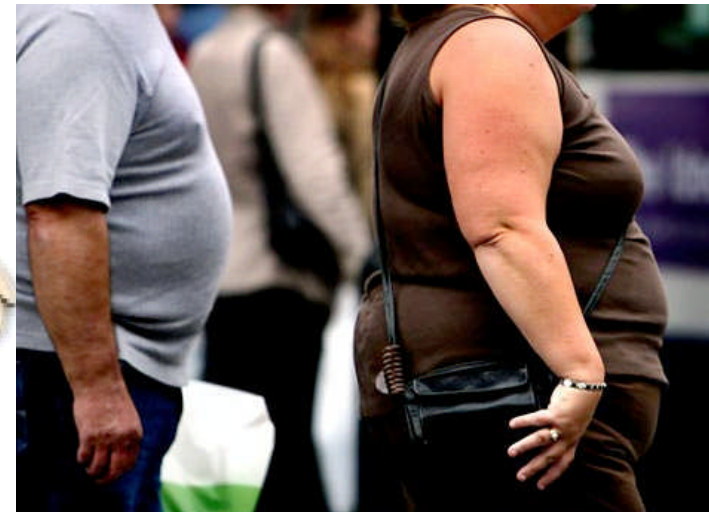
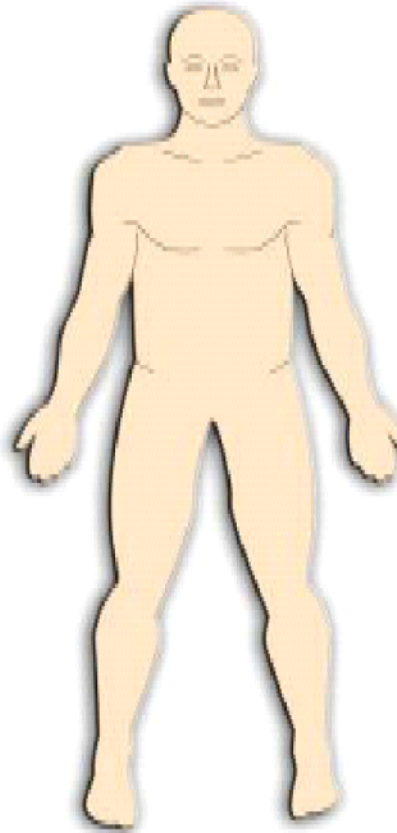
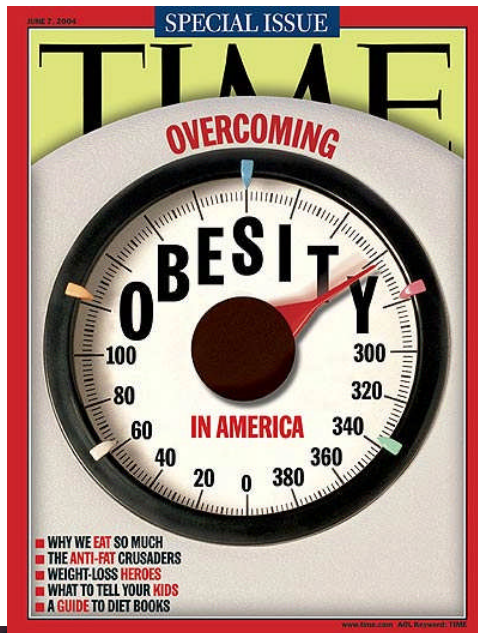
Conclusions



The Importance of the Microbiota



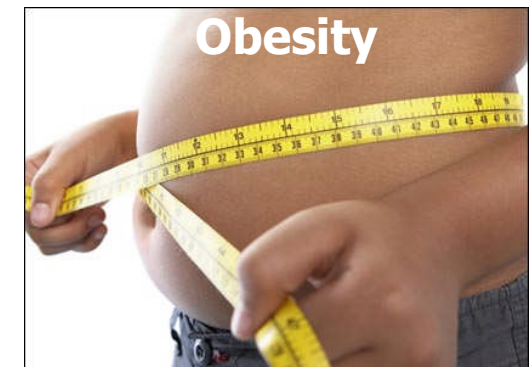
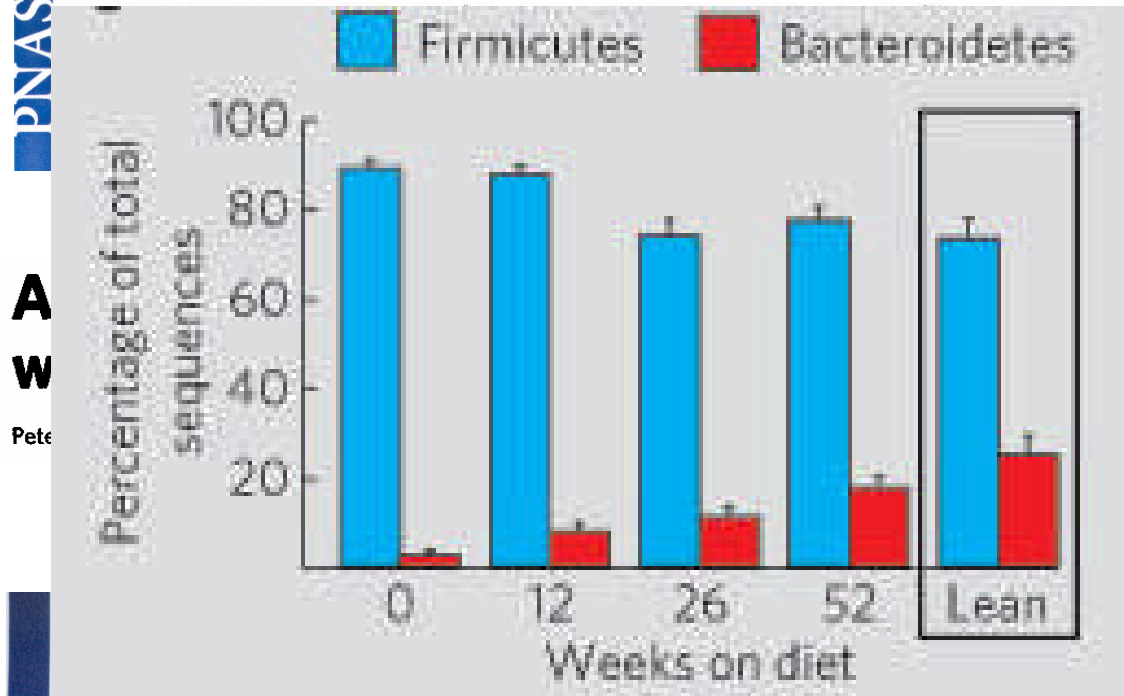
Impact of microbes has been underestimated – potential to improve Human health through gut flora



- gastrointestinal diseases, inflammatory disorders, obesity, metabolic syndrome...etc.

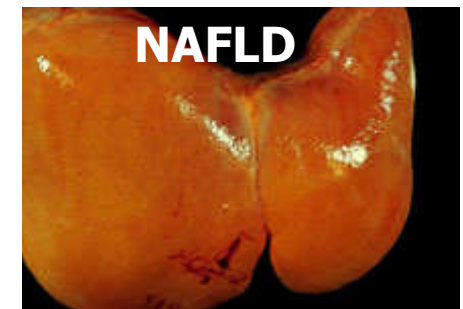
The Importance of the Microbiota

The gut microbiota as an environmental factor that regulates fat storage



“Our results indicate that the obese microbiome has an increased capacity to harvest energy from the diet. Furthermore, this trait is transmissible”:

“Our findings indicate that obesity has a microbial component, which might have potential therapeutic implications.”



A scanning electron micrograph (SEM) showing a cluster of adipocytes (fat cells). The cells are characterized by their large, rounded, and somewhat irregular shapes, which are typical of cells storing lipids. The surface of the cells appears smooth but with some texture. The background is a granular, light gray surface. A dark, elongated structure is visible in the upper right, and another dark, more complex structure is in the lower left.

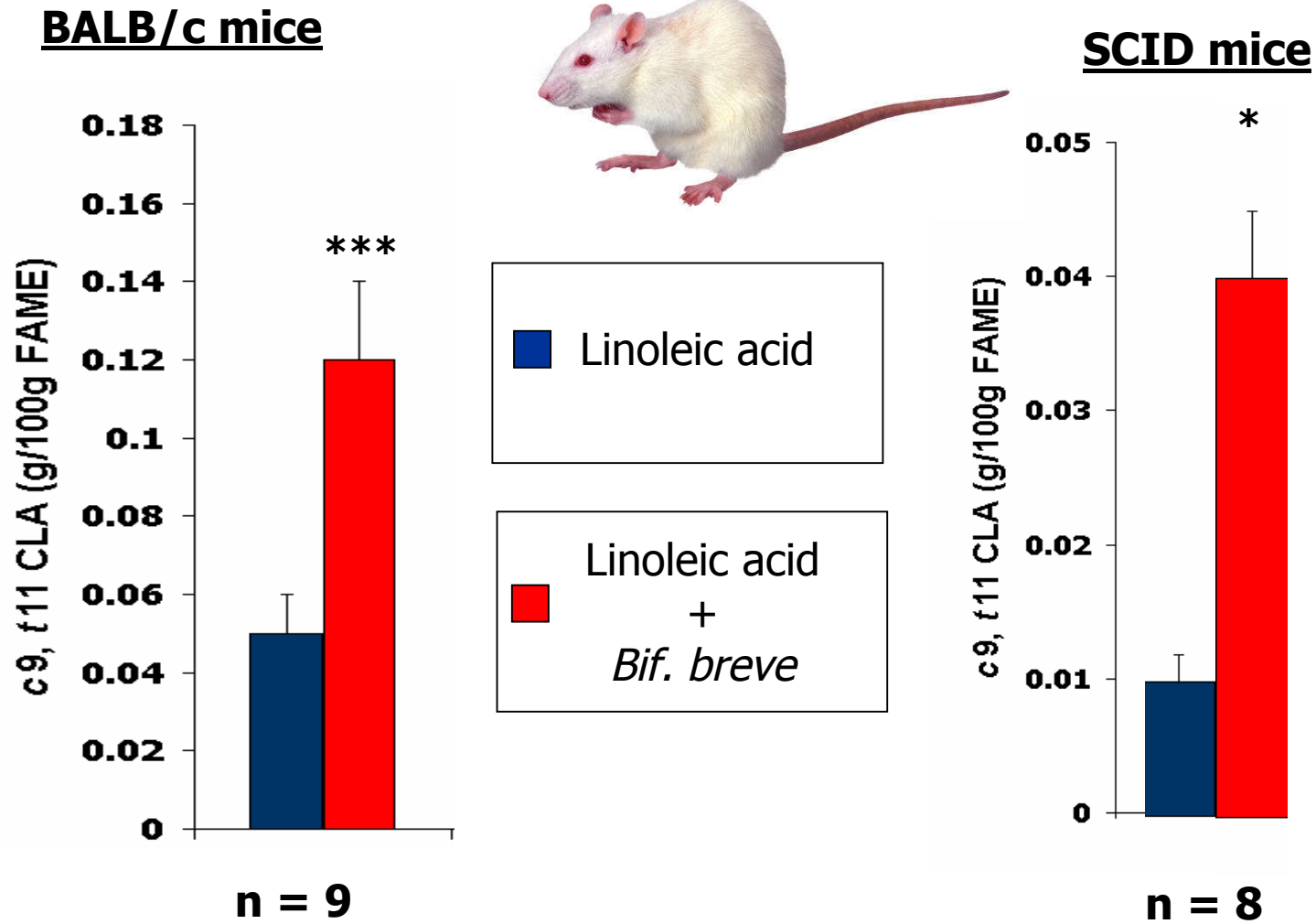
Does the microbiota affect the composition of fat as well as its quantity?

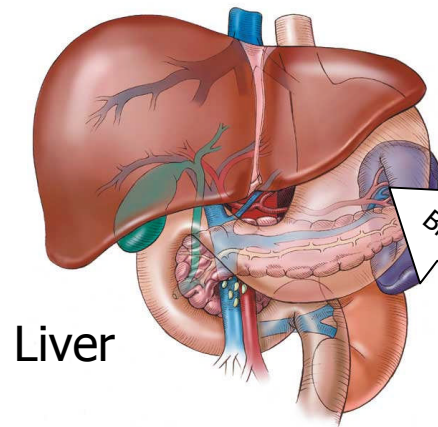


Bifidobacterium breve

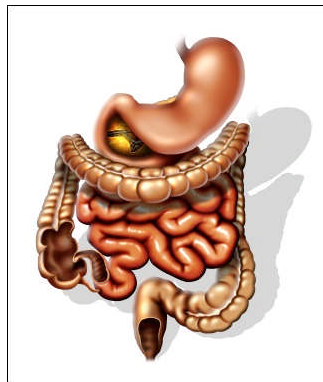
Barret E 2007 Applied Environ. Microbiol 73: 2333-2337

Microbial-induced compositional change in liver fat





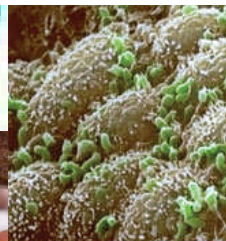
Liver



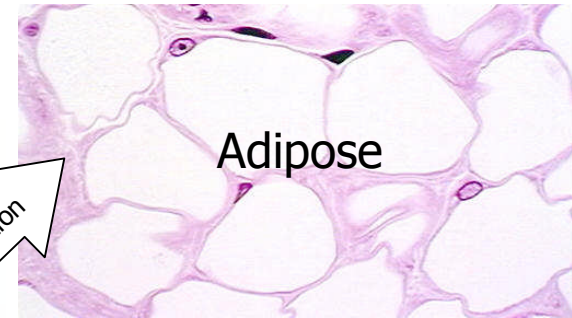
Intestine



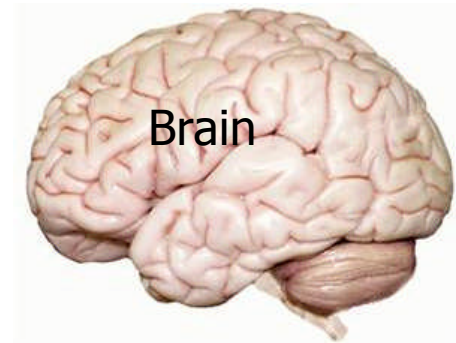
Luminal production by
gut microbiota



Bacteria changing food into
Healthy bioactive substances



Adipose



Brain

Bioactive Production

Bioactive Production

Bioactive Production

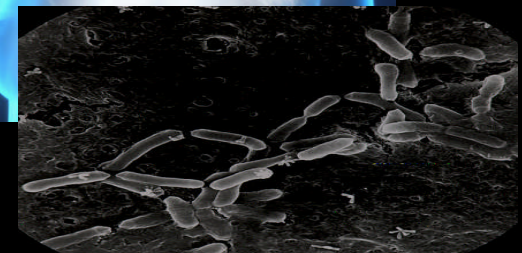
Bioactive Production

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Conclusions

- Research Strategy to develop multidisciplinary programmes in specific areas
- Large mining projects for FF ingredients in dairy and the marine
- The influence of Gut flora has been underestimated
- Food can programme flora and thereby health





Catherine Stanton Ger Fitzgerald Colin Hill Charlie Daly



Tony Ryan Fergus Shanahan Ted Dinan Eamon Quigley



“Let food be your medicine”