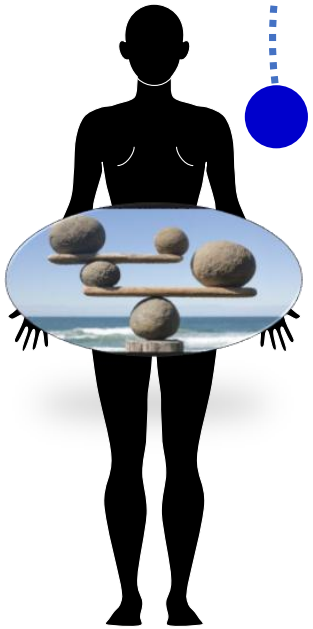
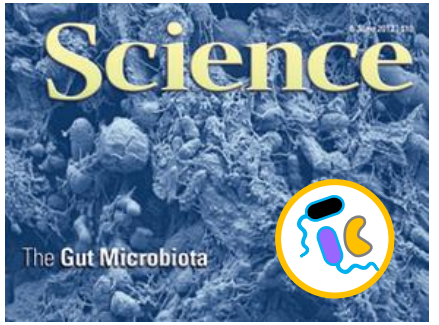
iata
Instituto de Agroquímica y Tecnología de Alimentos

XXIX AETC 2017 Jornadas Técnicas

RELACIÓN ENTRE LA MICROBIOTA INTESTINAL Y LA SALUD Y CONTRIBUCIÓN DE LA FIBRA EN LA DIETA





CSIC
Consejo Superior de Investigaciones Científicas

Laboratorio de Ecología Microbiana, Nutrición y Salud.

MARINA ROMANÍ-PÉREZ

XXIX AETC 2017 Jornadas Técnicas

OVERVIEW

1. GUT MICROBIOTA
2. GUT MICROBIOTA & DISEASES. OBESITY
3. MICROBIOME-BASED INTERVENTIONS FOR PROMOTING METABOLIC HEALTH. PREBIOTICS & PROBIOTICS
4. MICROBIOTA-BY-DIET INTERACTION. SCFAs
5. GUT MICROBIOTA-HOST COMMUNICATION
6. GROUP OF MICROBIAL ECOLOGY, NUTRITION AND HEALTH. 'On the way to evaluate new probiotics'
   - 6.1 Evaluation of the potential probiotic *Bacteroides uniformis* CECT 7771
   - 6.2 Evaluation of dietary fiber supplementation (WBE) combine with *B. uniformis* CECT 7771 intervention

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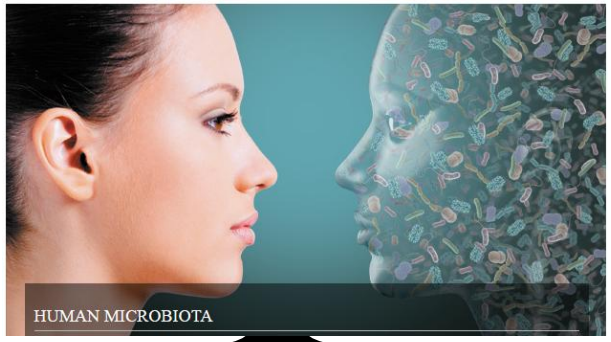
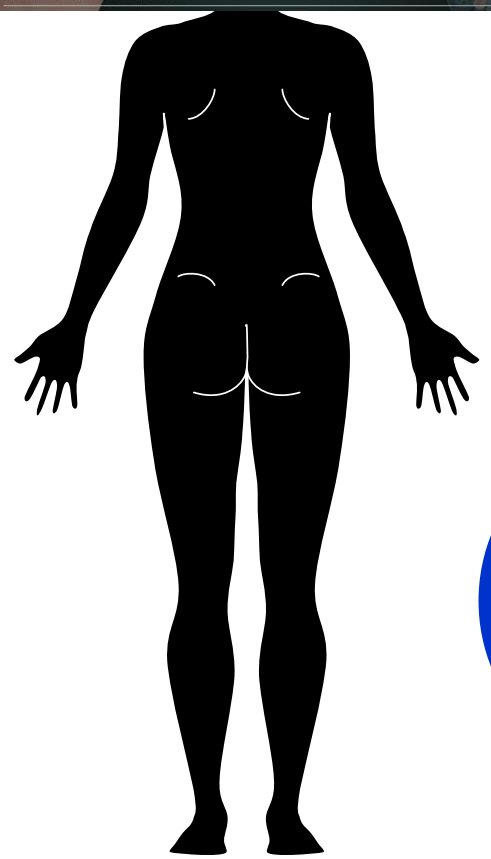
1. GUT MICROBIOTA

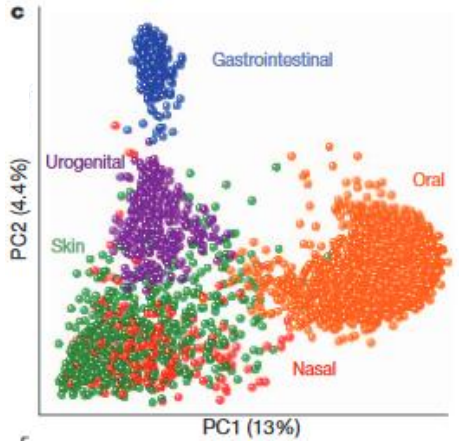
39 trillion microbial cells

1-3% of body mass





Body habitat groups



The Human Microbiome Project Consortium

10 times more cells than human cells

150 times more genes than human genes

HOST GENOME (Ekaryotic)

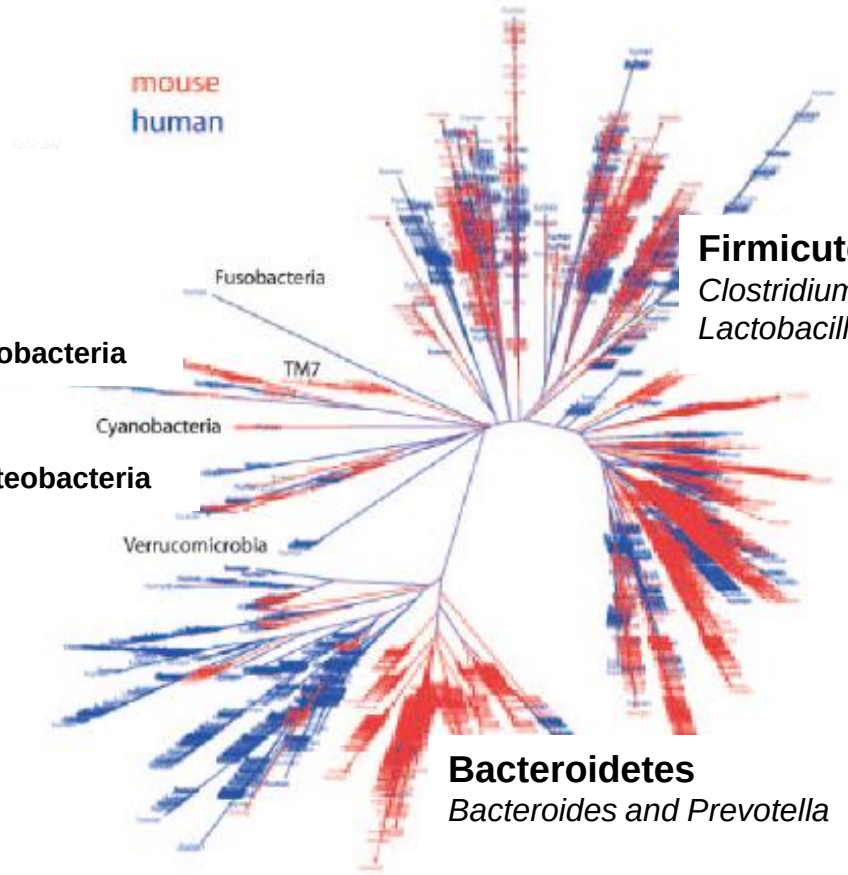
HOLOGENOME

GENOME OF SYMBIOTIC MICROBES (Prokaryotic)

PHENOTYPE PLASTICITY

1. GUT MICROBIOTA

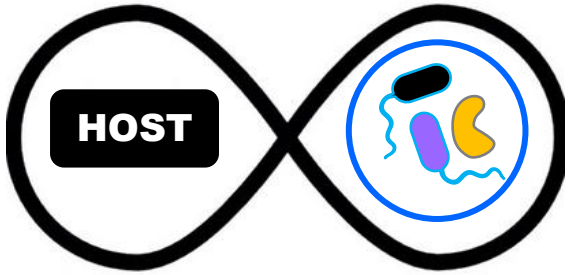
PHYLOGENY OF BACTERIAL PHYLA



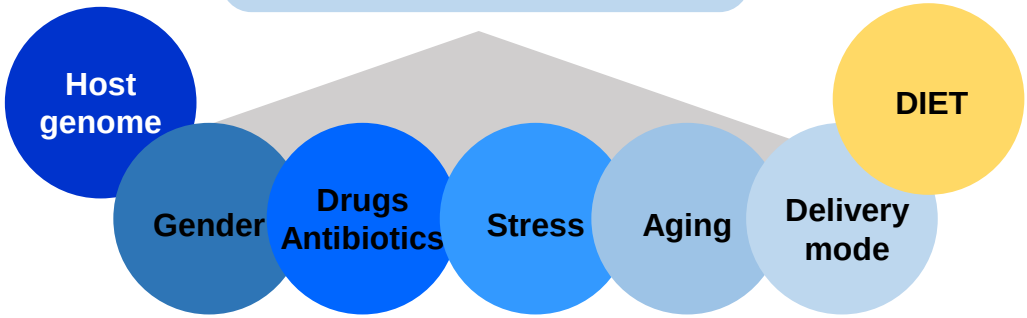
Firmicutes
Clostridium, Enterococcus, Lactobacillus and Ruminococcus

Bacteroidetes
Bacteroides and Prevotella

SYMBIOSIS



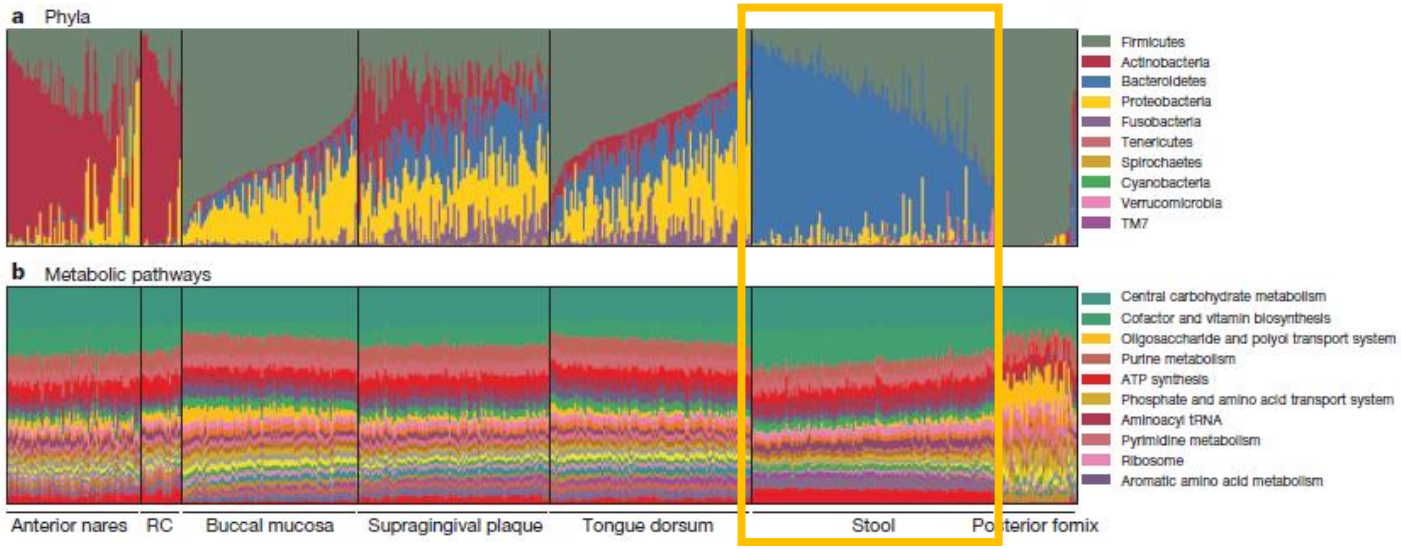
Dynamic microbial community struture among individuals



HOST PHENOTYPE PLASTICITY

1. GUT MICROBIOTA

Stability of metabolic pathways among individuals



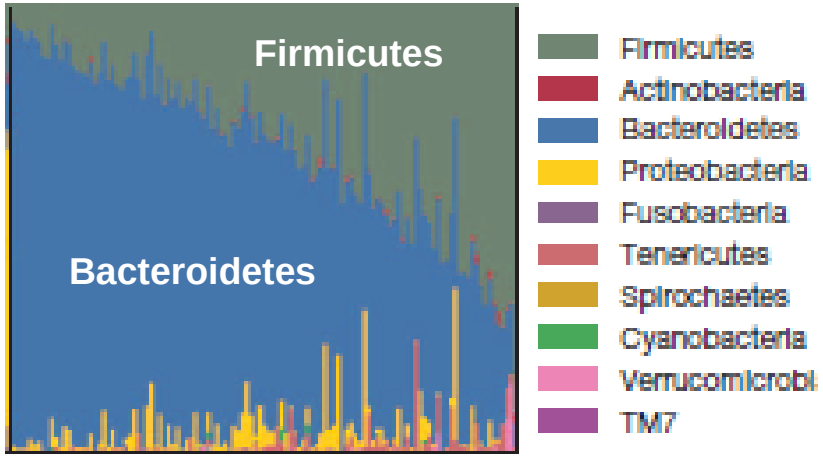
The Human Microbiome Project Consortium

HOST ⇔ **Gut microbiota**

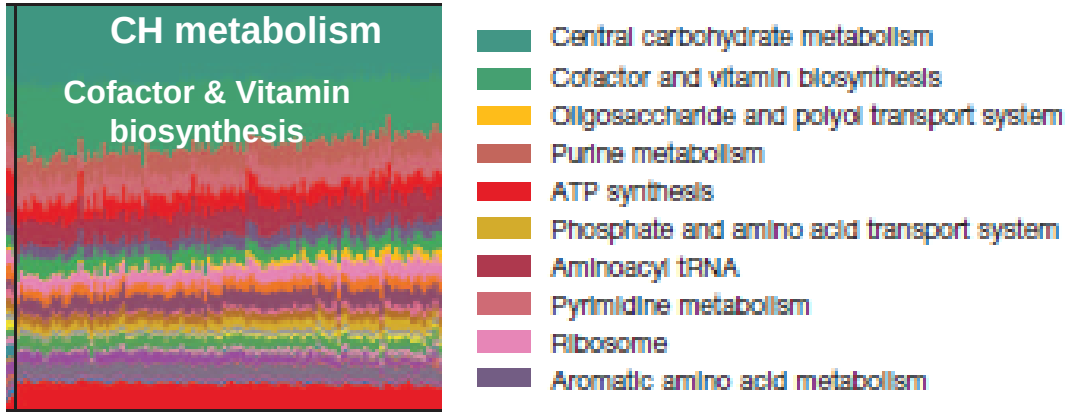
Nutrients
Shelter

- **Energy harvest**
- **Protection against pathogens**
- **Immunomodulation**
- **Energy metabolic status**

Phyla



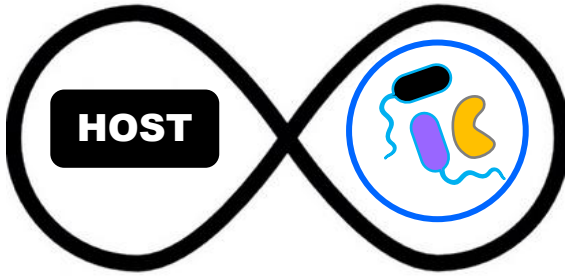
Gut microbiota



Gut microbiota

1. GUT MICROBIOTA & HOST

SYMBIOSIS



MUTUALISM

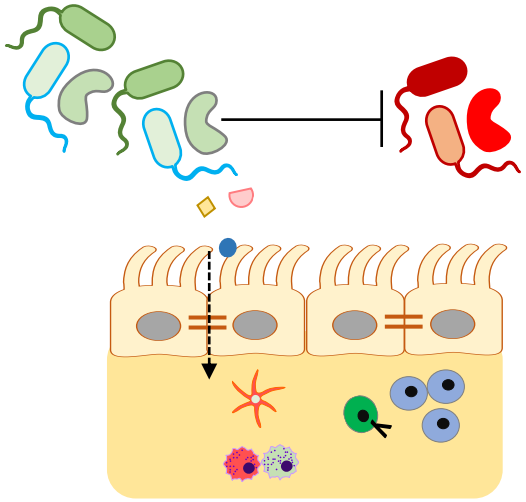
COMMENSALISM

PARASITISM

SYMBIONTS

PATHOSYMBIONTS

Eubiosis



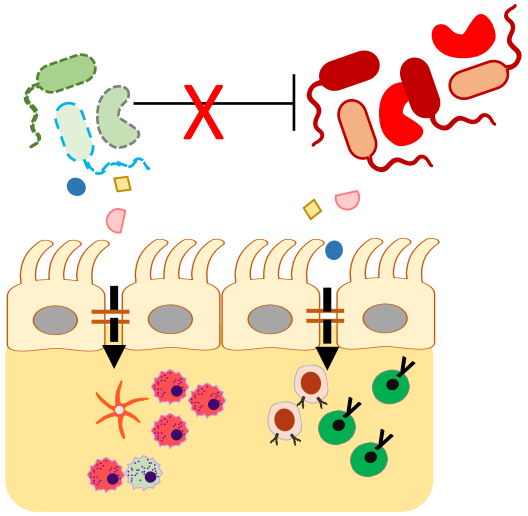
Immune homeostasis

Healthy state

PATHOSYMBIONTS

SYMBIONTS

Dysbiosis



Proinflammatory state

Intestinal and extra-inetstinal Inflammatory DISEASES

DC
T cells
M1
Treg
M2
B cells

2. GUT MICROBIOTA & DISEASES

Dysbiosis → **Proinflammatory state** → CHRONIC

PATHOSYMBIONTS

SYMBIONTS

Intestinal and extra-intestinal Inflammatory DISEASES

- Inflammatory bowel disease
- Celiac disease
- Cardiovascular diseases
- Mental diseases (emotional, cognitive-related diseases; anxiety, depression, autism, etc)
- Metabolic diseases: Diabetes (T1D or T2D), Obesity, metabolic syndorme

A Pyrosequencing Study in Twins Shows That Gastrointestinal Microbial Profiles Vary With Inflammatory Bowel Disease Phenotypes

BEN P. WILLING,* JOHAN DICKSVED,* JONAS HALFVARSON,‡ ANDERS F. ANDERSSON,§,‖ MARIANNA LUCIO,¶ ZONGLI ZHENG,# GUNNAR JÄRNEROT,‡ CURT TYSK,‡,** JANET K. JANSSON,‡‡ and LARS ENGSTRAND§

GASTROENTEROLOGY 2010;139:1844–1854

The Duodenal Microbiota Composition of Adult Celiac Disease Patients Is Associated with the Clinical Manifestation of the Disease

Pirjo Wacklin, PhD, Katri Kaukinen, MD,† Elina Tuovinen, MSc,* Pekka Collin, MD,† Katri Lindfors, PhD,‡ Jukka Partanen, PhD,* Markku Mäki, MD,‡ and Jaana Mättö, PhD**

(Inflamm Bowel Dis 2013;0:1–8)

PSYCHOSOMATIC MEDICINE
Journal of Biobehavioral Medicine
Author Manuscript In Press

Psychosomatic Medicine
Author's Accepted Manuscript

Article Title: Brain-gut-microbiota axis in psychiatry: novel paradigm or false dawn?

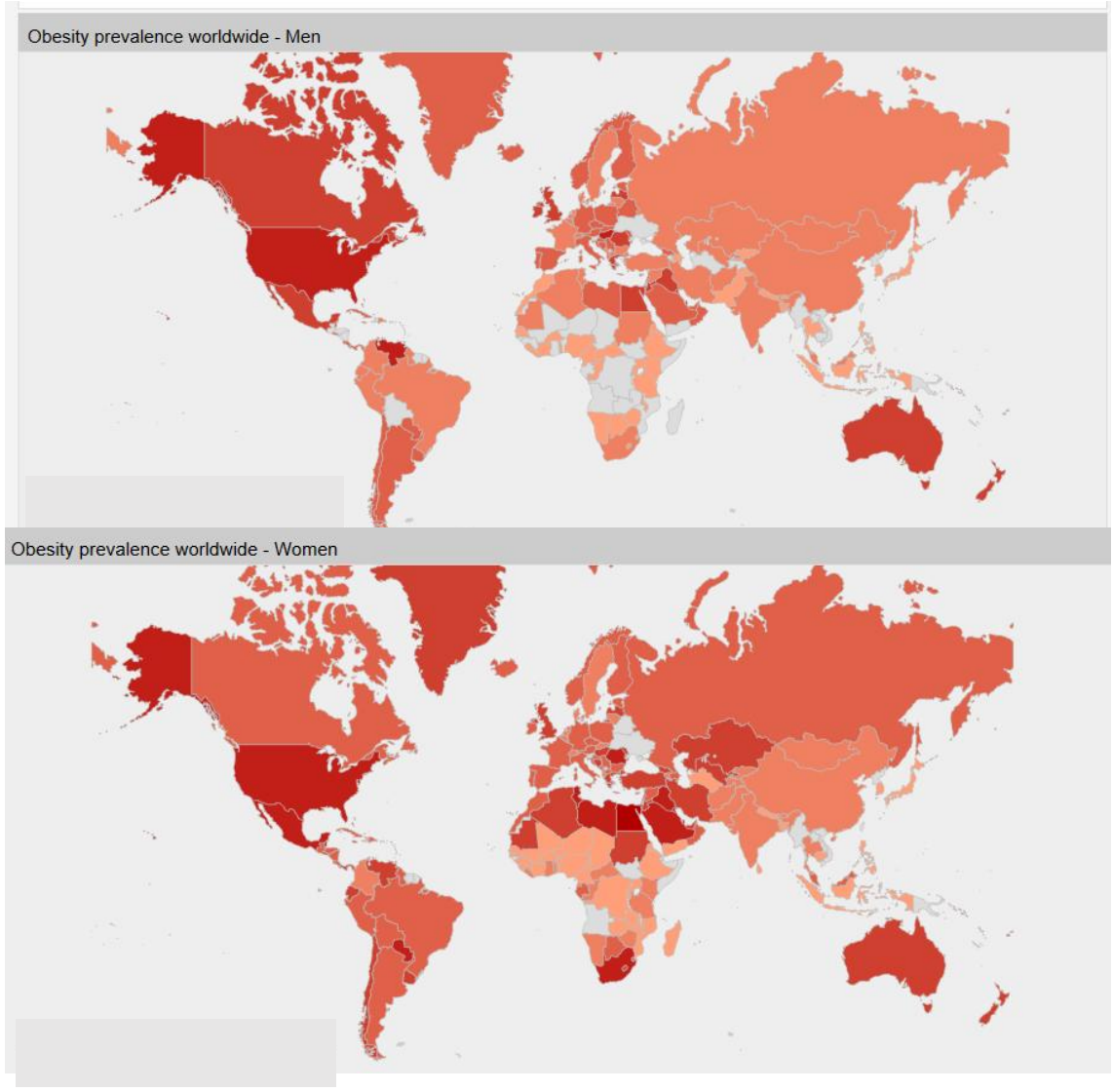
Authors: Timothy G. Dinan and John Cryan

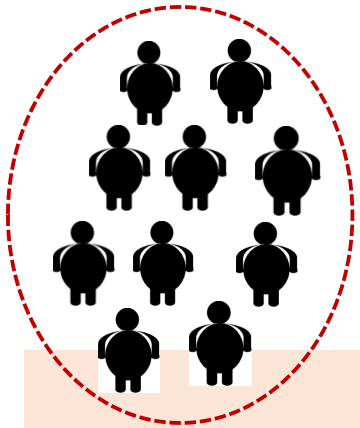
CellPress
Cell Metabolism
Article

Intermittent Fasting Promotes White Adipose Browning and Decreases Obesity by Shaping the Gut Microbiota

Guolin Li,[1,2,3,7,*] Cen Xie,[1,7] Siyu Lu,[2] Robert G. Nichols,[4] Yuan Tian,[4] Licen Li,[2] Daxeshkumar Patel,[1] Yinyan Ma,[5] Chad N. Brocker,[1] Tingting Yan,[1] Kristopher W. Krausz,[1] Rong Xiang,[6] Oksana Gavrilova,[5] Andrew D. Patterson,[4] and Frank J. Gonzalez[1,8,*]

2. GUT MICROBIOTA & OBESITY





KEY FACTS OF OBESITY

- ↗prevalence from 1975 (x3)
- In 2016:
  - ADULTS: 39% overweight and 13% obese.
  - CHILDREN & ADOLESCENTS: 18% overweight or obese
- Obesity ranks fifth in risk of global deaths in the general population
- ↗ prevalence in low and middle-income countries
- **OBESITY IS PREVENTABLE**

worldobesity.org
www.who.int

2. GUT MICROBIOTA & OBESITY

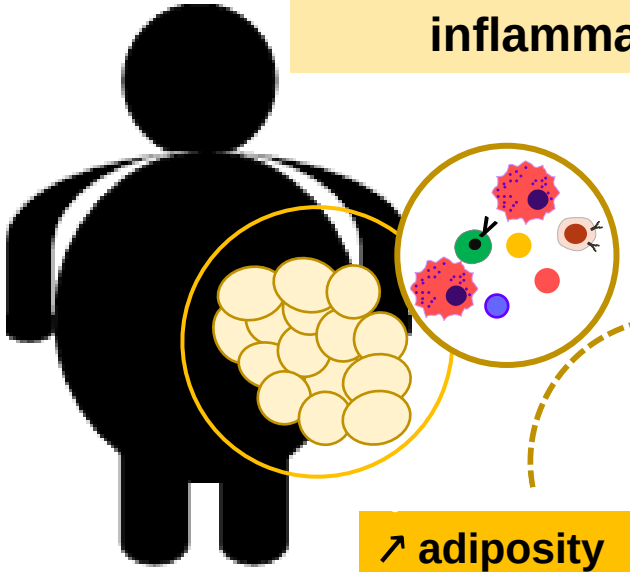
PATHOPHYSIOLOGY OF OBESITY

Energy expenditure

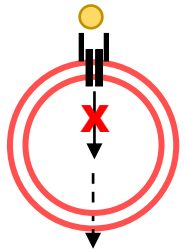
Energy intake

Energy imbalance

State of Chronic low-grade of inflammation



↗ **adiposity**



METABOLIC PROFILE

Insulin resistance

Systemic Insulin resistance

Metabolic comorbidities

T2D, NAFLD, dyslipidaemia, cardiovascular disease, etc

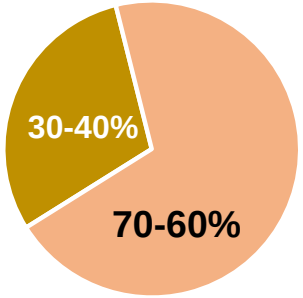
BMI: Kg/m²
(body mass index)

www.who.int
World Health Organization

Overweight: 25 ≥ BMI ≤ 30
Obesity: BMI ≥ 30

2. GUT MICROBIOTA & OBESITY

Genetic factors



Environmental factors

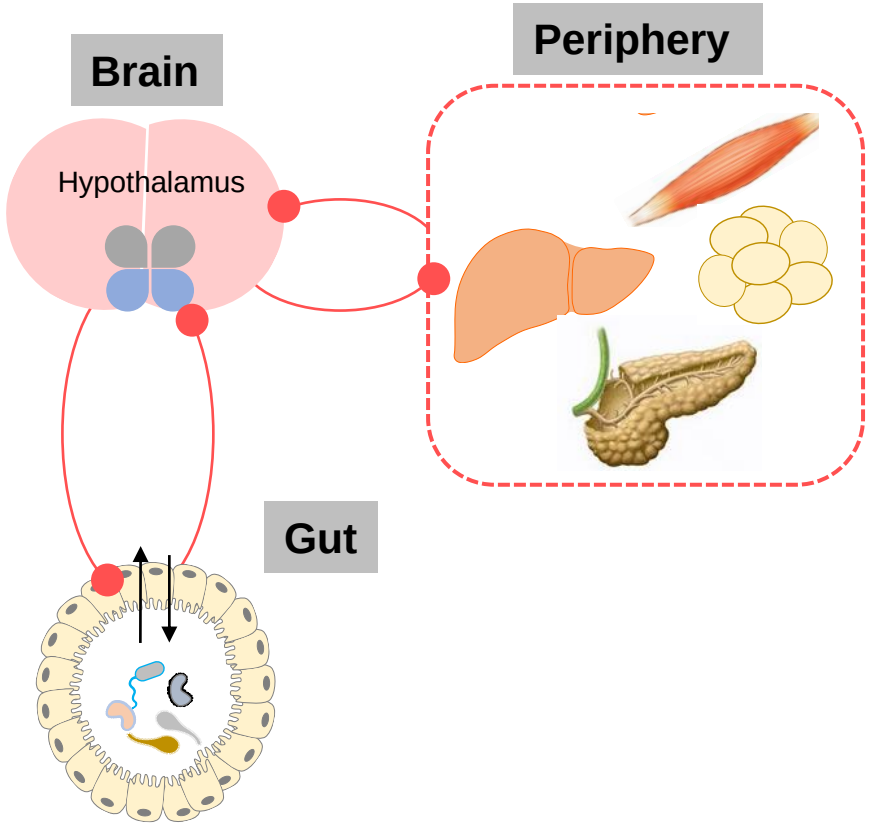
Sedentary life style

↘ satiety signals sensitivity

DIET: Energy-dense foods

Gut microbiota

Gut-brain-periphery axis



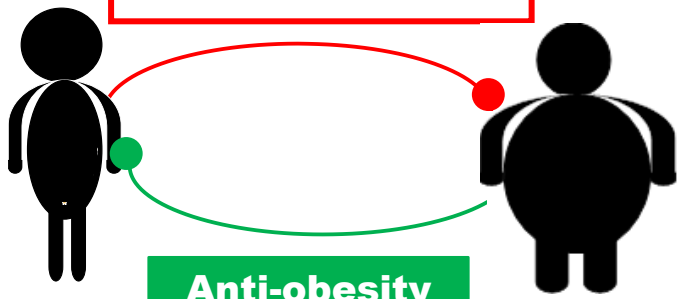
ENERGY IMBALANCE

Over-eating

↑ adiposity

Glucose intolerance

Insulin resistance



Anti-obesity interventions

ENERGY BALANCE

Restoration of gut-brain communication

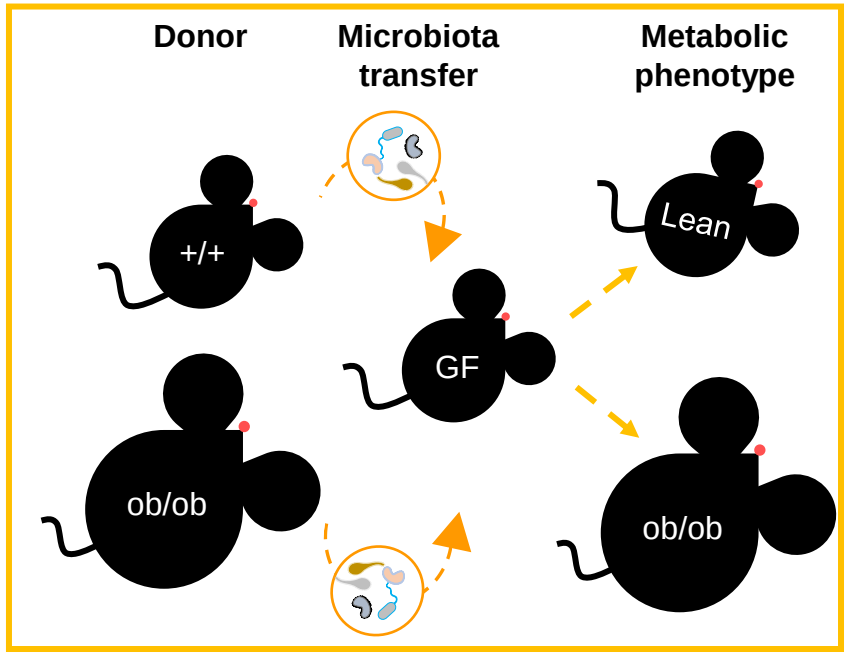
EUBIOSIS

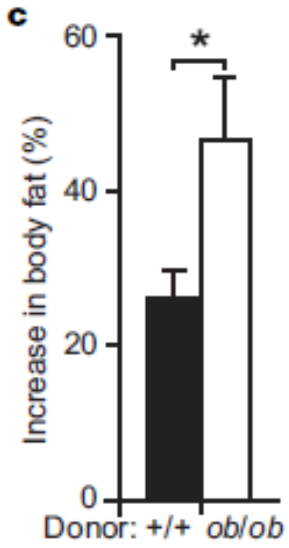
2. GUT MICROBIOTA & OBESITY

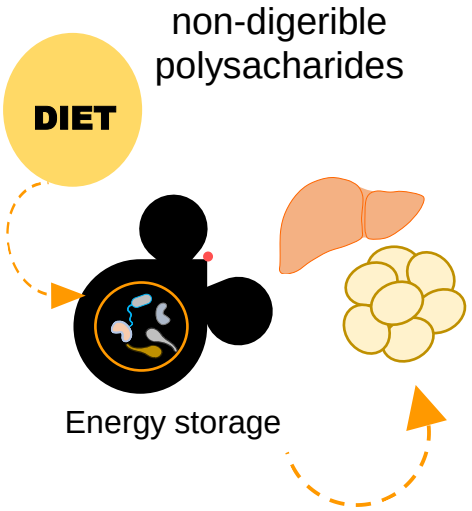
nature

An obesity-associated gut microbiome with increased capacity for energy harvest

Peter J. Turnbaugh[1], Ruth E. Ley[1], Michael A. Mahowald[1], Vincent Magrini[2], Elaine R. Mardis[1,2] & Jeffrey I. Gordon[1]







Gut microbial communities

↓

↑ Extraction and storage of energy from diet

↓

Individual predisposition to obesity

Gut microbiota is an enviromental factor of obesity

2. GUT MICROBIOTA & OBESITY

Science
AAAS

Gut Microbiota from Twins Discordant for Obesity Modulate Metabolism in Mice
Vanessa K. Ridaura *et al.*
Science **341**, (2013);
DOI: 10.1126/science.1241214

Discordant Twins

Lean

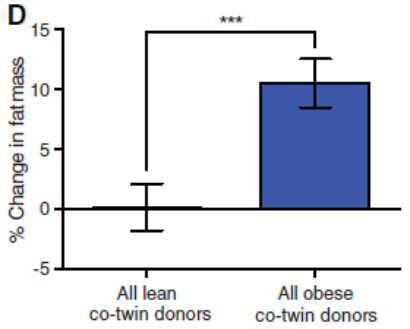
GF mice

Ln

Obese

GF mice

Ob



Cohousing

Ln

Ob

Ln

Bacteroidetes invasion

Microbiota invasion depends on microbiota-by-diet interaction

LoSF-HiFV ✓

HiSF-LoFV x

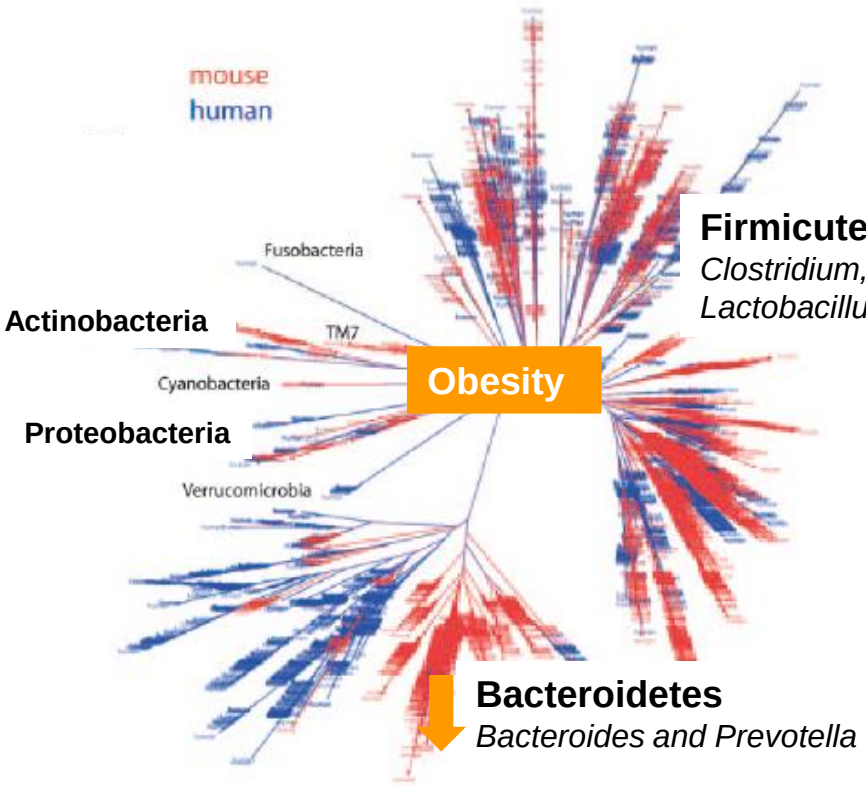
Gut microbiota invasion linked to leaness

2. GUT MICROBIOTA & OBESITY

Obesity alters gut microbial ecology

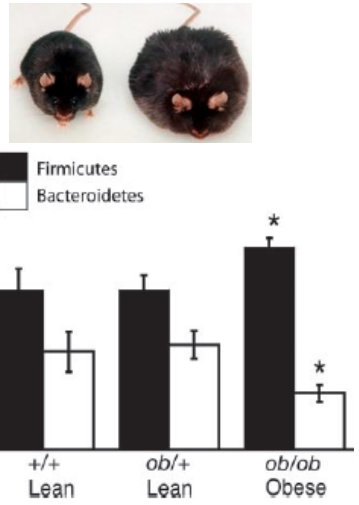
PNAS Free Full Text

Ruth E. Ley†, Fredrik Bäckhed†, Peter Turnbaugh†, Catherine A. Lozupone‡, Robin D. Knight§, and Jeffrey I. Gordon†¶



Firmicutes
Clostridium, Enterococcus, Lactobacillus and Ruminococcus

Bacteroidetes
Bacteroides and Prevotella

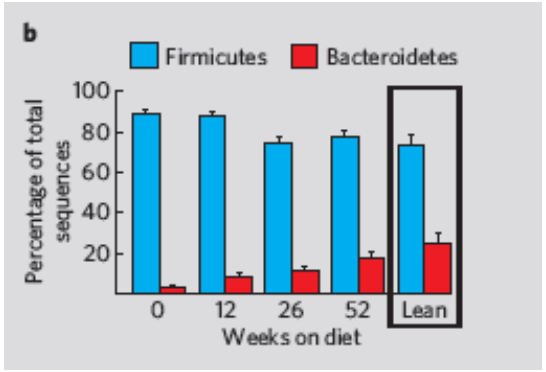


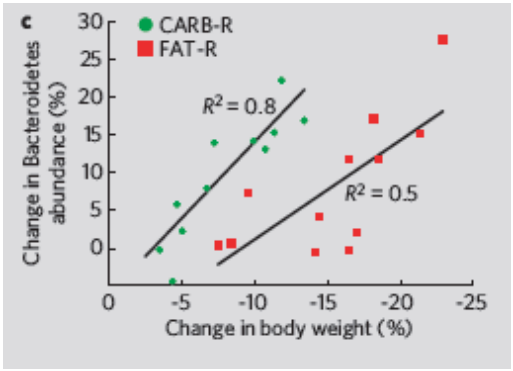
ob/ob 50% fewer Bacteroidetes

MICROBIAL ECOLOGY

Human gut microbes associated with obesity

Ley et al, Nature 2006





FAT-R, fat restricted
CARB-R, carbohydrate restricted

Manipulation of microbial community structure

MICROBIOME-BASED interventions for promoting metabolic health

PREBIOTICS

PROBIOTICS

FECAL TRANSFER

3. MICROBIOME-BASED INTERVENTIONS FOR PROMOTING METABOLIC HEALTH

Microbiome-based interventions

↓

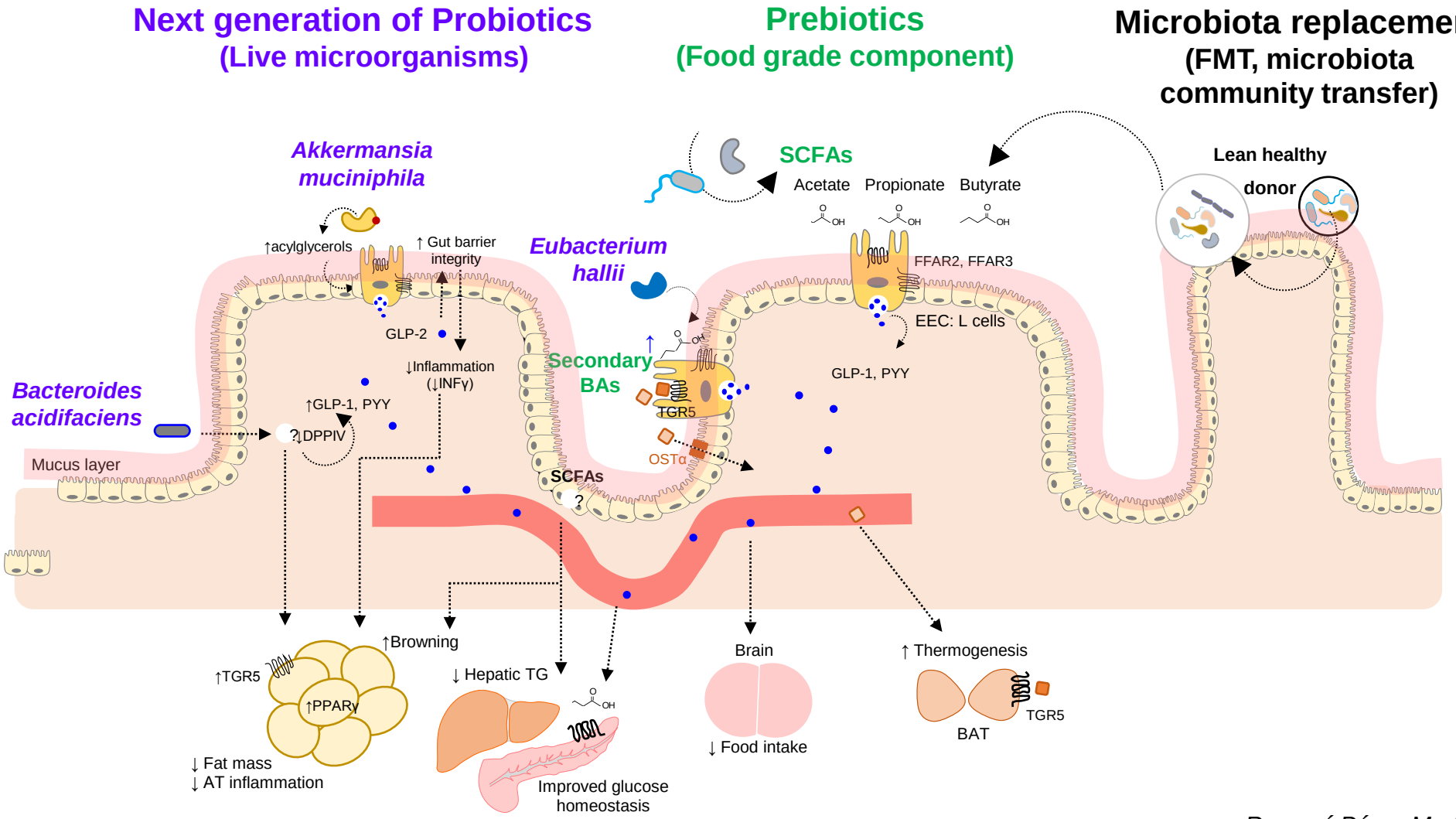
Alter composition/activity of host gut microbiota

↓

Health benefit

↓

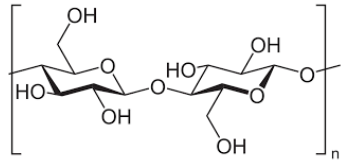
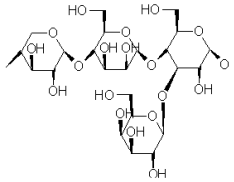
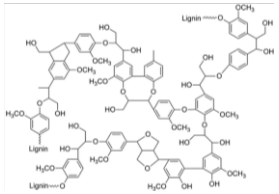
Metabolic Health

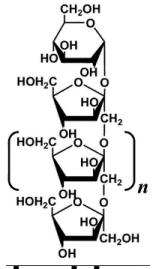
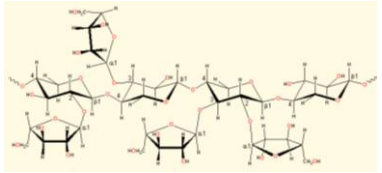
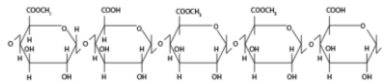


Romaní-Pérez M et al, 2017

3.1 PREBIOTICS

DIETARY FIBER: indigestible plant polysaccharides

NUTRIENT	Natural SOURCE
Water-insoluble dietary fibers	
Cellulose 	 Cereals  Fruit  Vegetables
Hemicellulose 	 Cereals  Bran  Legumes
Lignin 	 Cereals  Garden beans
Resistant starch	 Corn  Wheat  Barley

NUTRIENT	Natural SOURCE
Water-soluble dietary fibers	
Inulin  **Fructooligosaccharides (FOS)**	 Chicory root  Onion  Leek  Banana
Arabinoxylan (Hemicellulose)  Arabinoxylan oligosaccharides **(AXOS)**	bran ~70% endosperm ~88%  Cereals  Wheat **Non-starch polysaccharide (NSP)**
Pectin 	 Fruits  Corn falkes  Carrots

Food and Agriculture Organization of the United Nations

3.2 PROBIOTICS

Food and Agriculture Organization of the United Nations

World Health Organization

Guidelines for the Evaluation of Probiotics in Food

Strain identification

Functional characterization ↔ Safety assesment

in vitro & in vivo

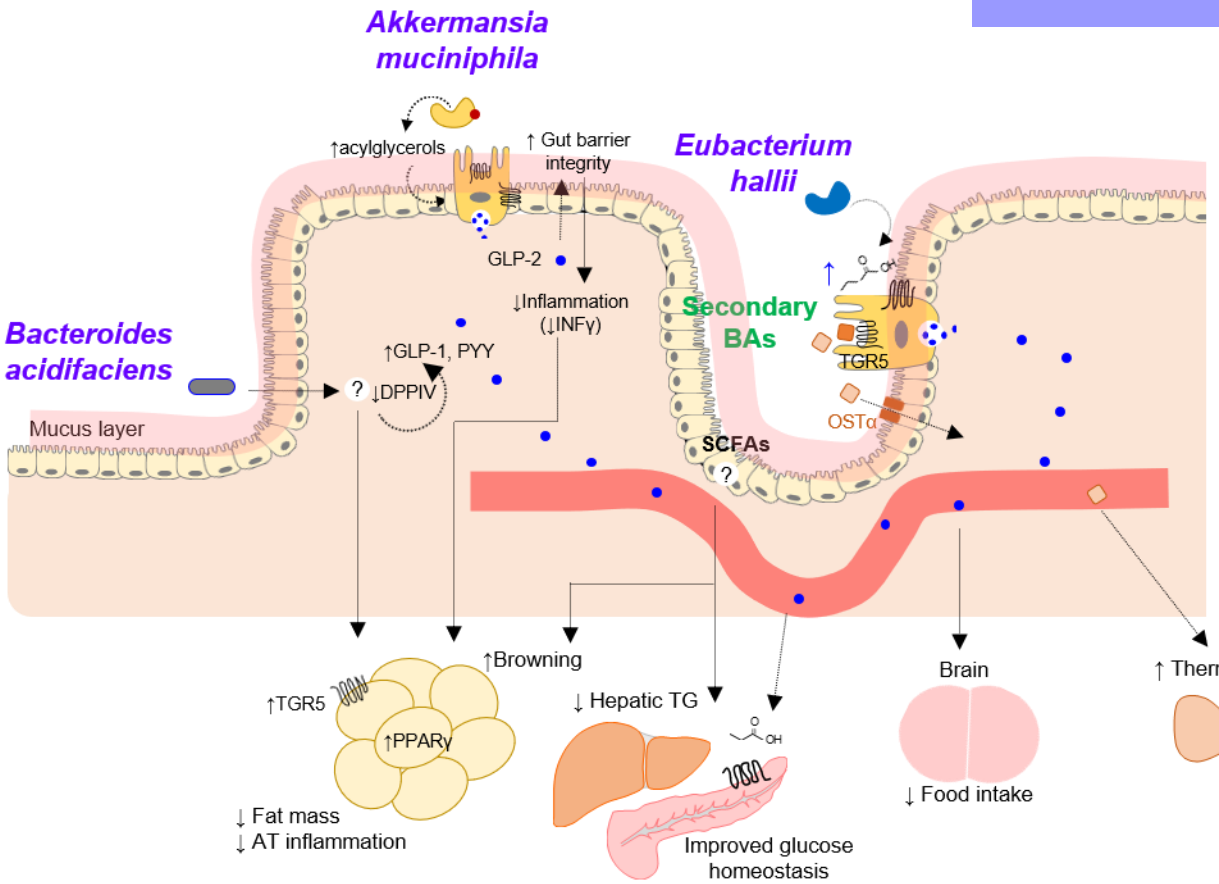
Efficacy
Phase 2 human trial (DBPC).
Probiotic vs placebo

Effectiveness
Phase 3 human trial
Probiotic vs standard treatment

Probiotic for FOOD

'Classical' probiotics

- Currently commercialized probiotics
- Lactic acid bacteria and bifidobacteria
- Biological samples or derived from fermented foods



Romaní-Pérez M et al, 2017

Next Generation of Probiotics (NGP)

Massive use of DNA sequencing in controlled (16S rRNA gene-based approach, whole-genome shotgun-based approach) **epidemiological studies**

NGP: Selected functionally distinct indigenous bacteria with potential higher efficacy of current probiotic formulation

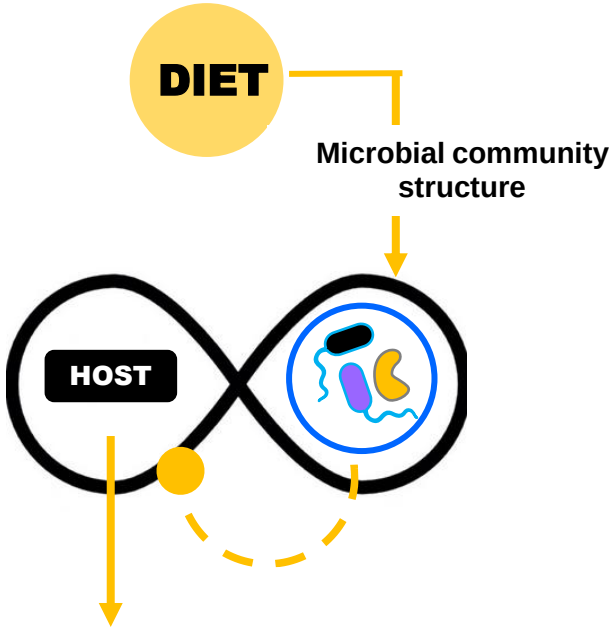
Evaluation of the administration of A. muciniphila on parameters of Metabolic Syndorme

ClinicalTrials.gov Identifier:
NCT02637115

Sponsor:
Patrice D. Cani

4. MICROBIOTA-BY-DIET INTERACTION. SCFAs

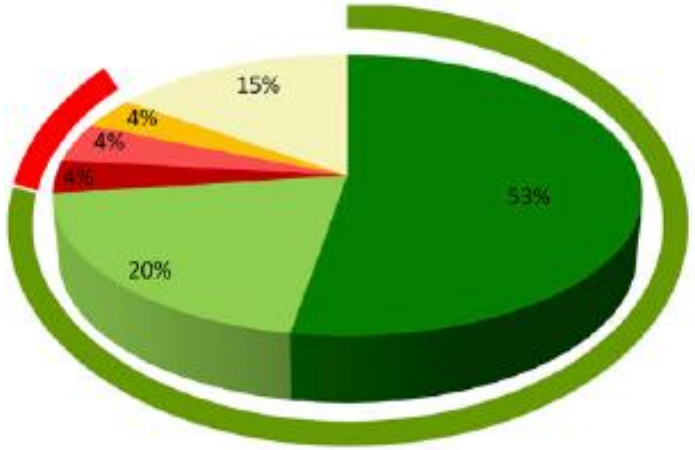
MICROBIOTA-BY-DIET INTERACTION

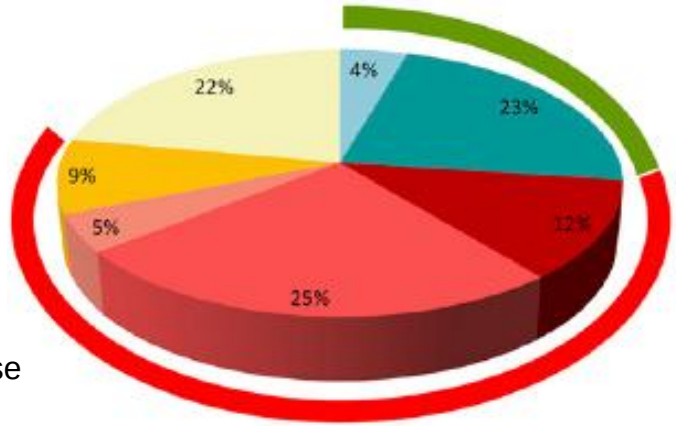


Different diets in human population

Burkina Faso children
DIET: high in FIBER and low in fat

European children
DIET: high in animal PROTEIN, SUGAR and FAT. Low in fiber





Whole grains
Dietary fiber
↓
Xylane, xylose, carboxymethylcellulose
↓
SCFA-producers

BF
- Prevotella
- Xylanibacter
- Bacteroidetes
- Acetitomaculum
- Faecalibacterium
- Subdoligranulum
- Firmicutes
- Others

EU
- Alistipes
- Bacteroides
- Bacteroidetes
- Acetitomaculum
- Faecalibacterium
- Roseburia
- Subdoligranulum
- Firmicutes
- Others

SCFA-producers → Pathogen intestinal microbes
SCFA-producers → Benefits to metabolic health

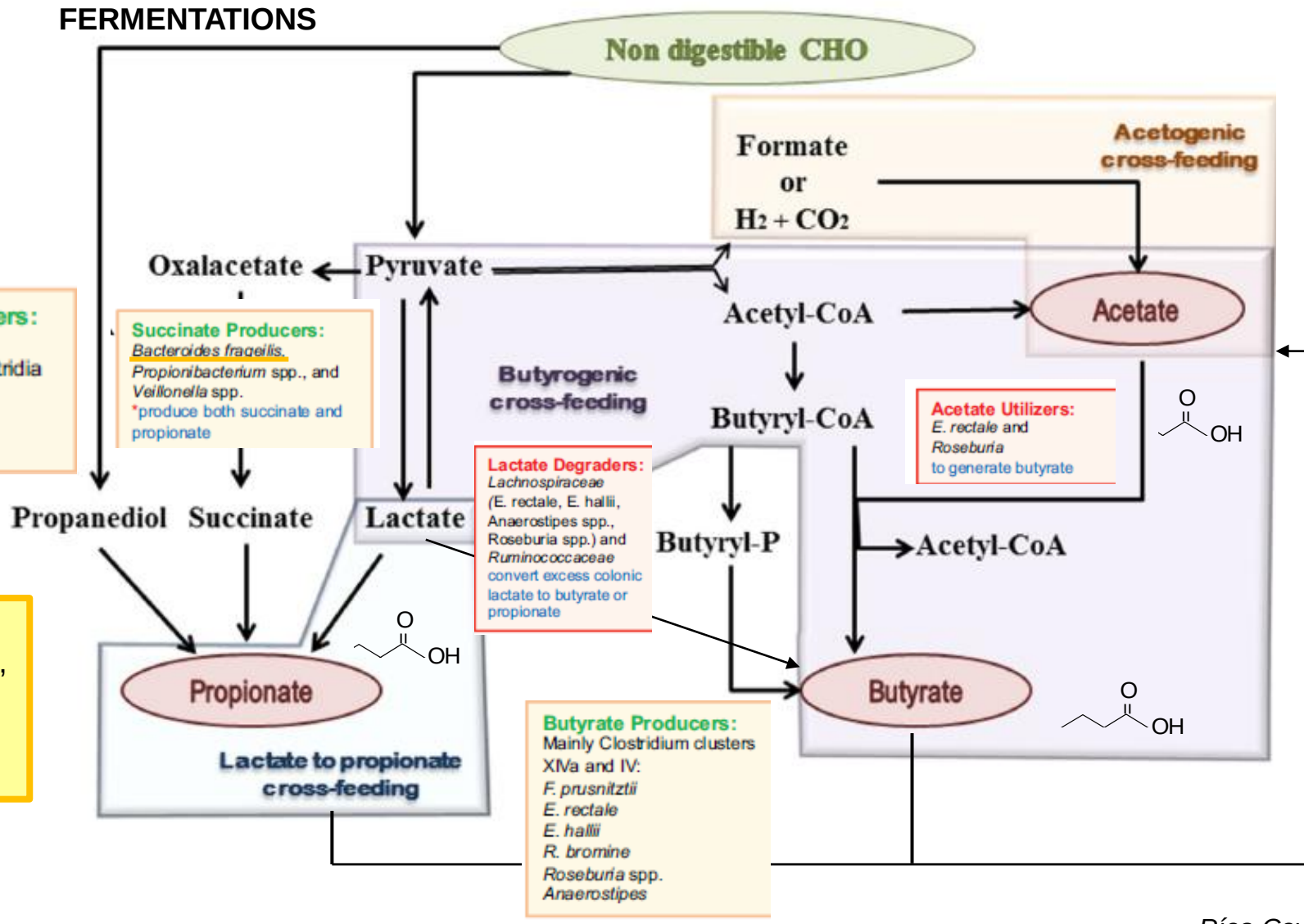
De Filippo et al, PNAS 2010

4. MICROBIOTA-BY-DIET INTERACTION. SCFAs

DIETARY FIBER

Gut microbiota metabolic routes

SHORT CHAIN FATTY ACIDS



Acetate Producers:
Many members of gut microbiota
Majority of Firmicutes phylum
Bacteroides (*B. thetaiotaomicron*)
Proteobacteria (*Desulfovibrio pigler*)
Ruminococci**
Bifidobacteria
Clostridia
Eubacteria
Fusobacteria
Peptococci
Peptostreptococci
Propionibacteria
Veillonella

Propionate Producers:
Mainly Bacteroidetes*
(Bacteriodes) and Clostridia
(*Clostridium* cluster IX)
Propionibacteria*
Veilonella*

Succinate Producers:
Bacteroides fragelis,
Propionibacterium spp., and
Veillonella spp.
*produce both succinate and propionate

Lactate Degraders:
Lachnospiraceae
(E. rectale, E. hallii,
Anaerostipes spp.,
Roseburia spp.) and
Ruminococcaceae
convert excess colonic lactate to butyrate or propionate

Acetate Utilizers:
E. rectale and
Roseburia
to generate butyrate

Bacteroides
Resistant starchs (1, 4), arabynoxylans, pectin, inulin, FOS, mucin, mucopolysaccharides

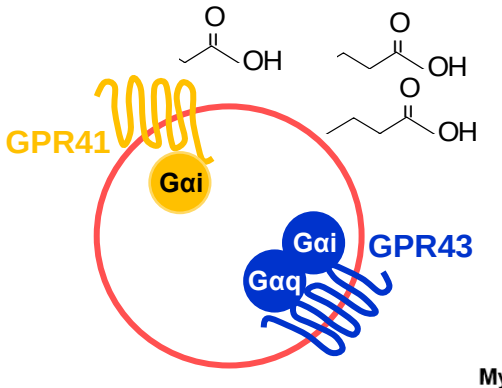
Butyrate Producers:
Mainly Clostridium clusters XIVa and IV:
F. prusnitztii
E. rectale
E. hallii
R. bromine
Roseburia spp.
Anaerostipes

Butyrate Degraders:
Sulfate- or nitrate- reducing acetogenic bacteria
Acetobacterium, Acetogenium, Eubacterium and *Clostridium* species
degrade butyrate and propionate into acetate

Ríos-Covián et al, 2016 & Basson et al, 2016

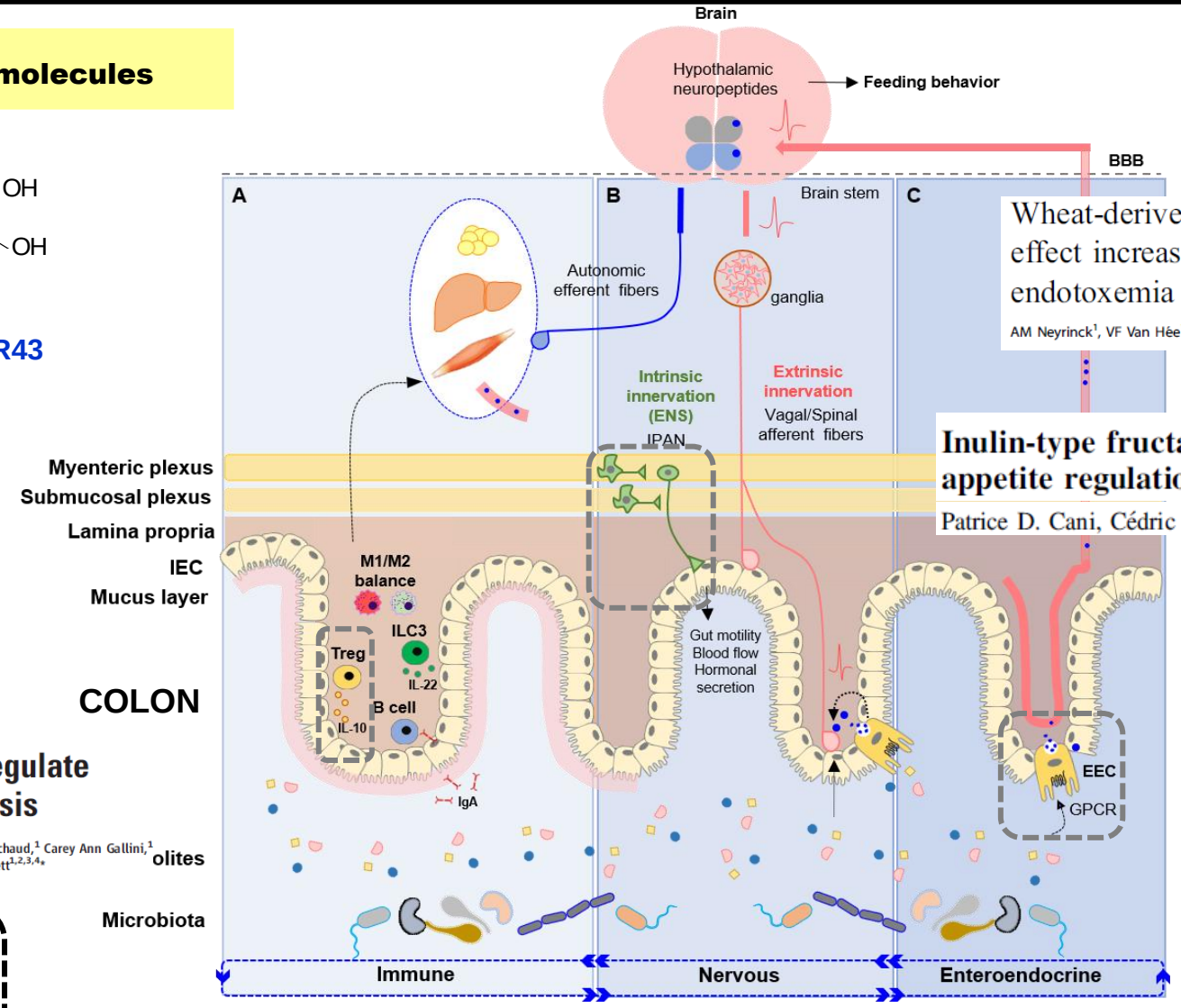
5. GUT MICROBIOTA-HOST COMMUNICATION

SCFAs: biactive molecules



Cellular response

- Enteroendocrine cells
- Neurons
- Inmmune cells



COLON

The Microbial Metabolites, Short-Chain Fatty Acids, Regulate Colonic T_{reg} Cell Homeostasis

Patrick M. Smith,[1] Michael R. Howitt,[1] Nicolai Panikov,[1] Monia Michaud,[1] Carey Ann Gallini,[1] Mohammad Bohlooly-Y,[5] Jonathan N. Glickman,[6,7] Wendy S. Garrett[1,2,3,4,*]

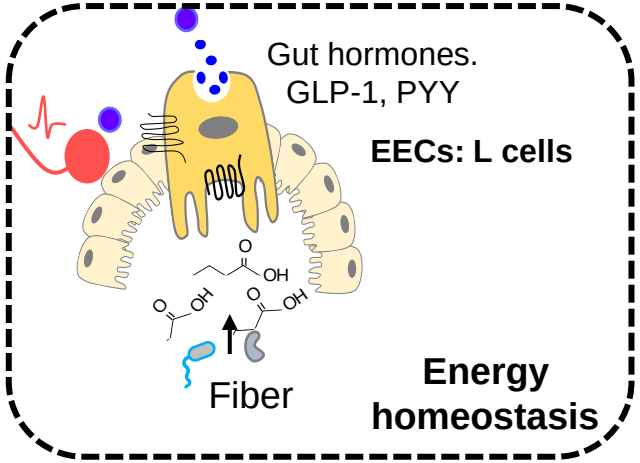
olites

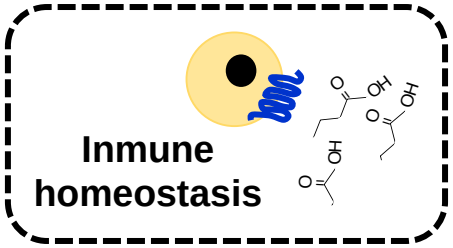
Wheat-derived arabinoxylan oligosaccharides with prebiotic effect increase satietogenic gut peptides and reduce metabolic endotoxemia in diet-induced obese mice

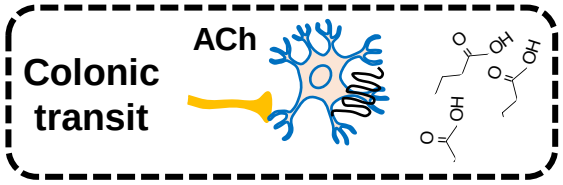
AM Neyrinck[1], VF Van Hée[1], N Piront[2], F De Backer[1], O Toussaint[2], PD Cani[1] and NM Delzenne[1]

Inulin-type fructans modulate gastrointestinal peptides involved in appetite regulation (glucagon-like peptide-1 and ghrelin) in rats*

Patrice D. Cani, Cédric Dewever and Nathalie M. Delzenne†







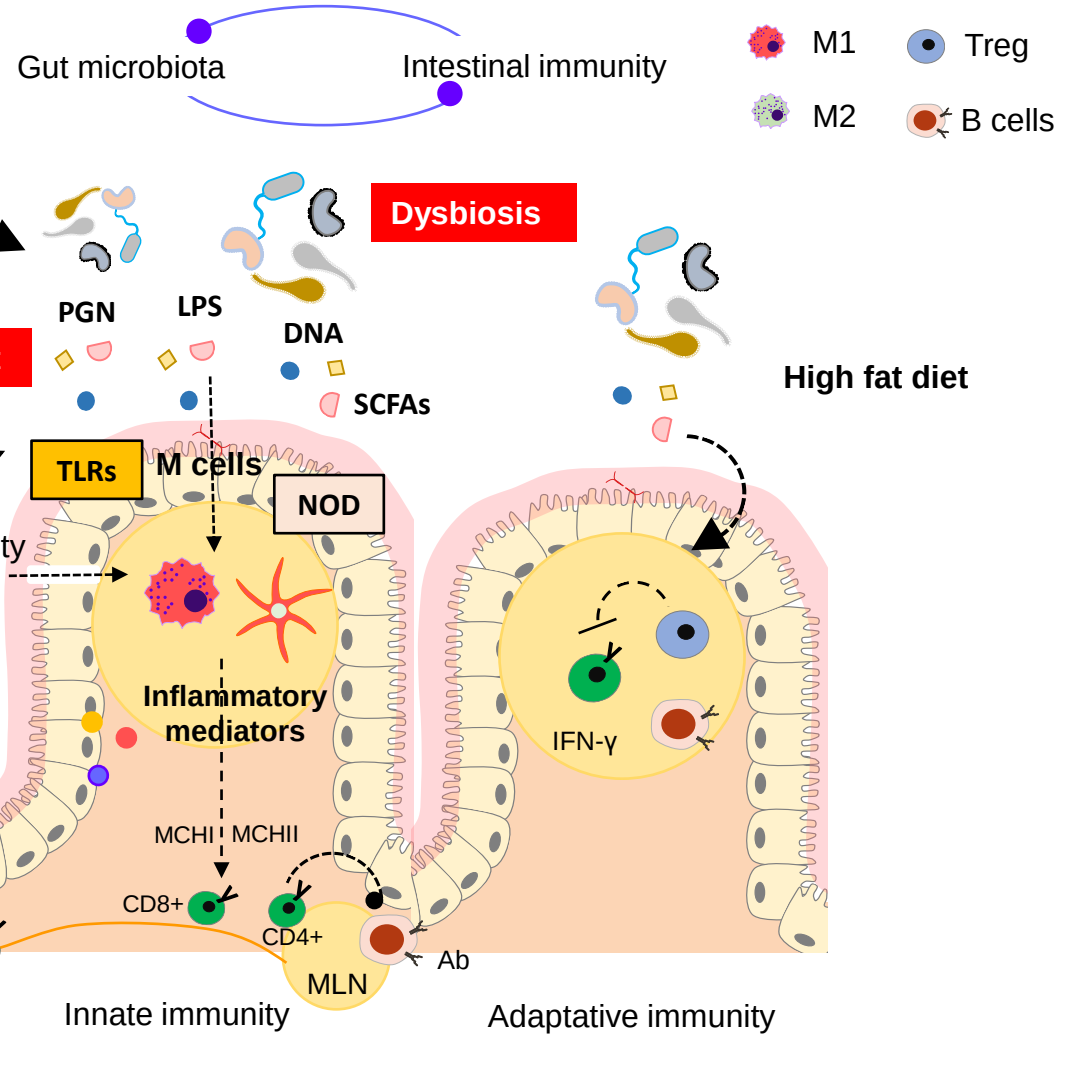
GASTROENTEROLOGY 2010;138:1772–1782

Short-Chain Fatty Acids Regulate the Enteric Neurons and Control Gastrointestinal Motility in Rats

RODOLPHE SORET,*,‡,§,‖ JULIEN CHEVALIER,*,‡,§,‖ PIERRE DE COPPET,‡,§,‖,¶ GUILLAUME POUPEAU,‡,§,‖,¶ PASCAL DERKINDEREN,*,‡,§,‖ JEAN PIERRE SEGAIN,‡,§,‖,¶ and MICHEL NEUNLIST*,‡,§,‖

5. GUT MICROBIOTA-HOST COMMUNICATION IMMUNOMODULATION

Obesity→ State of Chronic low-grade of inflammation



Wire et al. Cell Metabolism 2016

6. GROUP OF MICROBIAL ECOLOGY, NUTRITION AND HEALTH.
'On the way to evaluate new probiotics'

Evaluation of probiotics for food

Strain identification

Functional characterization ↔ Safety assesment

in vitro & in vivo

↓

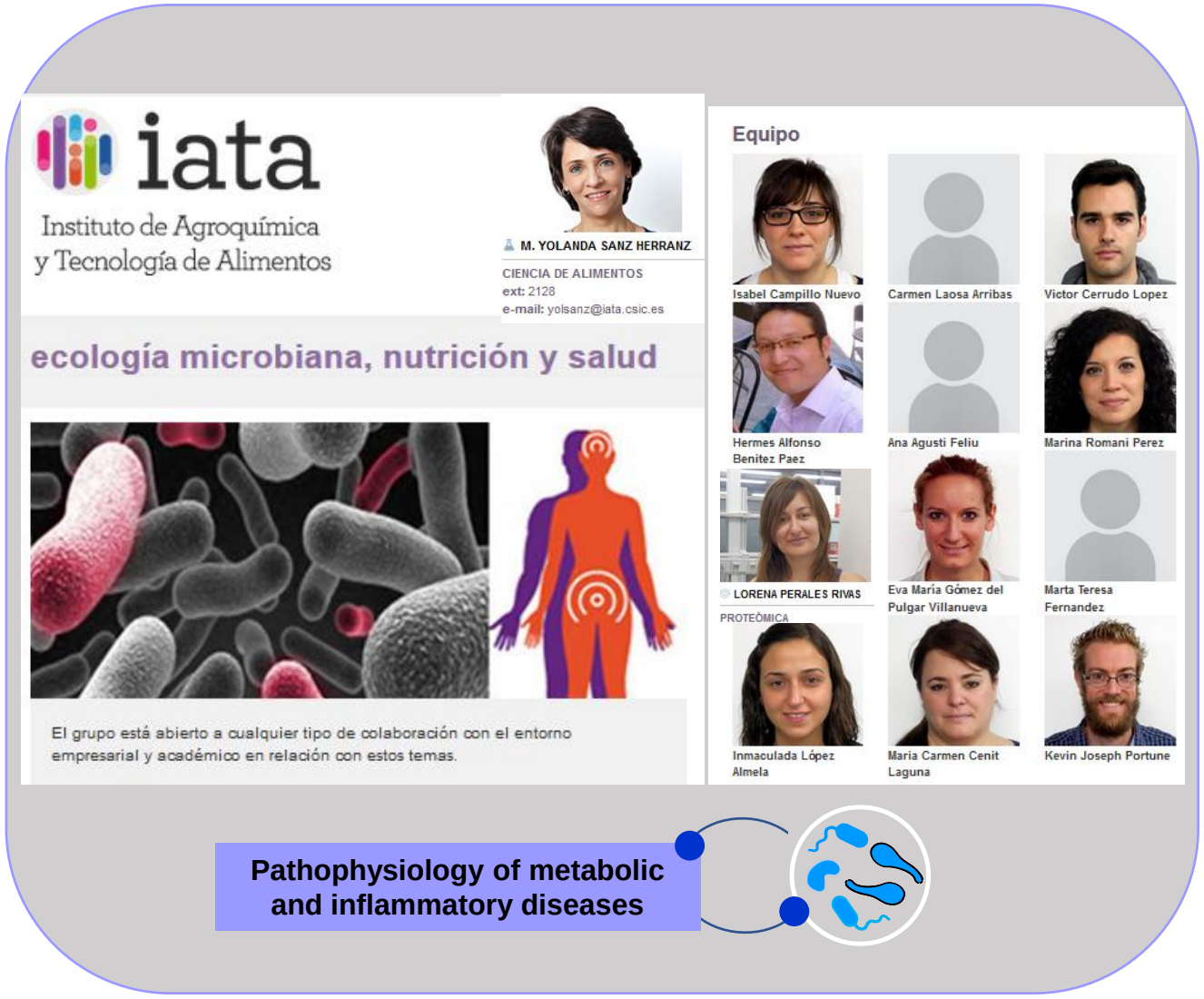
Phase 2 human trial (DBPC)
Probiotic vs placebo

↓

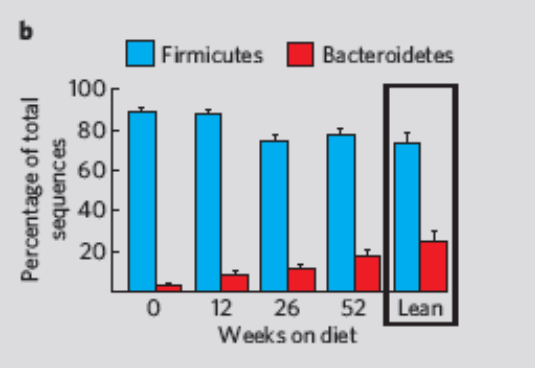
Phase 3 human trial
Probiotic vs standard treatment

↓

Probiotic for FOOD

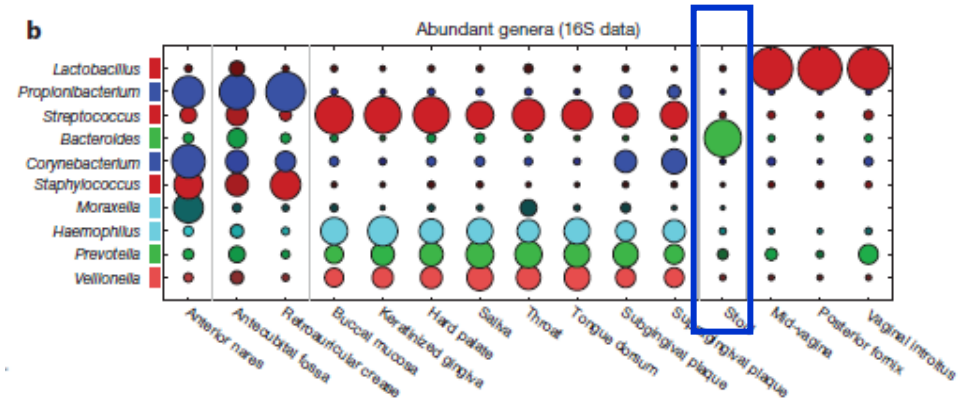


6.1 'On the way to evaluate new probiotics' *in vitro* functional characterization of *Bacteroides uniformis* CECT 7771



Bacteroides-Prevotella
Bacteroides fragilis

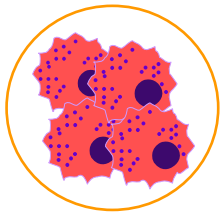
Anti-obesity effects



Strain identification

- Higher abundance in breast-fed than in formula-fed infants.
- ***B. uniformis* CECT 7771** isolated from stools of healthy breast-fed infants

In vitro Functional characterization



Macrophages

Different strains of *Bacteroides*

Table 2. Effect of different *Bacteroides* strains on cytokine production by RAW264.7 macrophages.

Bacteroides strains	Cytokine production	
	TNF-α (pg/ml)	IL-10 (pg/ml)
DEMEN	491.2(112.1)$^{a,\ b'}$	97.2(10.8)$^{a,a'}$
LPS	1425.4(77.6)$^{b,\ a'}$	162.3(37.6)$^{a,a'}$
B. dorei SS1	3765.5(150.0)$^{b,b',a''}$	215.8(12.5)$^{b,a',b''}$
B. ovatus SU2	4515.7(211.3)$^{b,b',b''}$	271.5(8.1)$^{b,b',b''}$
B. distasonis CAY3	4462.4(173.9)$^{b,b',b*}$	215.8(9.7)$^{b,a',b''}$
B. uniformis CECT 7771	2998.4(50.4)$^{b,b',a''}$ ↓	341.3(13.5)$^{b,b',a''}$ ↑
B. thetaiotaomicron SAC4	2931.2(464.5)$^{b,b',a''}$	109.2(3.0)$^{a,a',b''}$
B. fragilis SX3	6657.3(278.3)$^{b,b',b*}$	81.2(14.6)$^{a,a',b''}$
B. caccae SV3	11622.0(818.3)$^{b,b',b''}$	171.7(12.9)$^{b,a',b''}$
B. finegoldii SX2	6535.8(62.2)$^{b,b',b''}$	83.5(17.4)$^{a,a',b''}$

Gauffin et al. PLoS One. 2012

6.1 'On the way to evaluate new probiotics' *in vivo* functional characterization of *Bacteroides uniformis* CECT 7771

In vivo Functional characterization of Bacteroides uniformis CE T 7771

DIET INDUCED OBESITY (DIO)

DIET	PROTEINS (% of Kcal)	CH (% of Kcal)	FAT (% of Kcal)	FRUCTOSE (% of Kcal)
SD	23	64	13 (corn oil)	0
HFHFD	18	34	48 (palm oil)	20

Placebo (10% skimmed milk)

B. uniformis CECT 7771 (1X10^{9}CFU)

Placebo (10% skimmed milk)

B. uniformis CECT 7771 (1X10^{9}CFU)

weeks

10 — **OGTT**

14 — **IMMUNOMETABOLIC PARAMETERS**

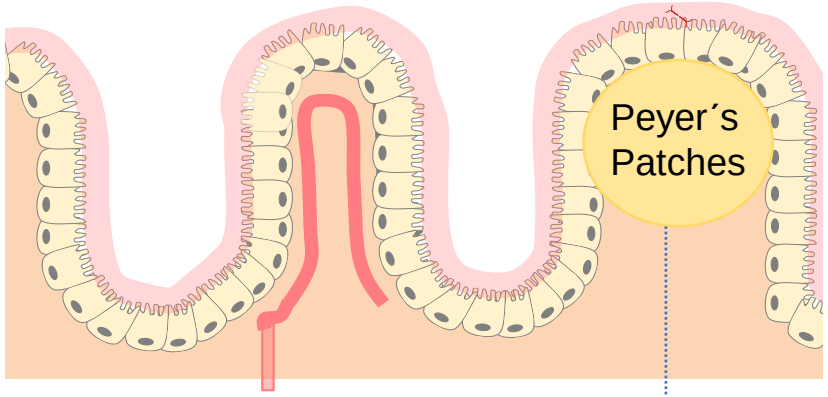
SD-Standard Diet

HFHFD-High Fat High Fructose diet

IMMUNOMETABOLIC PARAMETERS


Emanuel Fabersani


Isabel Campillo Nuevo

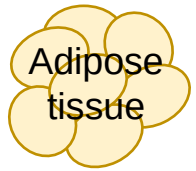


Fecal samples

Gut microbiota

Blood

Triglycerides
Cholesterol
Glucose
Leptin



Lympoid cells: B cells and T cells

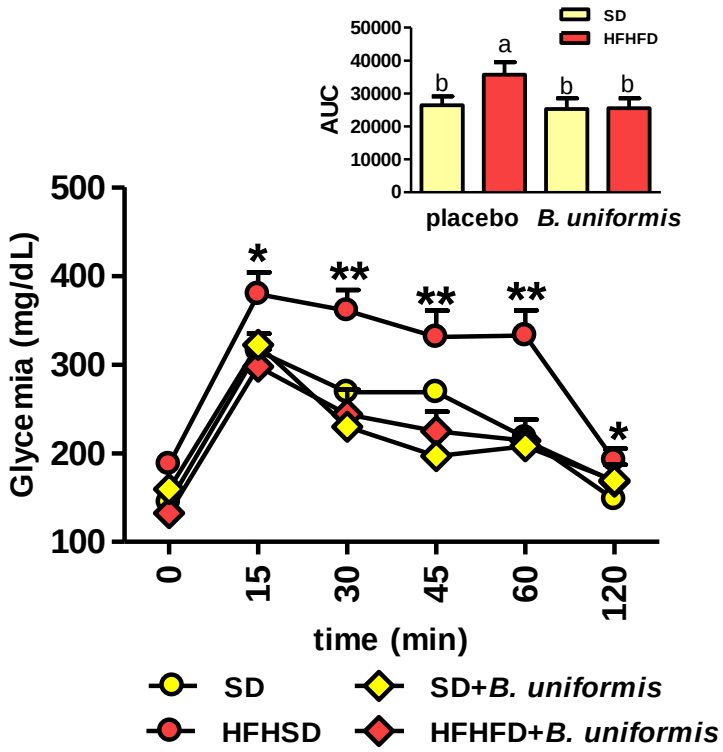
Myeloid cells: macrophages

Cytokines

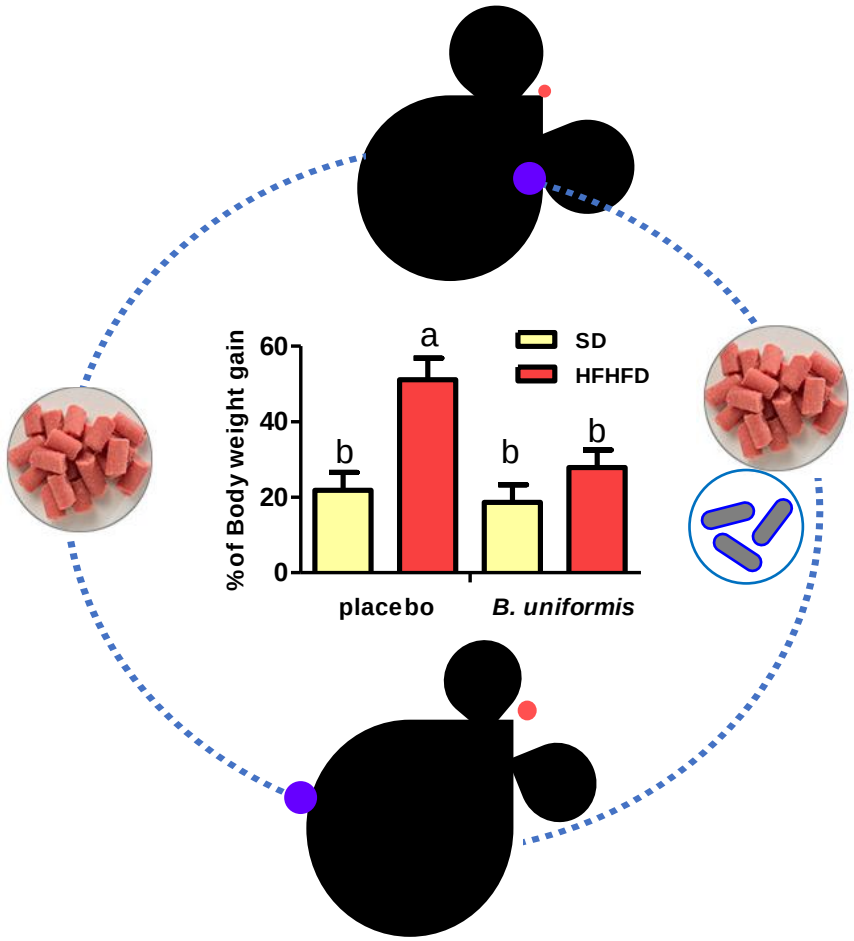
6.1 'On the way to evaluate new probiotics'
in vivo functional characterization of *Bacteroides uniformis* CECT 7771

METABOLIC PHENOTYPE

Oral glucose intolerance

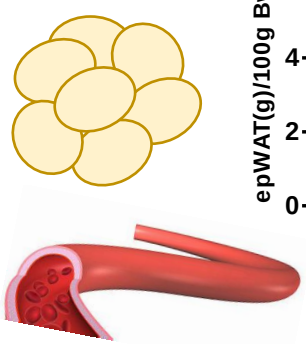


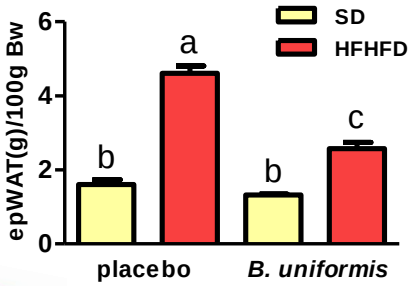
Lean phenotype



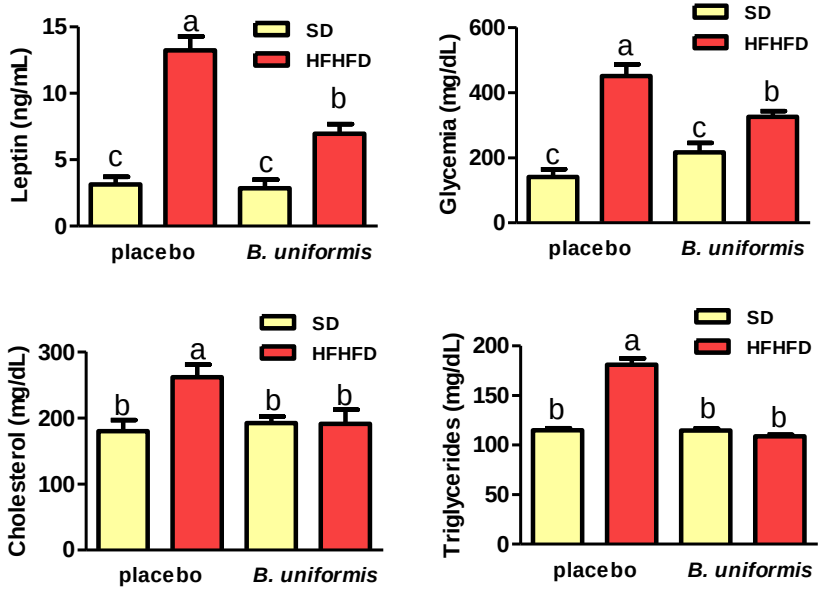
Obese phenotype

Adipose tissue





Hyperleptinemia, hyperglycemia, hypercholesterolemia, hypertriglyceridemia

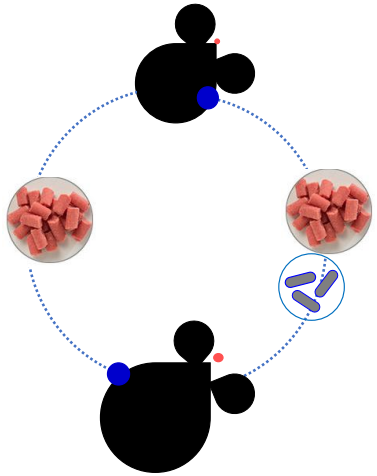


6.1 'On the way to evaluate new probiotics' *in vivo* functional characterization of *Bacteroides uniformis* CECT 7771

Mechanistic understanding of how *B. uniformis* promote anti-obesity effects

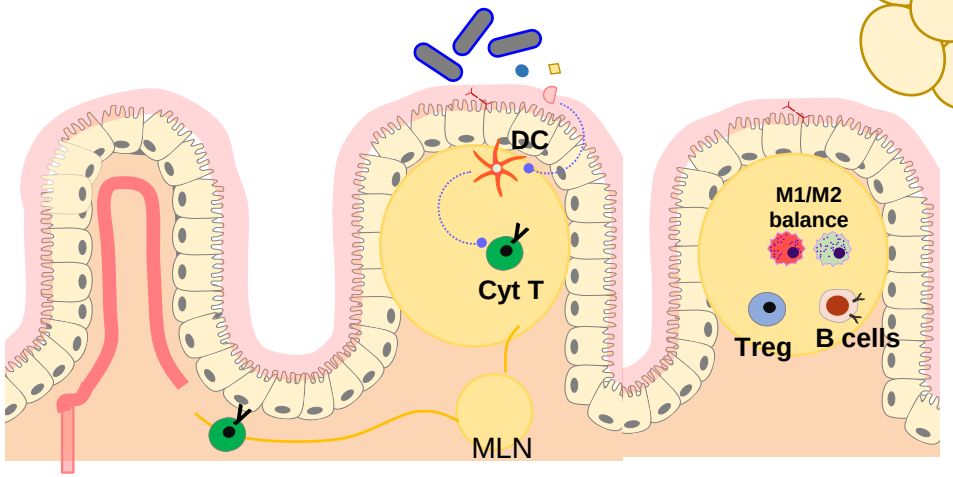
Lean phenotype

ANTIINFLAMMATORY RESPONSE

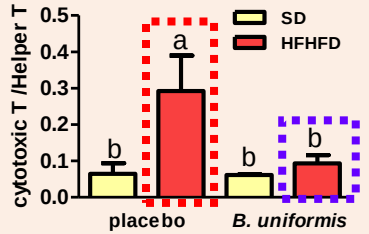


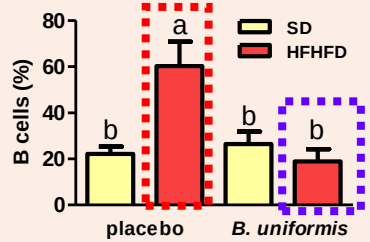
Obese phenotype

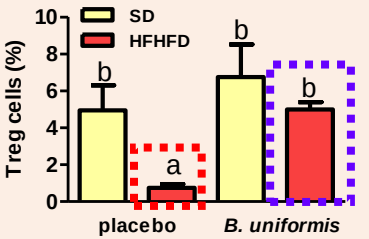
PROINFLAMMATORY STATE



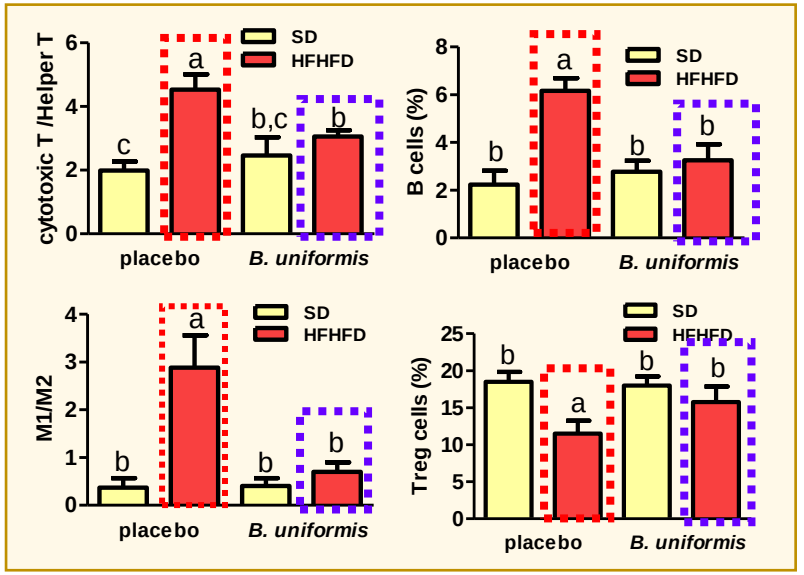
Blood



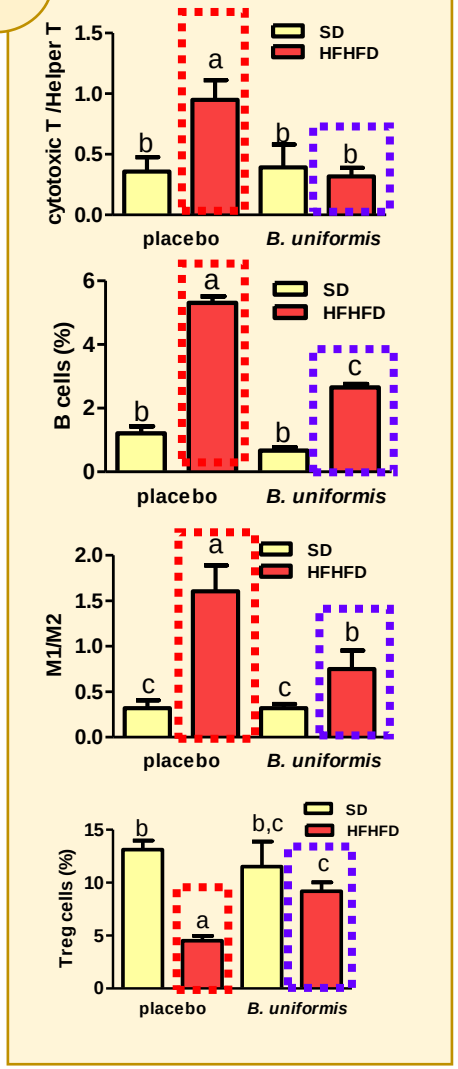




Peyer´s Patches



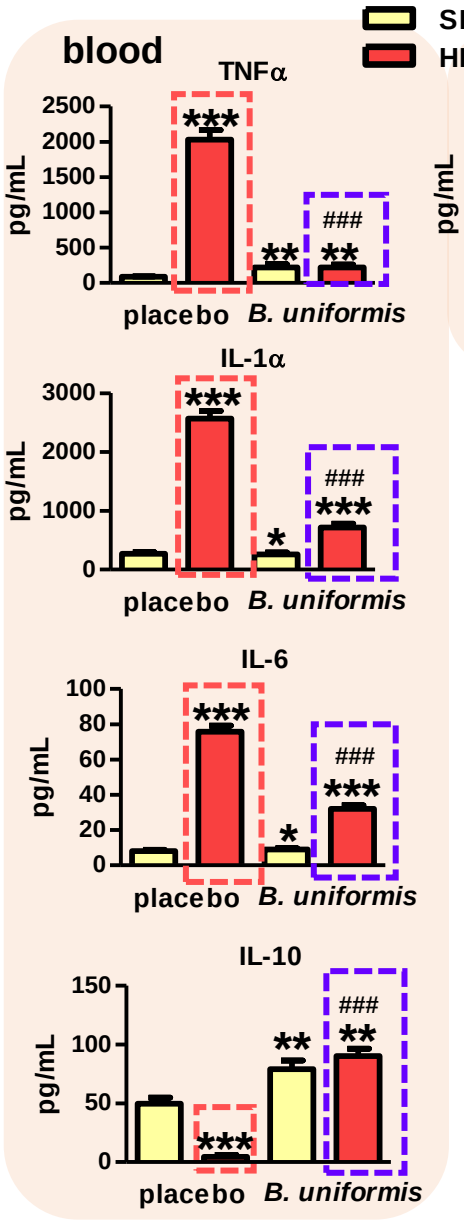
Adipose tissue

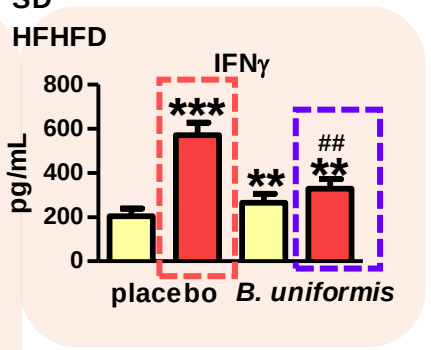


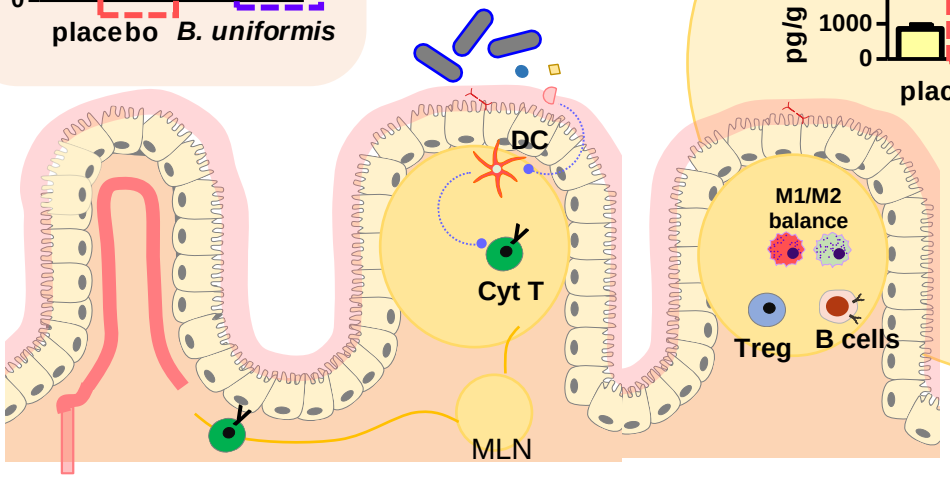
Dendritic cells (DC)
Cytotoxic T cell (cyt T)
regulatory T cells (Treg)

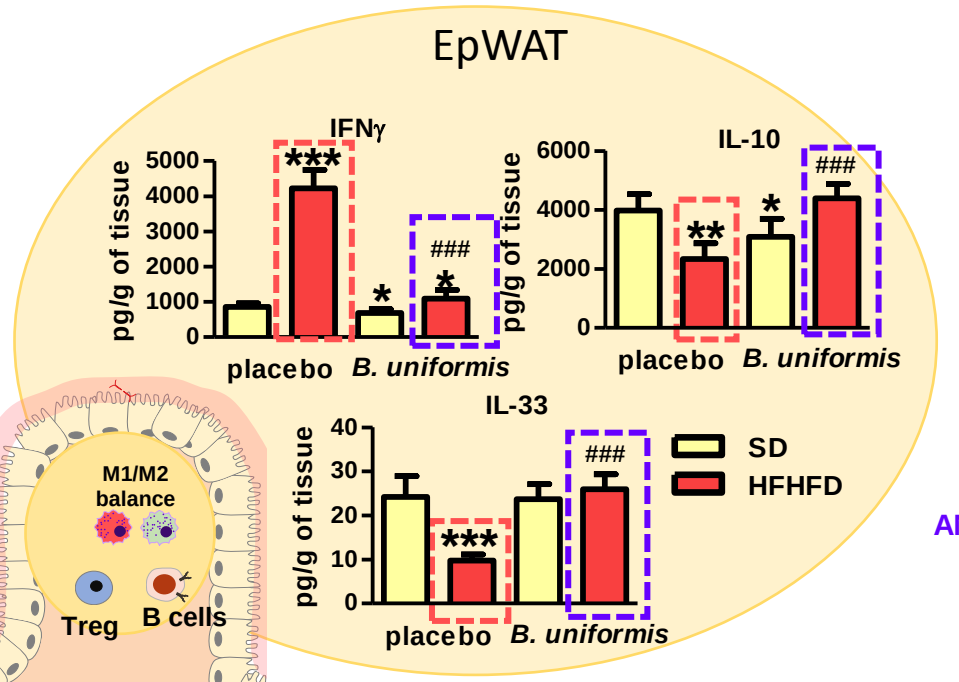
6.1 'On the way to evaluate new probiotics' *in vivo* functional characterization of *Bacteroides uniformis* CECT 7771

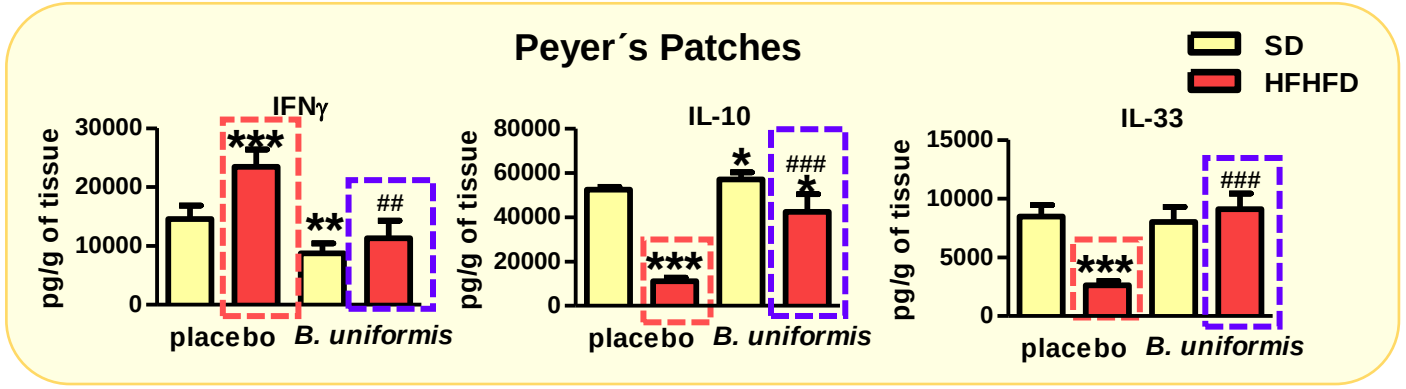
iata Instituto de Agroquímica y Tecnología de Alimentos — CSIC Consejo Superior de Investigaciones Científicas



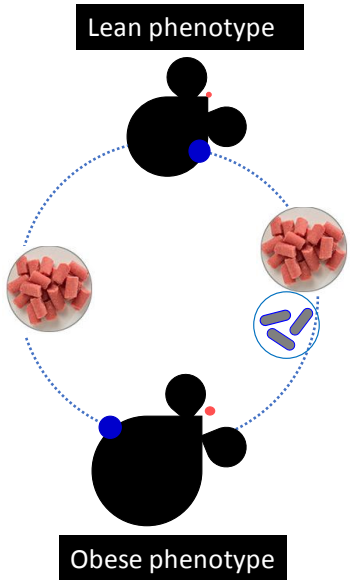








ANTIINFLAMMATORY STATE



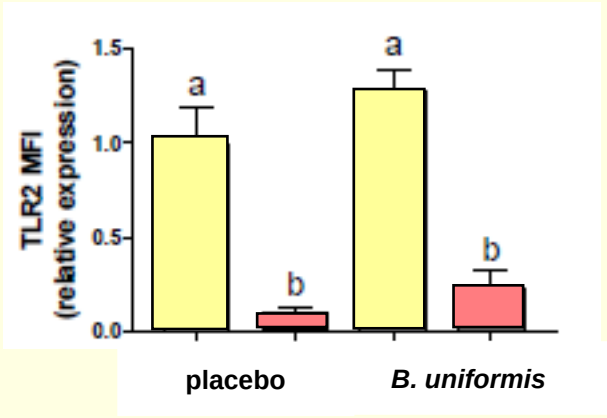
PROINFLAMMATORY STATE

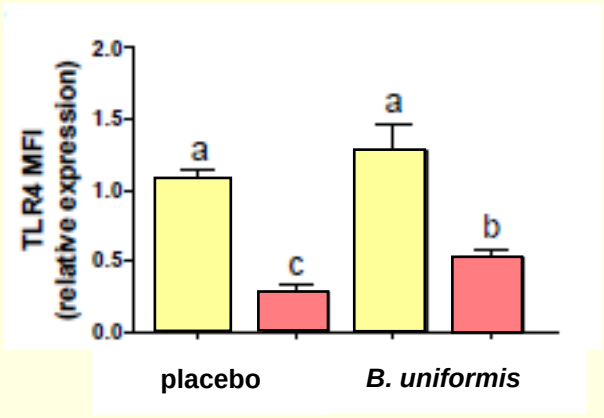
6.1 'On the way to evaluate new probiotics'
in vivo functional characterization of *Bacteroides uniformis* CECT 7771

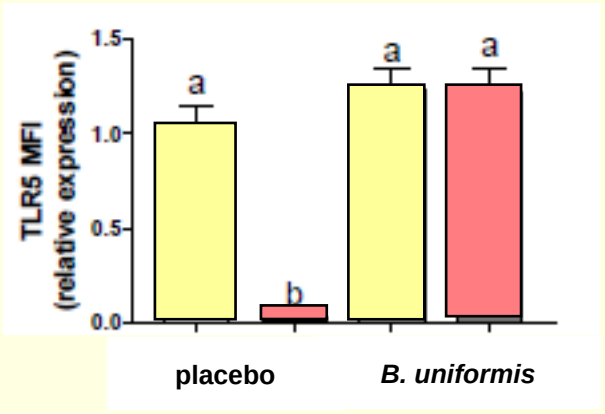
TLRs

ileum

Peyer´s Patches

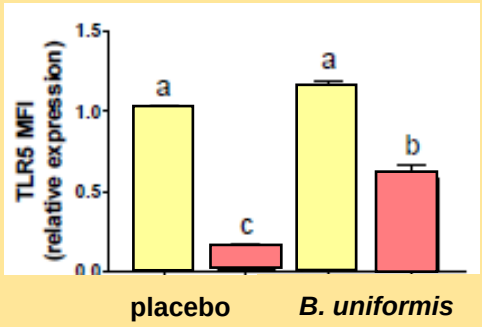




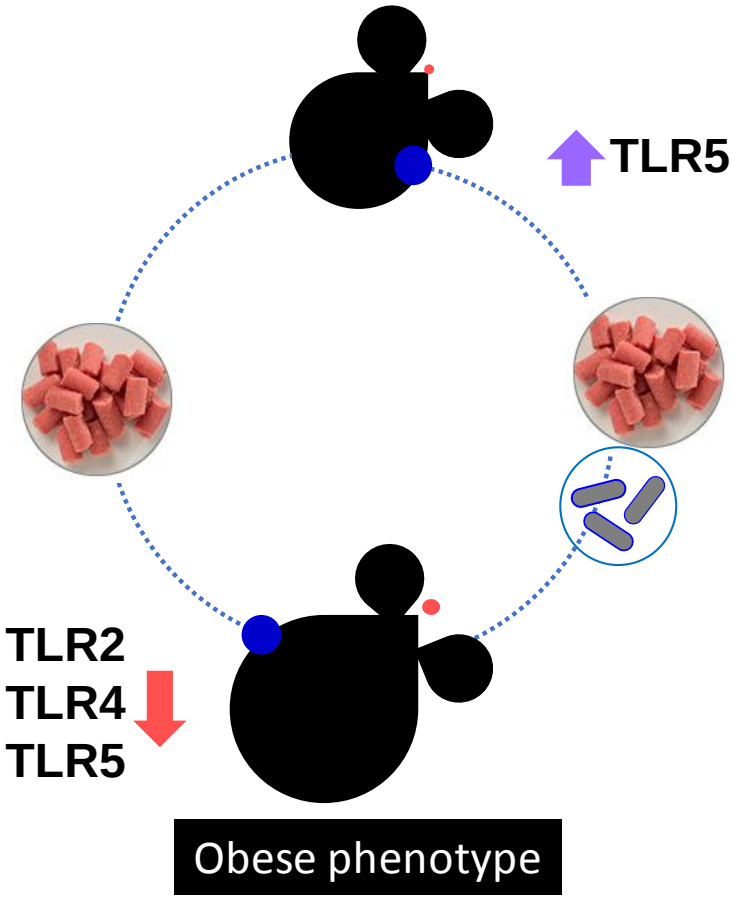


SD
HFHFD

Adipose tissue



Lean phenotype



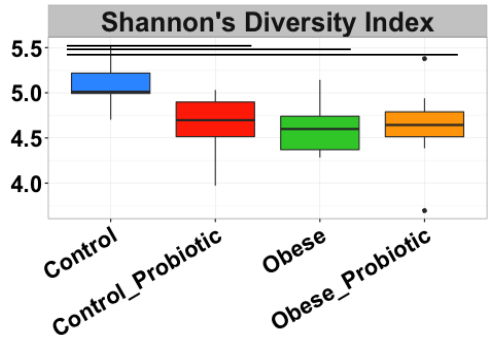
Obese phenotype

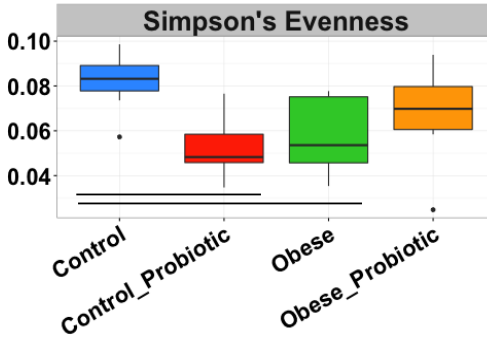
6.1 'On the way to evaluate new probiotics' *in vivo* functional characterization of *Bacteroides uniformis* CECT 7771

Kevin Joseph Portune

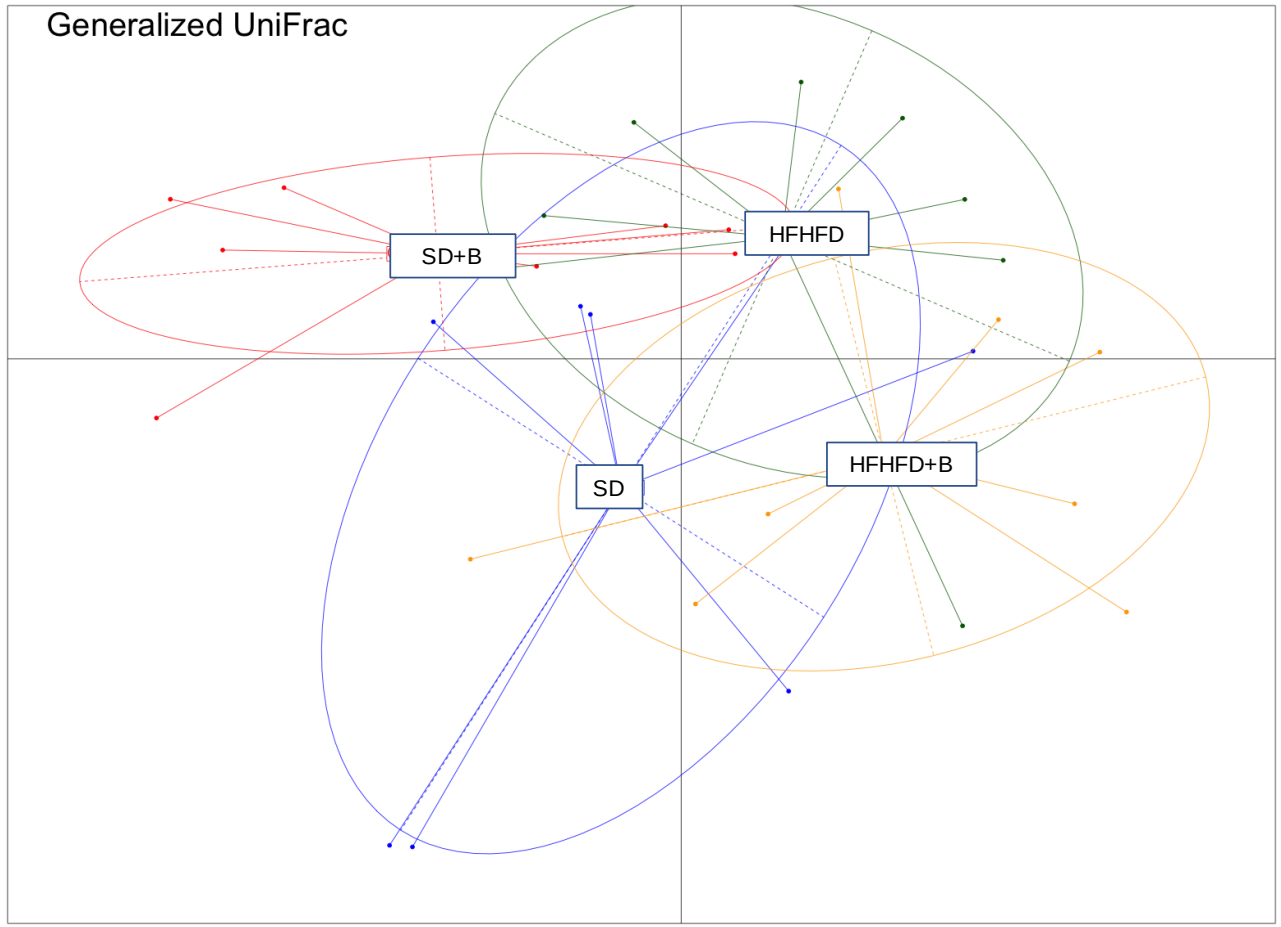
Gut microbiota

ALPHA DIVERSITY

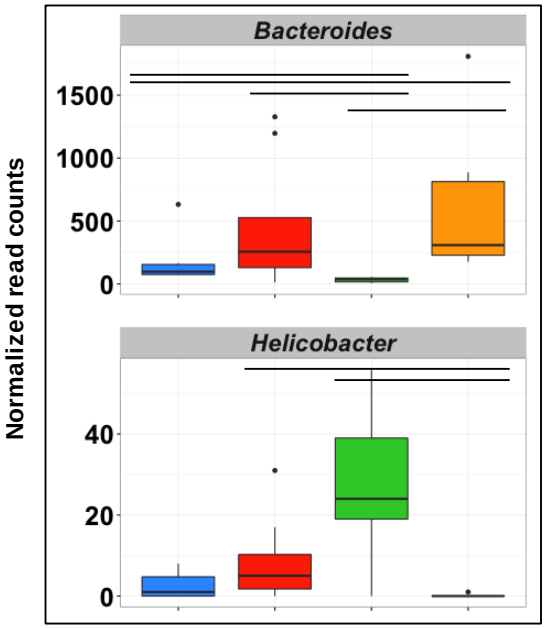


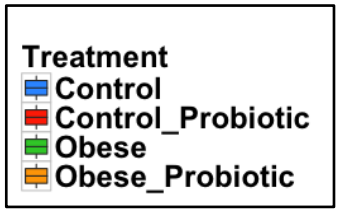


BETA DIVERSITY



Genera



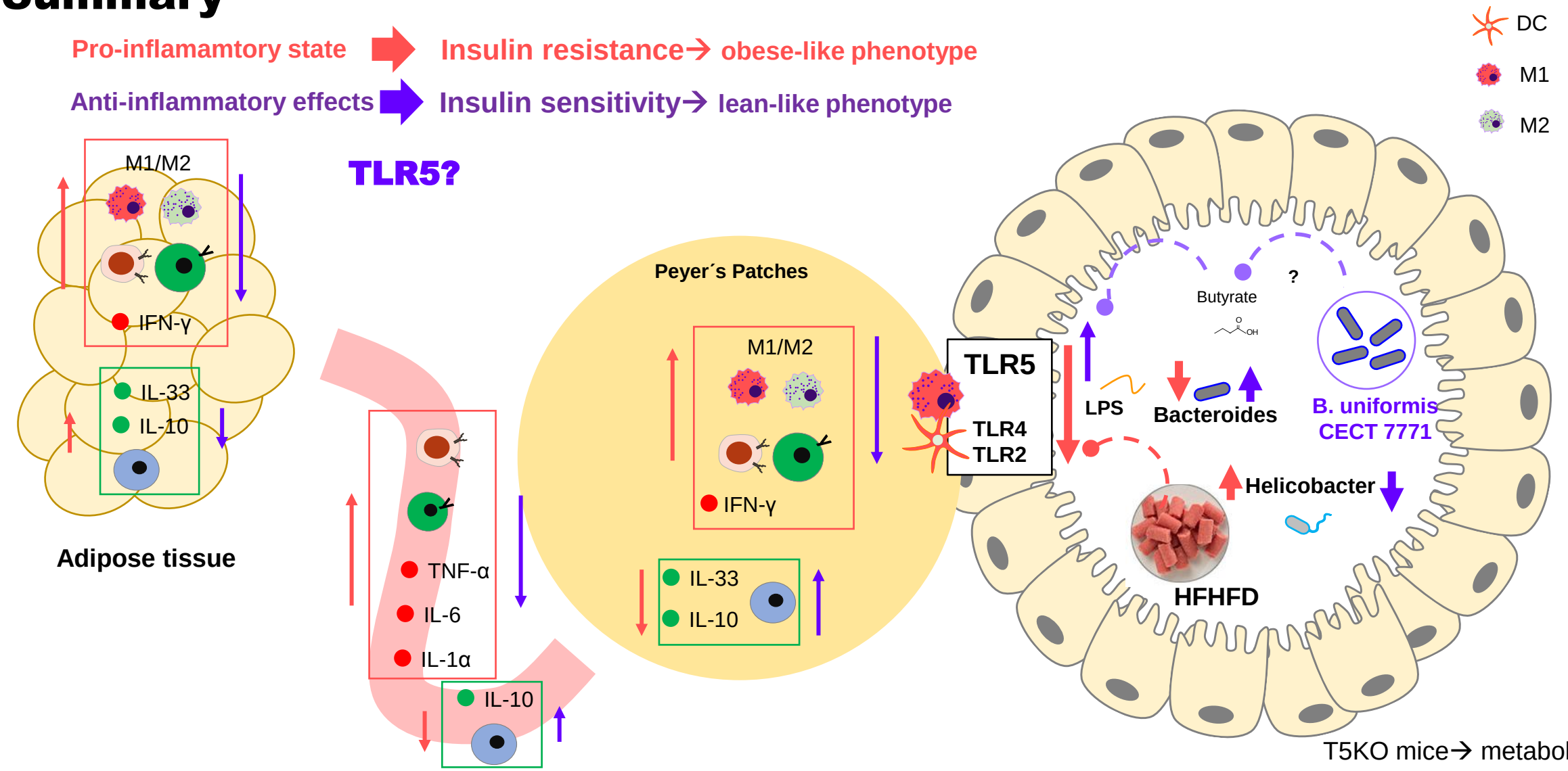


6.1 'On the way to evaluate new probiotics' *in vivo* functional characterization of *Bacteroides uniformis* CECT 7771

Summary

Pro-inflamamtory state → Insulin resistance→ obese-like phenotype

Anti-inflammatory effects → Insulin sensitivity→ lean-like phenotype



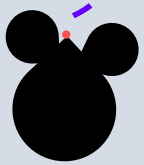
T5KO mice→ metabolic sindrome

Vijay-Kumar et al. 2010

6.1 'On the way to evaluate new probiotics' *in vivo* safety assesment of *Bacteroides uniformis* CECT 7771

Safety assesment

Acute toxicity assay: 6 days



Placebo
2x10^9 CFU

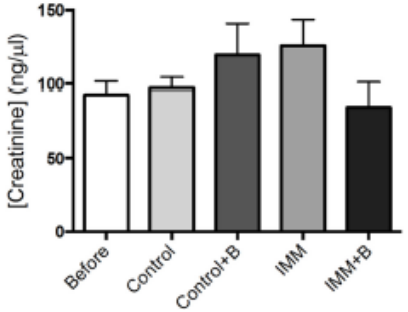
Dose: 100 times higher than in humans

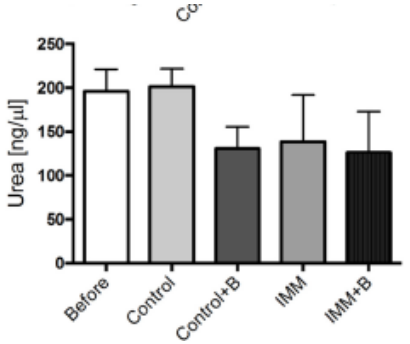
Immunocompetent mice

Immunosuppressed mice

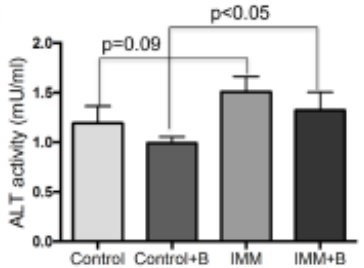
- Normal general health status: activity and behavior
- No difference in body weight gain or loss
- No bacterial translocation (blood, liver or mesenteric lymph nodes)

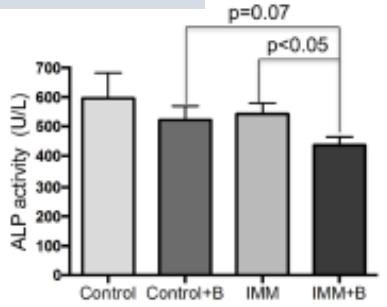
Normal kidney function



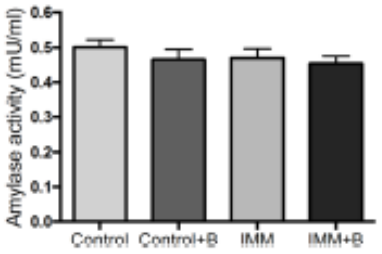


Normal liver function





Normal pancreatic function



Normal Gut mucosa integrity

Normal gut integrity
Immunosupression reduced:
-globet cells and villus height/crypt depth ratio in jejunum.
-crypt width in the colon.
-*B. uniformis* CECT 7771 reversed the reduced height/crypt depth ratio in jejunum

Antiinflammatory response

B. uniformis CECT 7771 reduced pro-inflammatory cytokines
B. uniformis CECT 7771 restored inflammatory cytokines of immunosuppressed mice

Eva María Gómez del Pulgar Villanueva

Ongoing experiment

Chronic toxicity assay: 3 months

Fernández-Murga & Sanz, PlosOne 2015

6.2 'On the way to evaluate new probiotics'
in vitro functional characterization of WBE and *B. uniformis* CECT 7771 intervention

Prebiotic & Probiotic intervention for FOOD

Anti-obesity strategies

Functional characterization

in vitro

in vivo

Bacteroides spp:
glycan enriched environments

Carbon source (0.5% w/v)
Glucose
inulin
Wheat Bran Extract (WBE)
gum arabic
pectin
type II mucin

***B. uniformis* CECT 7771**

in vitro characterization of the dietary patterns and metabolic phenotypes of *B. uniformis* CECT 7771

The Glycolytic Versatility of *Bacteroides uniformis* CECT 7771 and Its Genome Response to Oligo and Polysaccharides

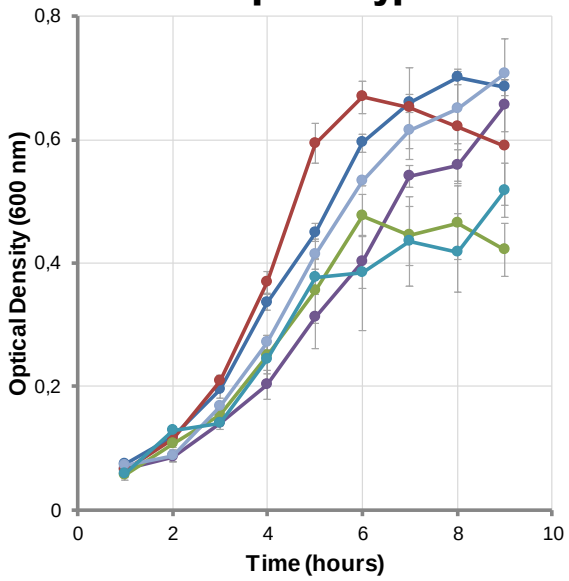
Alfonso Benítez-Páez†, *Eva M. Gómez del Pulgar*† *and Yolanda Sanz*


Hermes Alfonso Benitez Paez

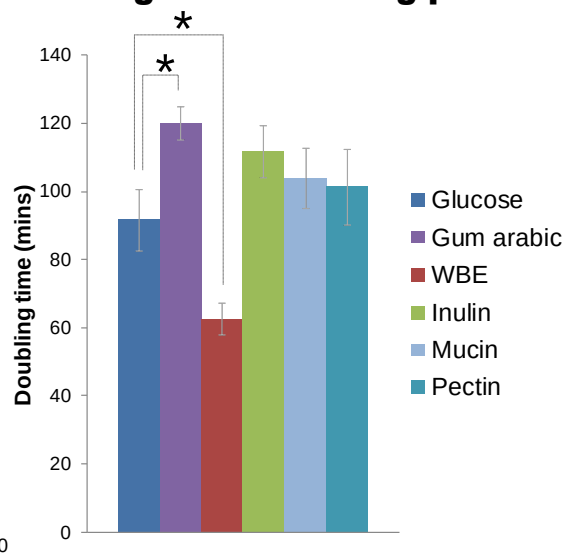

Eva María Gómez del Pulgar Villanueva

Growth fitness of B. uniformis CECT 7771 in different dietary fibers

Growth phenotypes



Doubling time in the log phase



↗non-digestible carbohydrates:
Arabinoxylans

arabinoxylan-degrading enzymes

Arabinoxylan oligosaccharides (AXOS)

SCFA (propionate)

Metabolic health

6.2 'On the way to evaluate new probiotics'
in vivo functional characterization of WBE and *B. uniformis* CECT 7771 intervention

Prebiotic & Probiotic intervention for FOOD

Anti-obesity strategies

Functional characterization

in vitro ***in vivo***

in vivo functional characterization on metabolic phenotype of **WBE+*B. uniformis* CECT 7771 intervention**

DIET INDUCED OBESITY (DIO)

Kcal (%)	Proteins	CH	Sucrose	Fat	WBE
SD	20	70	0	10	0
HFHS	20	35	**20**	**45**	0
HFHS+WBE	20	35	**20**	**45**	**5**

Placebo (10% skimmed milk)

Placebo (10% skimmed milk)

B. uniformis CECT 7771 (1X10^7 CFU)

Placebo (10% skimmed milk)

B. uniformis CECT 7771 (1X10^7 CFU)

weeks

14 — **OGTT**

17 — **IMMUNOMETABOLIC PARAMETERS**

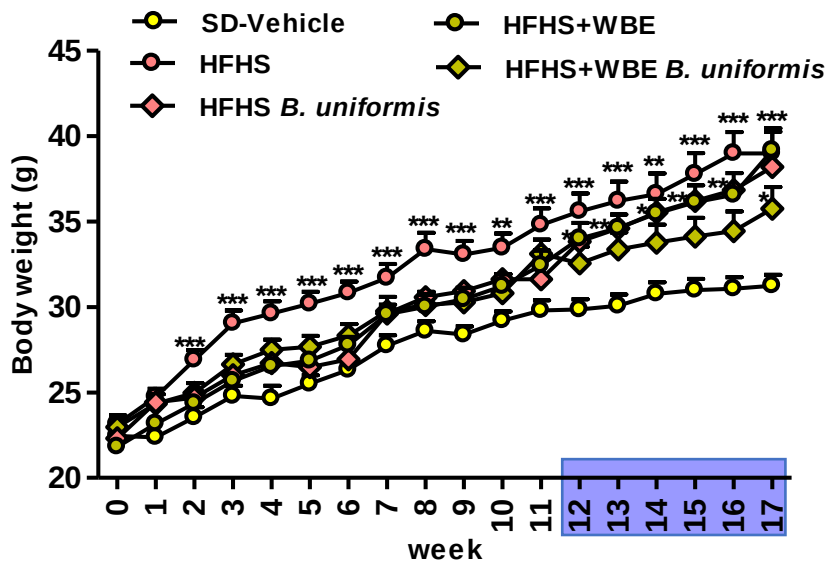
SD-Standard Diet

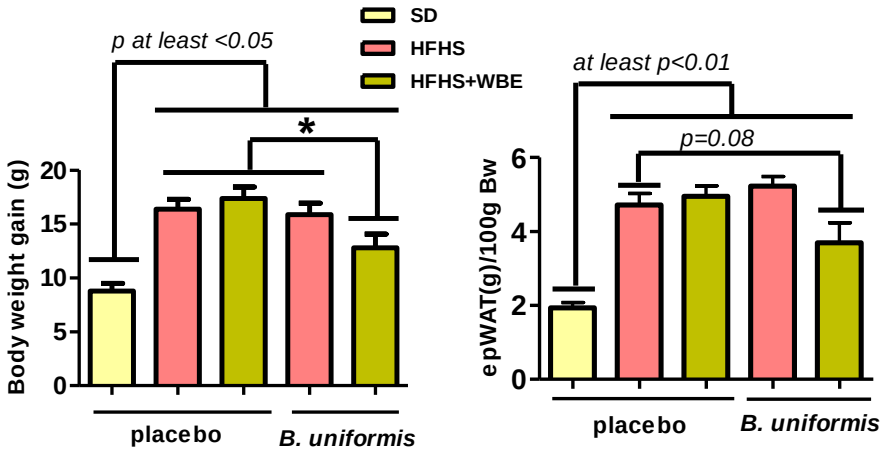
HFHS-High Fat High Sucrose diet

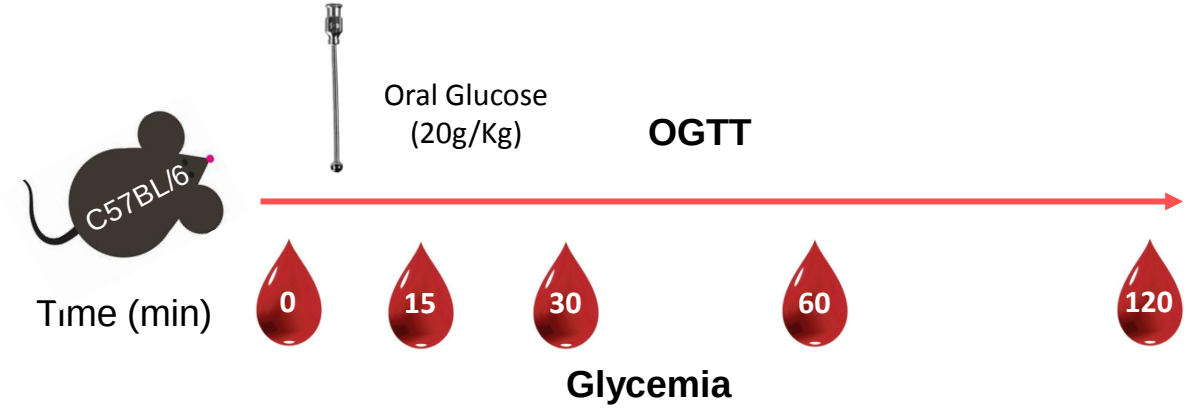
HFHS+WBE-HFHS+WBE

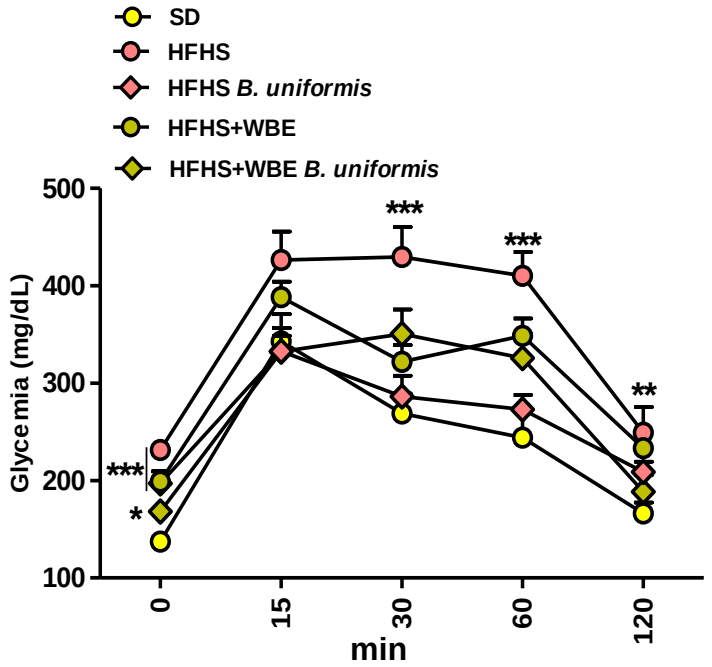
6.2 'On the way to evaluate new probiotics'
in vitro functional characterization of WBE and *B. uniformis* CECT 7771 intervention

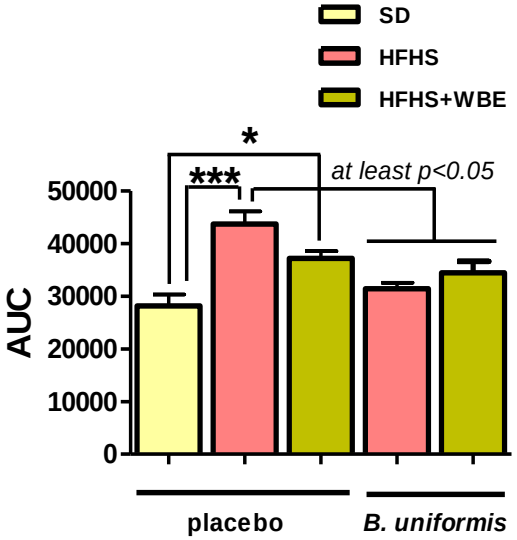
Preliminary results





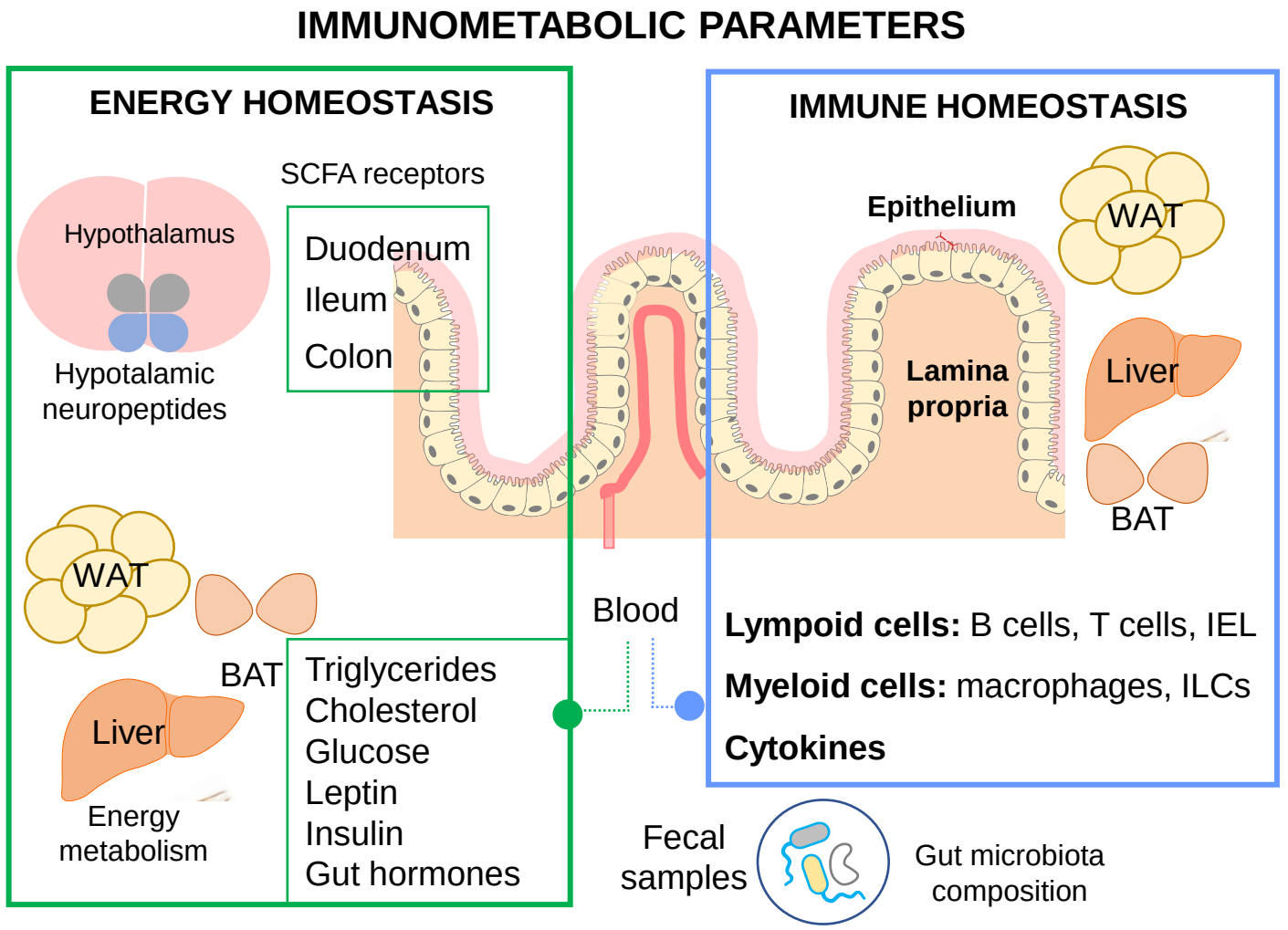






6.2 'On the way to evaluate new probiotics'
in vitro functional characterization of WBE and *B. uniformis* CECT 7771 intervention

ONGOING EXPERIMENTS



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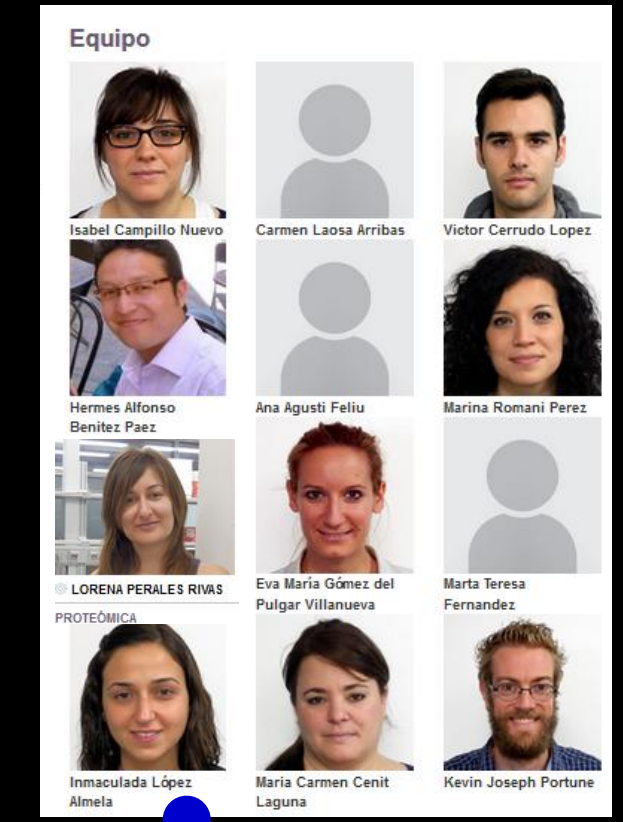
Instituto de Agroquímica y Tecnología de Alimentos

XXIX AETC 2017
Jornadas Técnicas

THANK YOU FOR YOUR ATTENTION



CSIC
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