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Research and Innovation in Nutrition: A major health issue Milk products and innovative fermented ingredients for target populations: Focus on the **PROLIFIC Project**

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Research and Innovation in Nutrition : A major health issue

Milk products and innovative fermented ingredients for target populations : Focus on the PROLIFIC Project

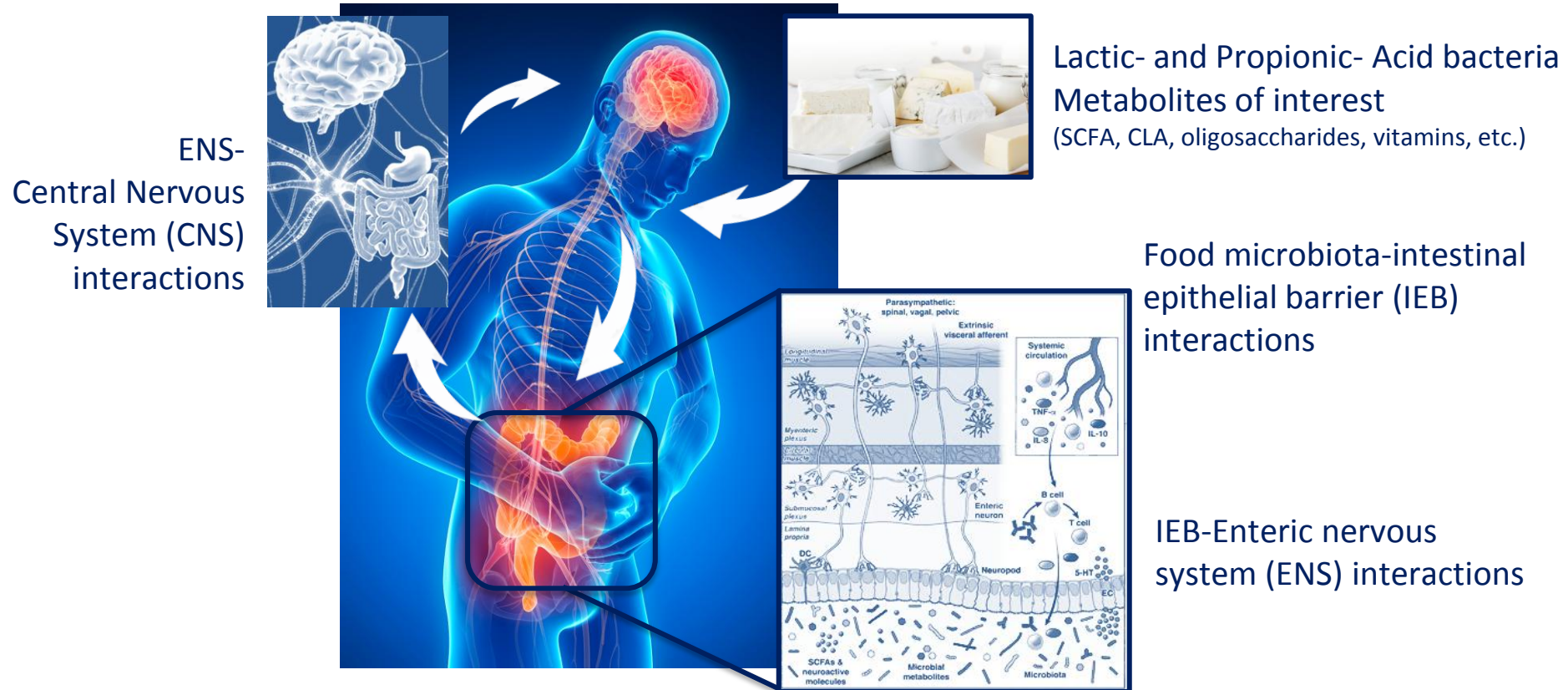


Yves LE LOIR

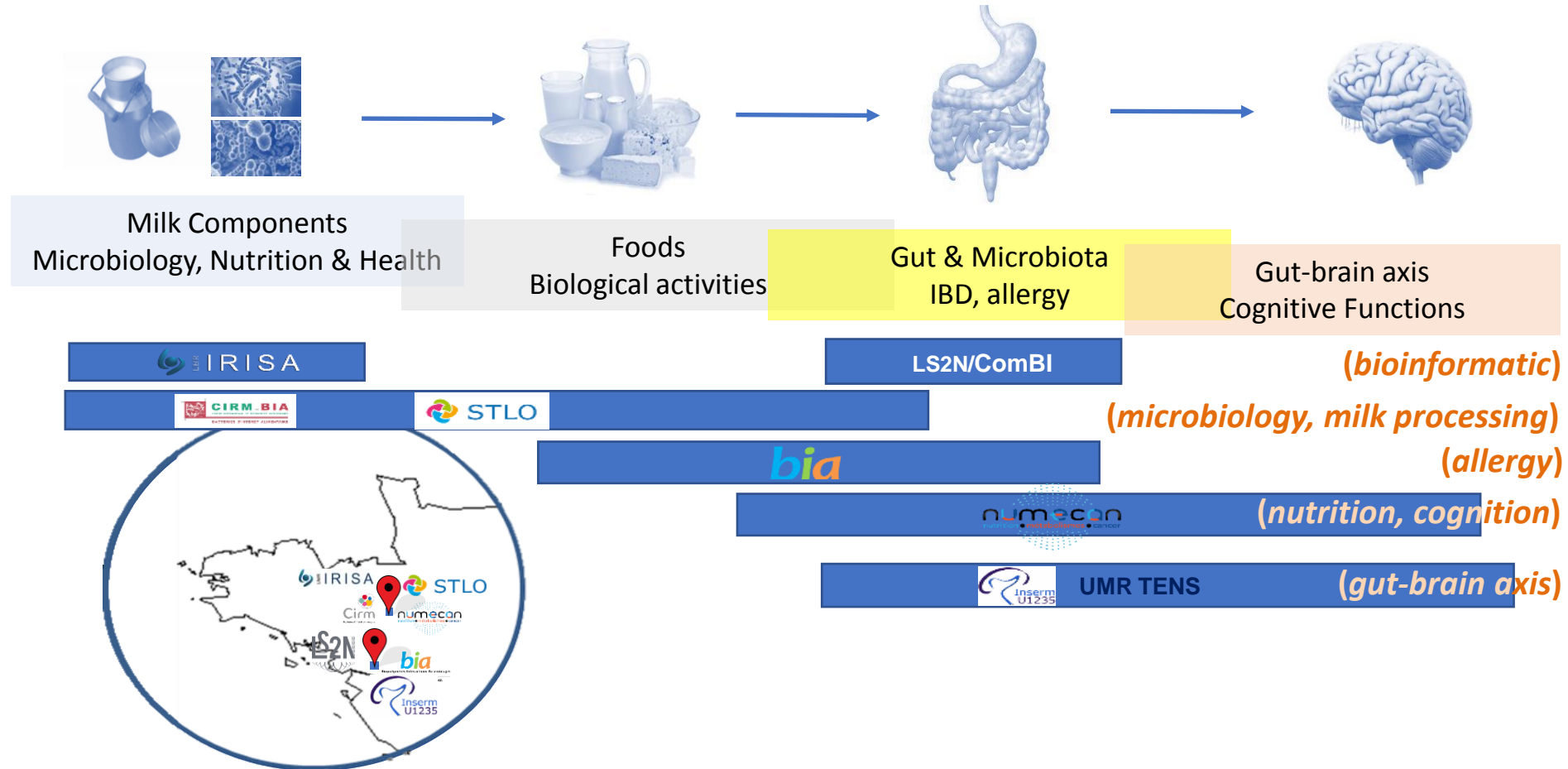
STLO - INRAE Institut Agro Rennes

PROLIFIC

« May your diet be your first medicine »



Scientific continuum and expertise

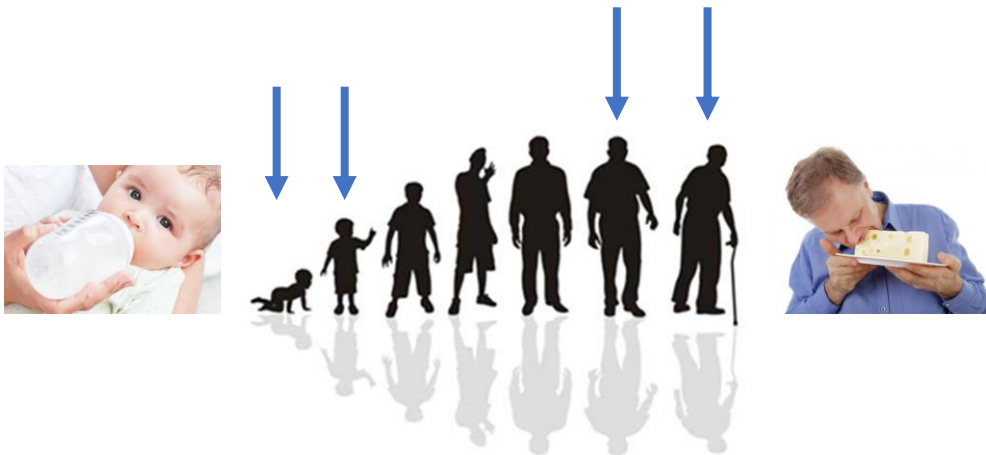


For which target populations?

The first **1000** days of life

(0-6 months and 6 months-3 years)

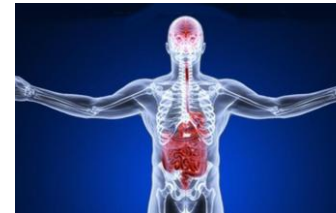
The **seniors**



For which functionalities ?



Colonisation and homeostasis
of gut microbiota



Cognitive development /
Neurodegeneration



Inflammation
Tolerance / Allergy

Human resources

5 PhD projects (*180 months*)

4 post-docs (*60 months*)

5 Contracts Technicians and Engineers (*90 months*)

Funding

13,9 M€ Full cost

7,55 M€ funded by Bba Milk Valley

1,86 M€ funded by Regions BZH and PDL

Thank you for your attention



Questions & Answers



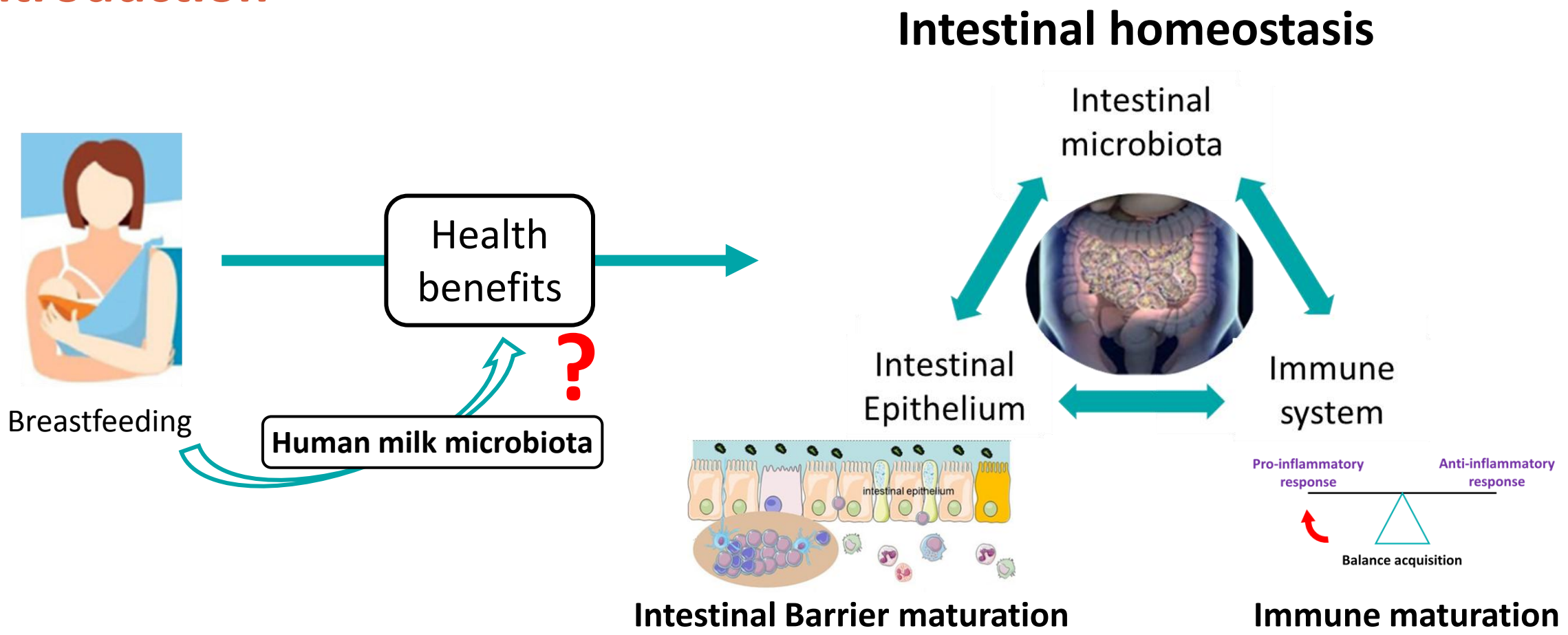
Two human milk synthetic bacterial community (SynCom) exhibited contrasted impacts *in vitro* on intestinal barrier and immune function



Charles LE BRAS
STLO & NuMeCan



➤ Introduction

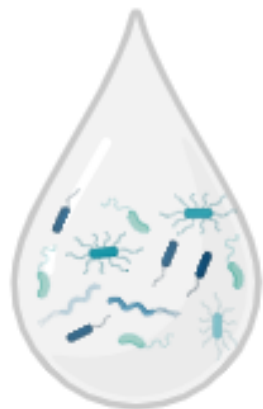


Our hypothesis is that the microbiota of human breast milk contributes to the health benefits of breast milk

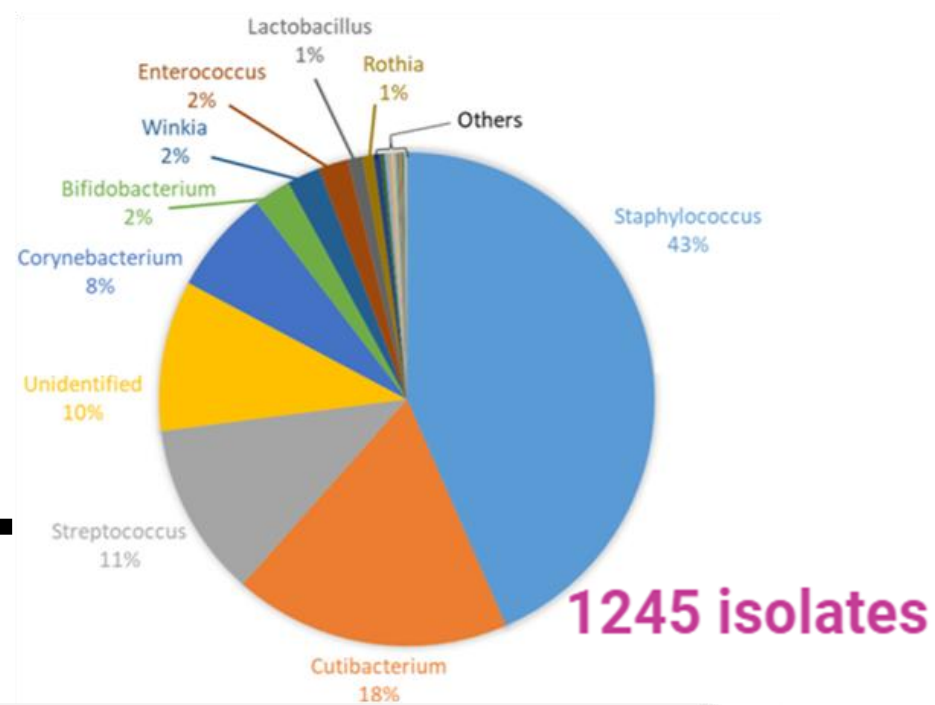


Strategy

28 Donors



Bacterial collection



Preselection

Human PBMC model

84 isolates

IL-10 and TNF- α

Quadricellular model

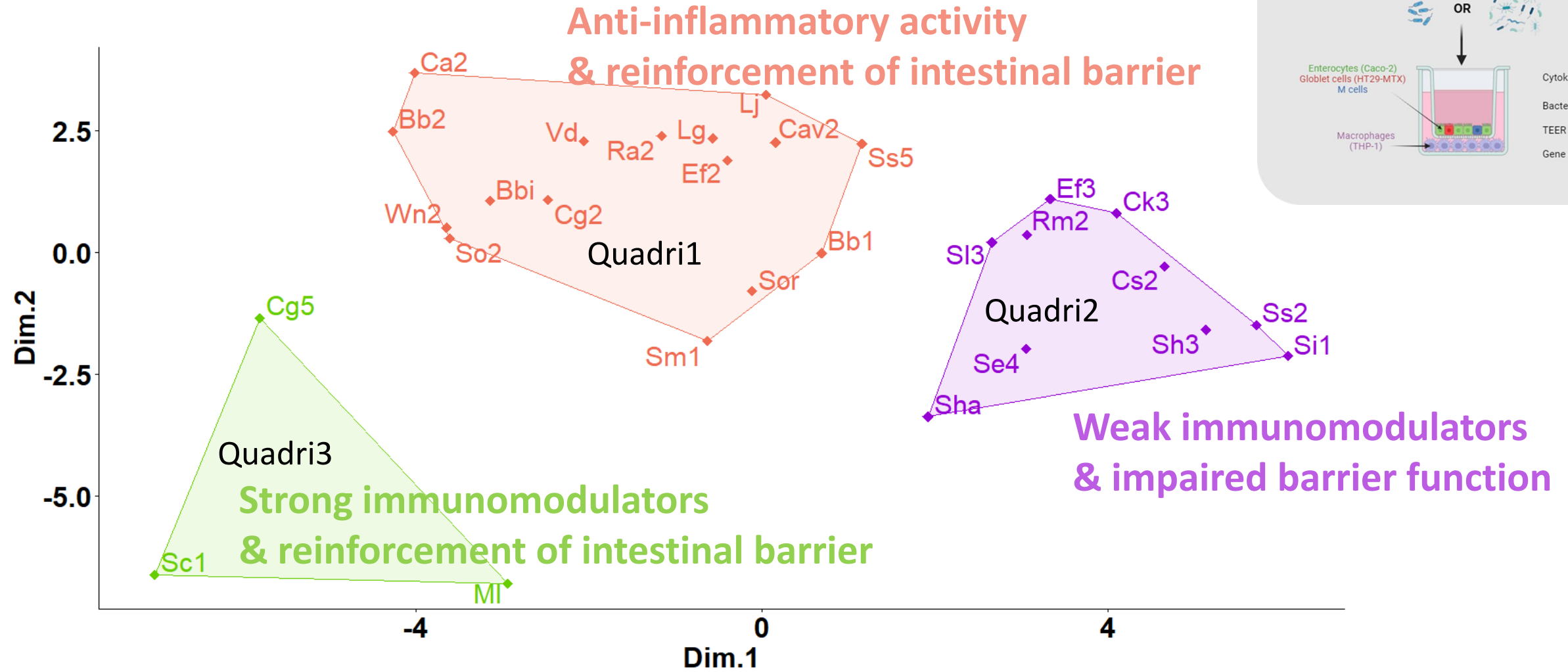
29 isolates OR 2 SynComs

Enterocytes (Caco-2)
Goblet cells (HT29-MTX)
M cells
Macrophages (THP-1)

- Cytokines production
- Bacterial translocation
- TEER
- Gene expression

Individual impact of HM bacteria on immune and barrier functions

Classification by *MultiDimensionate Scaling*



Great variability of functional profiles of HM bacteria

Immune and barrier properties of the 2 SynComs

sPLS-DA analysis

Design of 2 Synthetic Communities :

- ➔ Mimicking HM microbiota
- ➔ With different functional properties

SynCom AI

Anti-inflammatory

- Cutibacterium granulosum (Cg2)
- Staphylococcus haemolyticus (Sha)
- Winkia neuui (Wn2)
- Streptococcus infantis (Si1)
- Cutibacterium acnes (Ca2)
- Corynebacterium simulans (Cs2)
- Bifidobacterium breve (Bb1)
- Lactobacillus gasseri (Lg)

SynCom HI

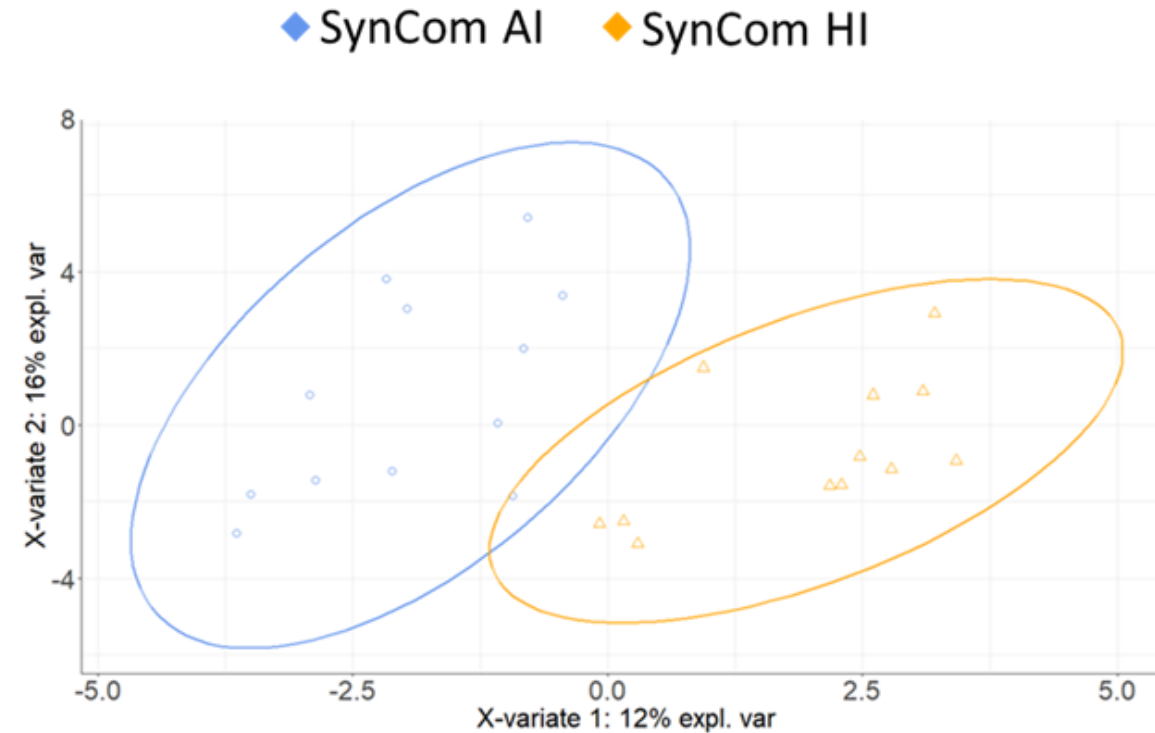
Strong immunomodulatory

- Cutibacterium granulosum (Cg5)
- Staphylococcus capitis (Sc1)
- Micrococcus luteus (Ml)
- Staphylococcus epidermidis (Se4)
- Streptococcus salivarius (Ss2)
- Corynebacterium kroppenstedtii (Ck3)
- Bifidobacterium breve (Bb2)
- Lactobacillus jensenii (Lj)

Anti-inflammatory

Common strains

- Rothia mucilaginosa (Rm2)
- Veillonella dispar (Vd)
- Bifidobacterium bifidum (Bbi)



- **Contrasted immunomodulatory properties as expected from the assembly**
- **New properties that differed from those of the individual bacteria**

Conclusion

- The profile of HM bacterial SynComs reflected the coexistence of specific bacterial profiles that comprise the HM microbiota, leading to its role in driving gut homeostasis
- The functional properties of the HM bacterial community relied on a combination of strain-specific features rather than on the taxonomic composition itself



Questions & Answers



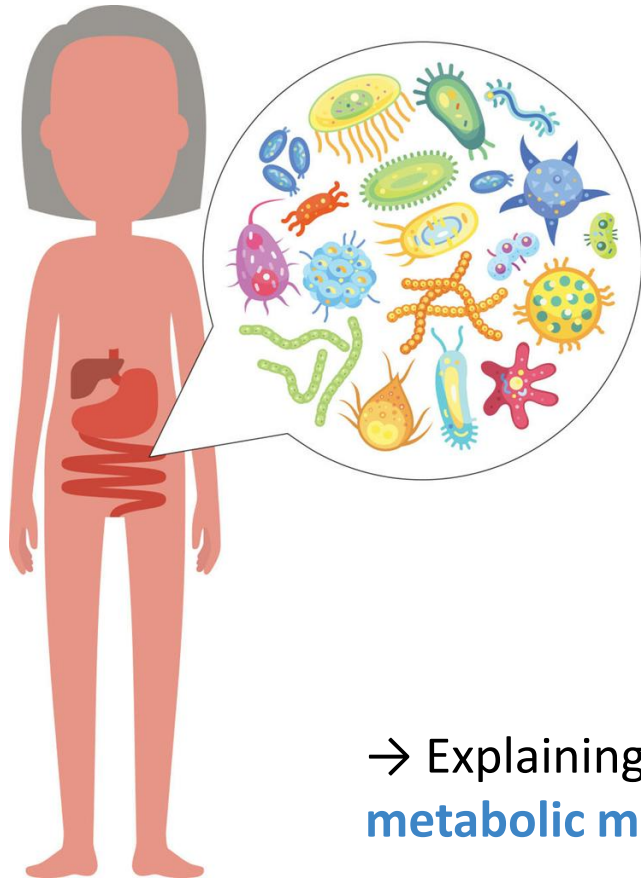
In silico modeling of host-lactic acid bacteria interactions at the Epithelial Intestinal Barrier



Anna LAMBERT

LS2N & TENS laboratories

The host - microbiota ecosystem

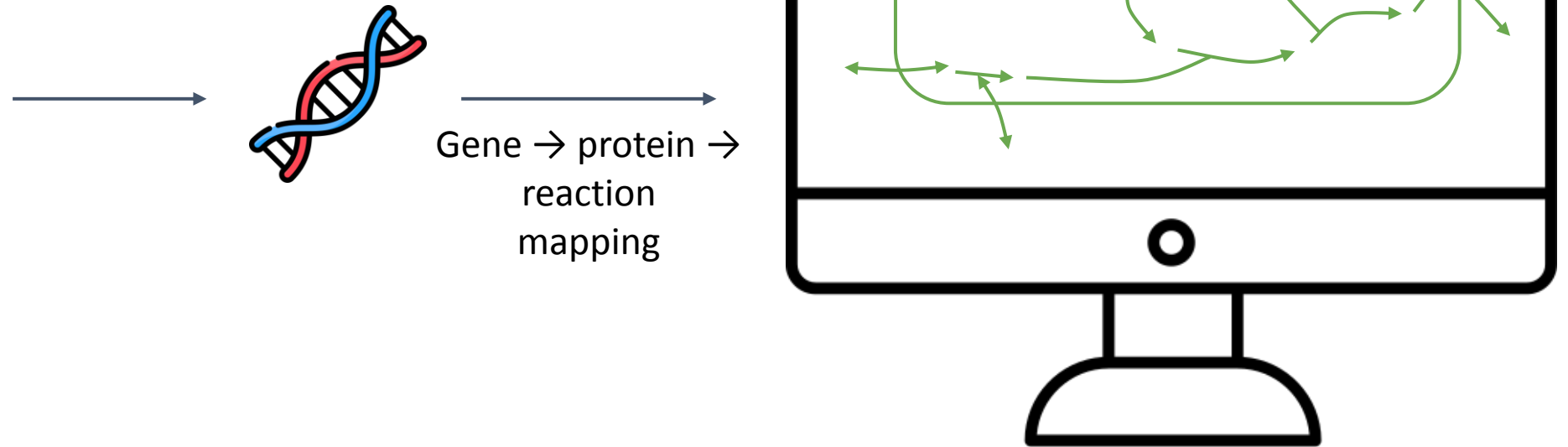


- The gut microbiota is a complex ecosystem
- It impacts our health in several ways, notably through metabolism (e.g. production of vitamins or butyrate)
- Mechanisms of action of many bacteria remains unclear

→ Explaining the influence of gut bacteria on the host using **computational metabolic models**



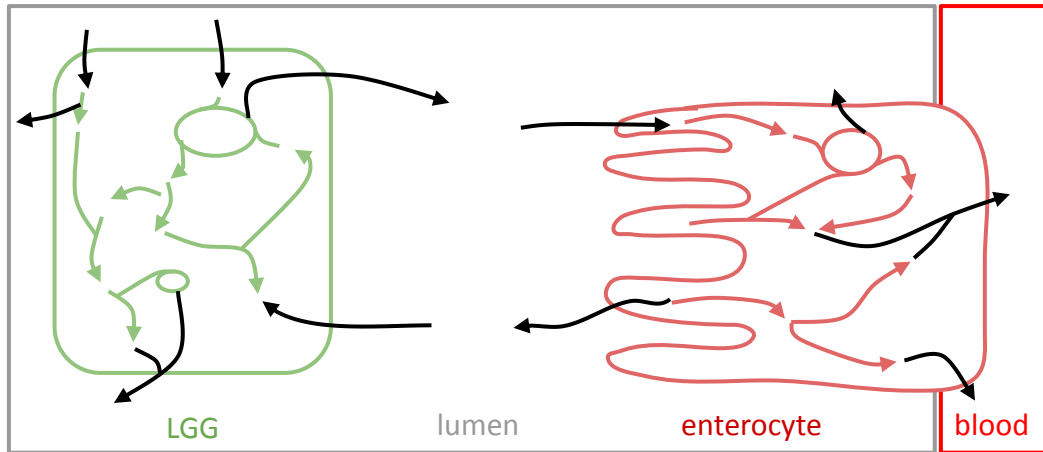
Metabolic modeling



Metabolic model : Informatic reproduction of the metabolic network of an organism



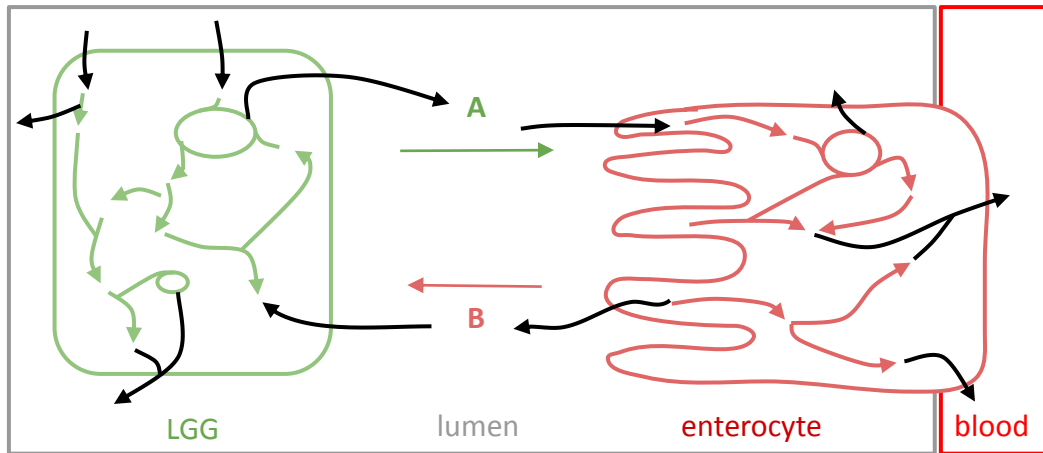
Exploration of ecosystem interaction



- Interaction score
(competition, neutrality, mutualism)

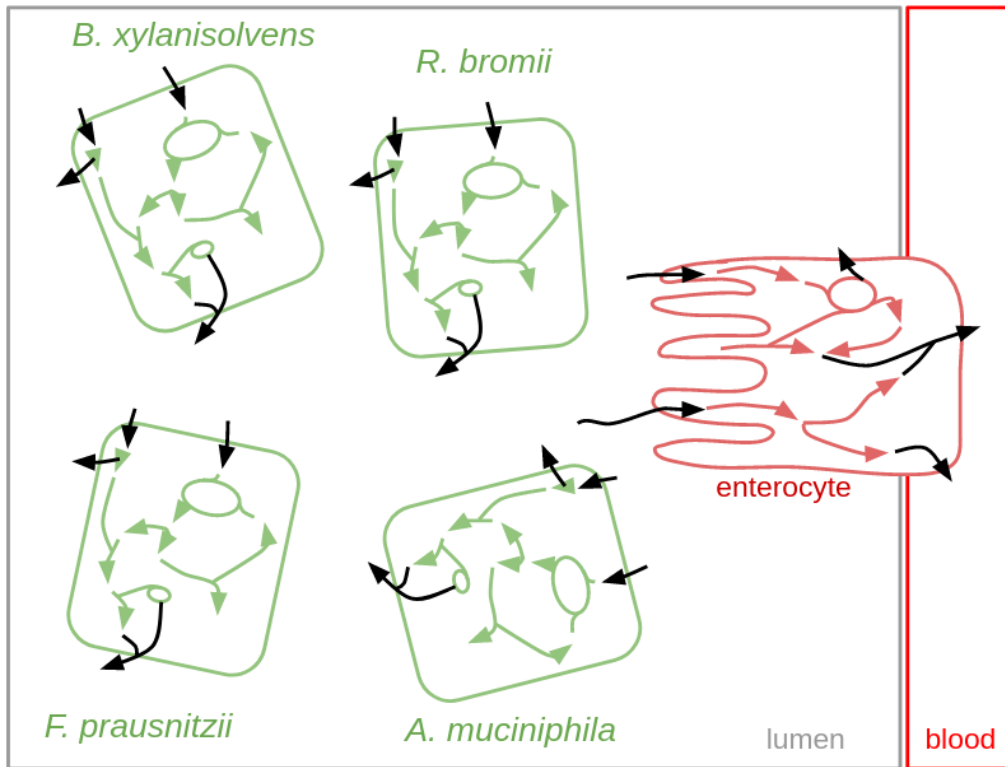


Exploration of ecosystem interaction



- Interaction score (competition, neutrality, mutualism)
- Cross-fed metabolites

Exploration of ecosystem interaction



- Interaction score (competition, neutrality, mutualism)
- Cross-fed metabolites
- Applied in larger ecosystems

Questions & Answers



Combined effects of propionic acid bacteria and n-6 polyunsaturated fatty acids on the intestinal barrier

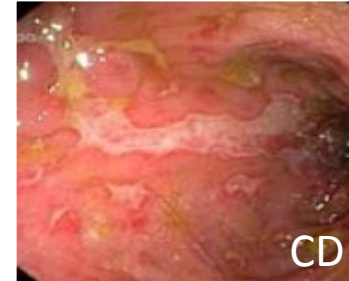


Marine MANTEL
TENS & STLO laboratories

Intestinal bowel disease (IBD)



Crohn's disease (CD) and Ulcerative colitis (UC)

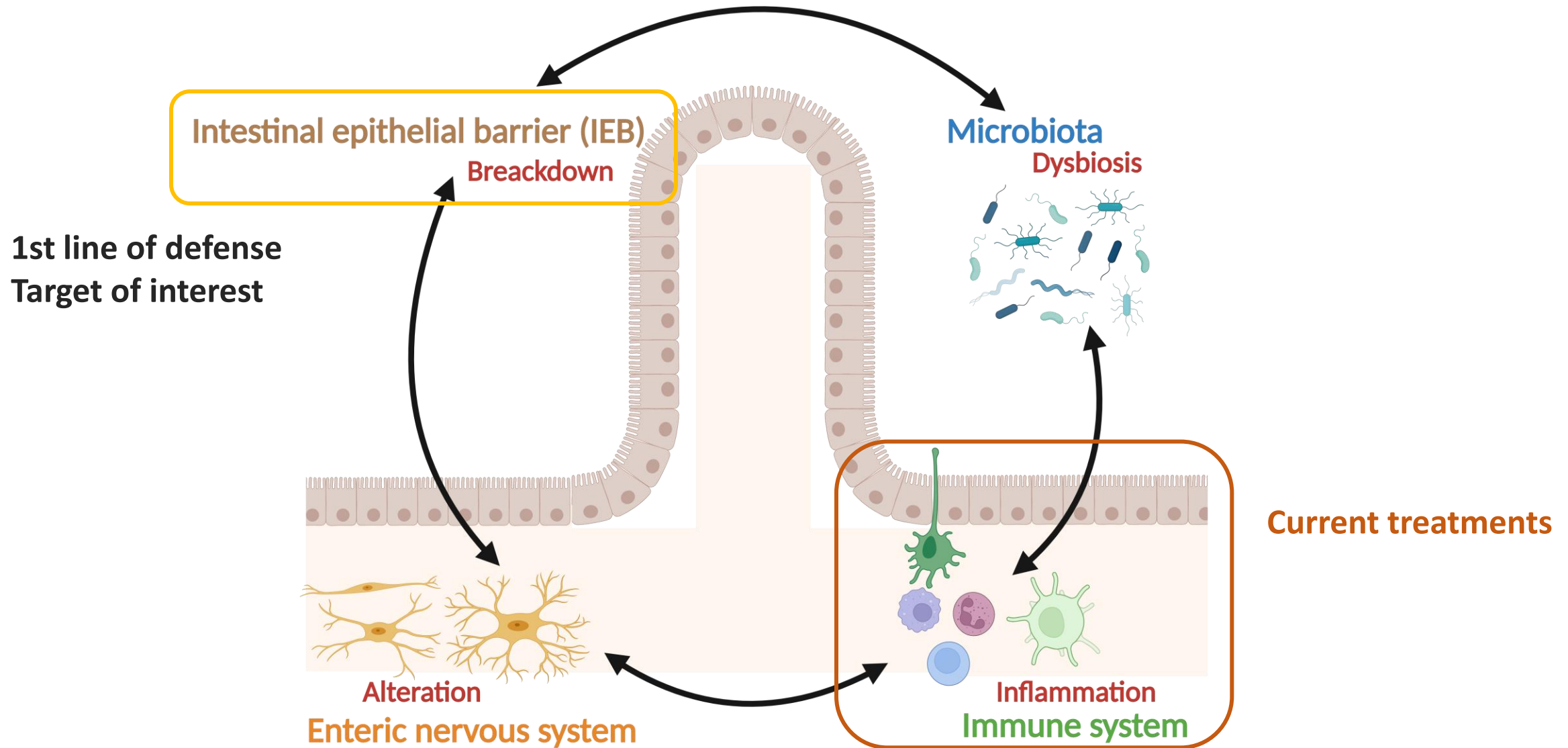


Chronic inflammation.

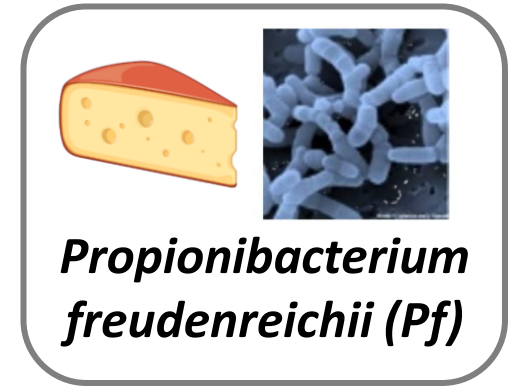
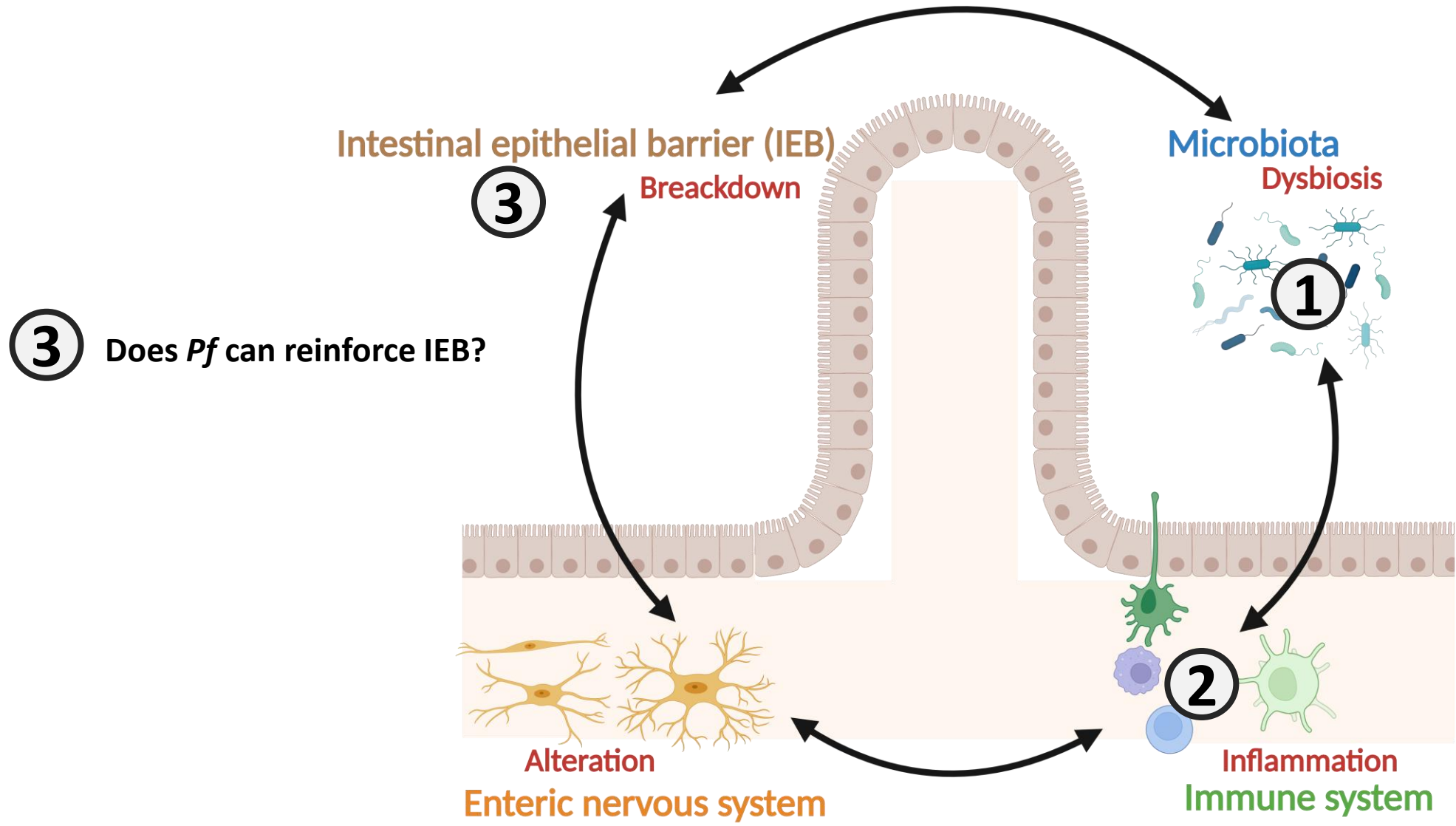
No curative treatment!



Intestinal bowel disease (IBD)



How to reinforce IEB?

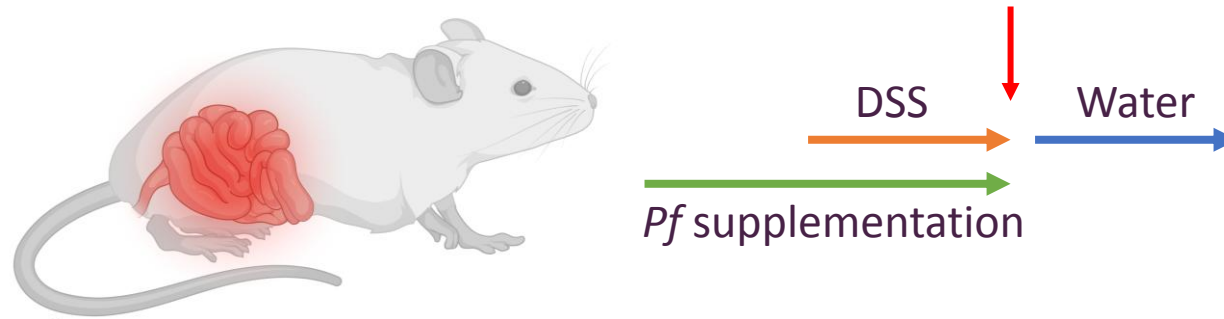


① Improved gut microbiota

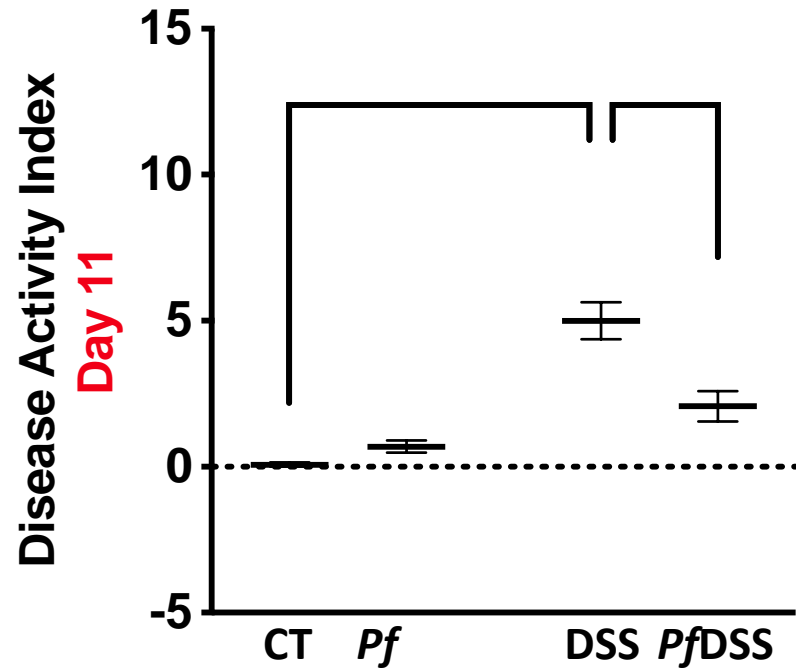
② Anti-inflammatory

Pf supplementation

DSS-induced colitis



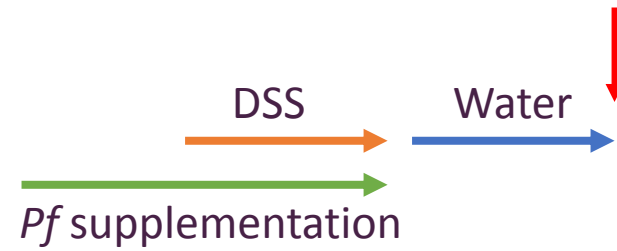
Colitis severity



Pf prevents colitis severity induced by the DSS.

Pf supplementation

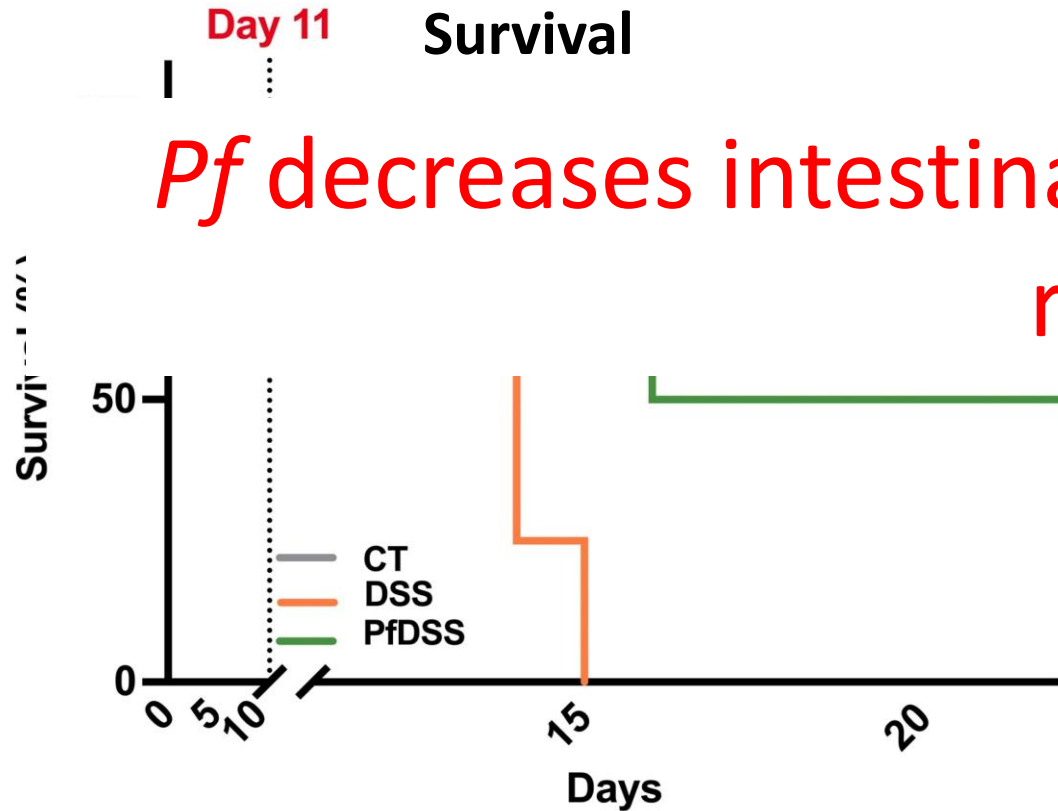
DSS-induced colitis



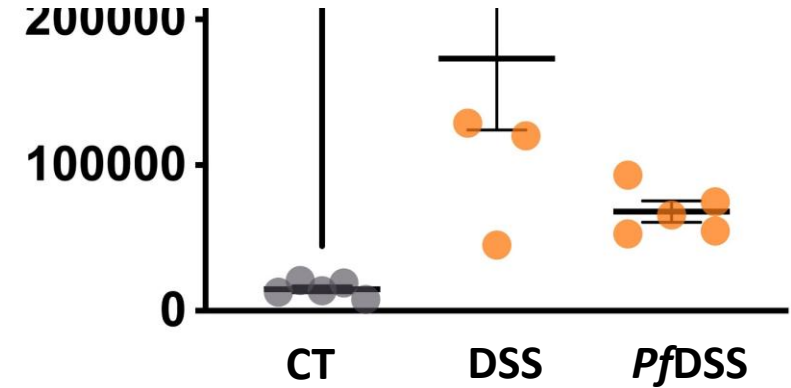
Recovery protocol

Intestinal permeability

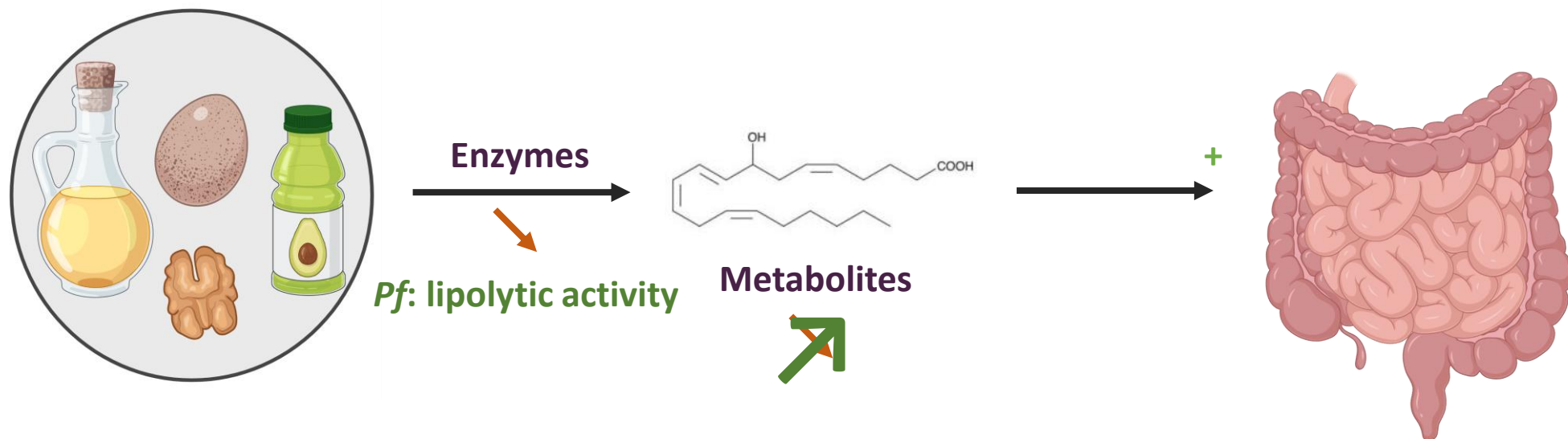
Pf decreases intestinal permeability and improves recovery.



Sulfonic abitar Day



N-6 diet: good for the gut?



Disruption of n-6 metabolism in IBD patients.

Combine protective effects of n-6 enriched diet and *Pf*?

Pf supplementation
N-6 enriched diet

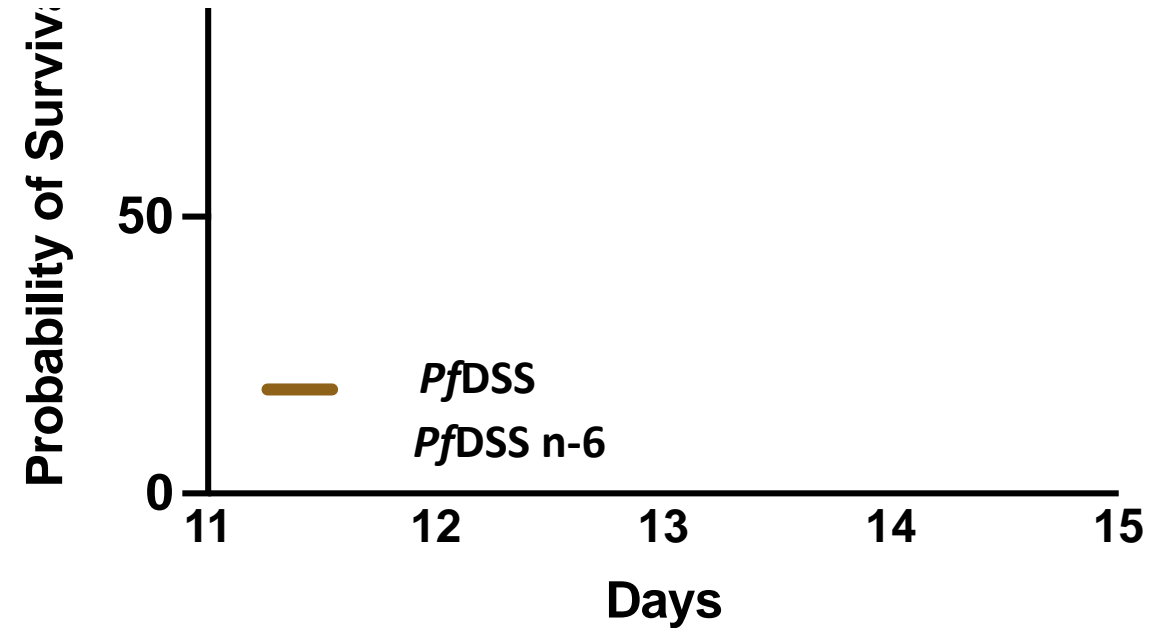
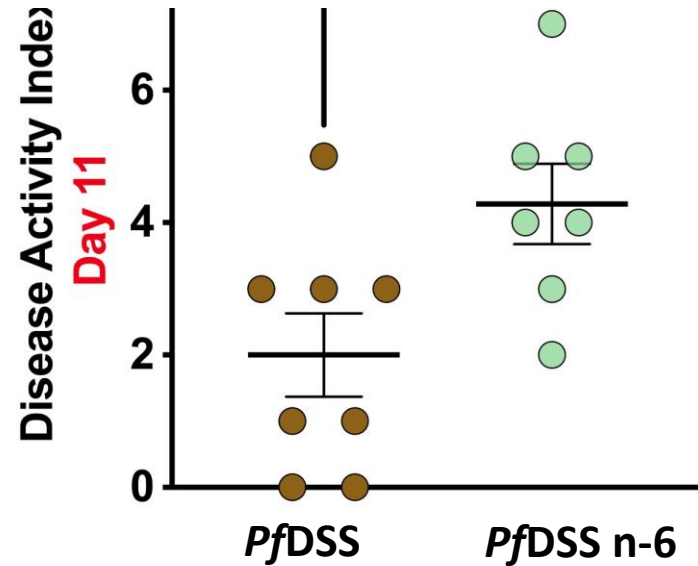
Recovery protocol



Colitis severity

Survival

N-6 enriched diet abrogates *Pf* protective effects.



Take home message

1) *Pf* reinforces IEB

2) *Pf* improves recovery and inhibits colitis

3) N-6 enriched diet abrogates *Pf* protective effects

Taking the patient's nutritional profile into account is essential
when integrating probiotics !



Questions & Answers

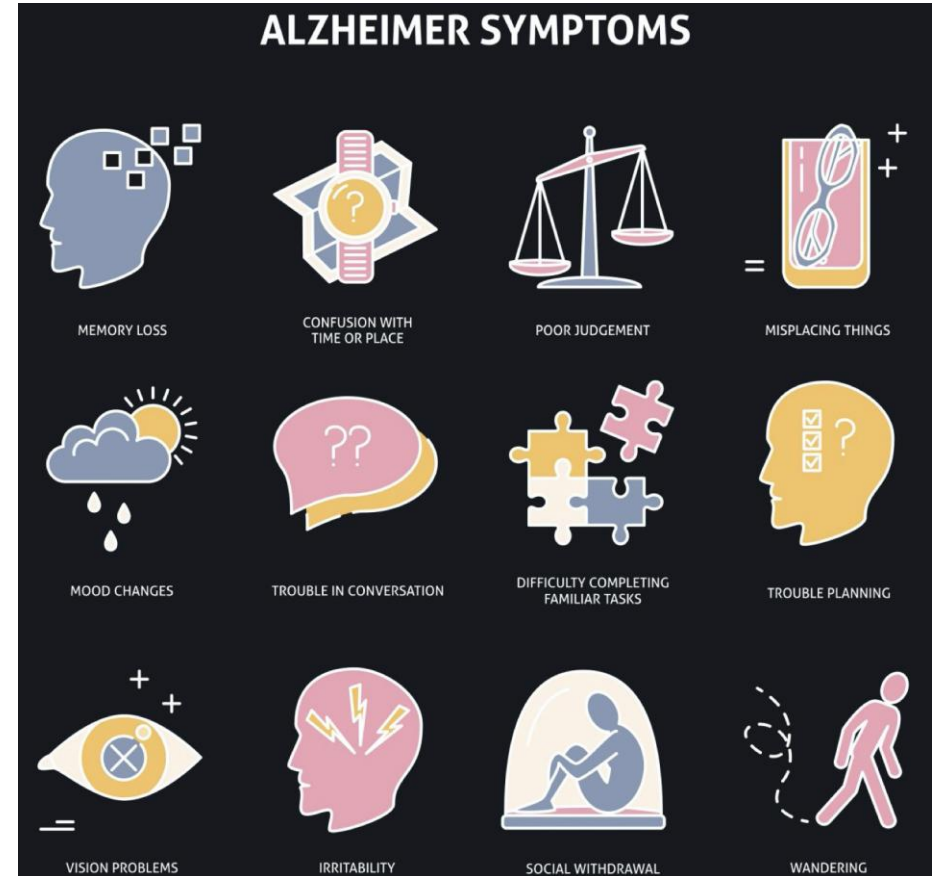
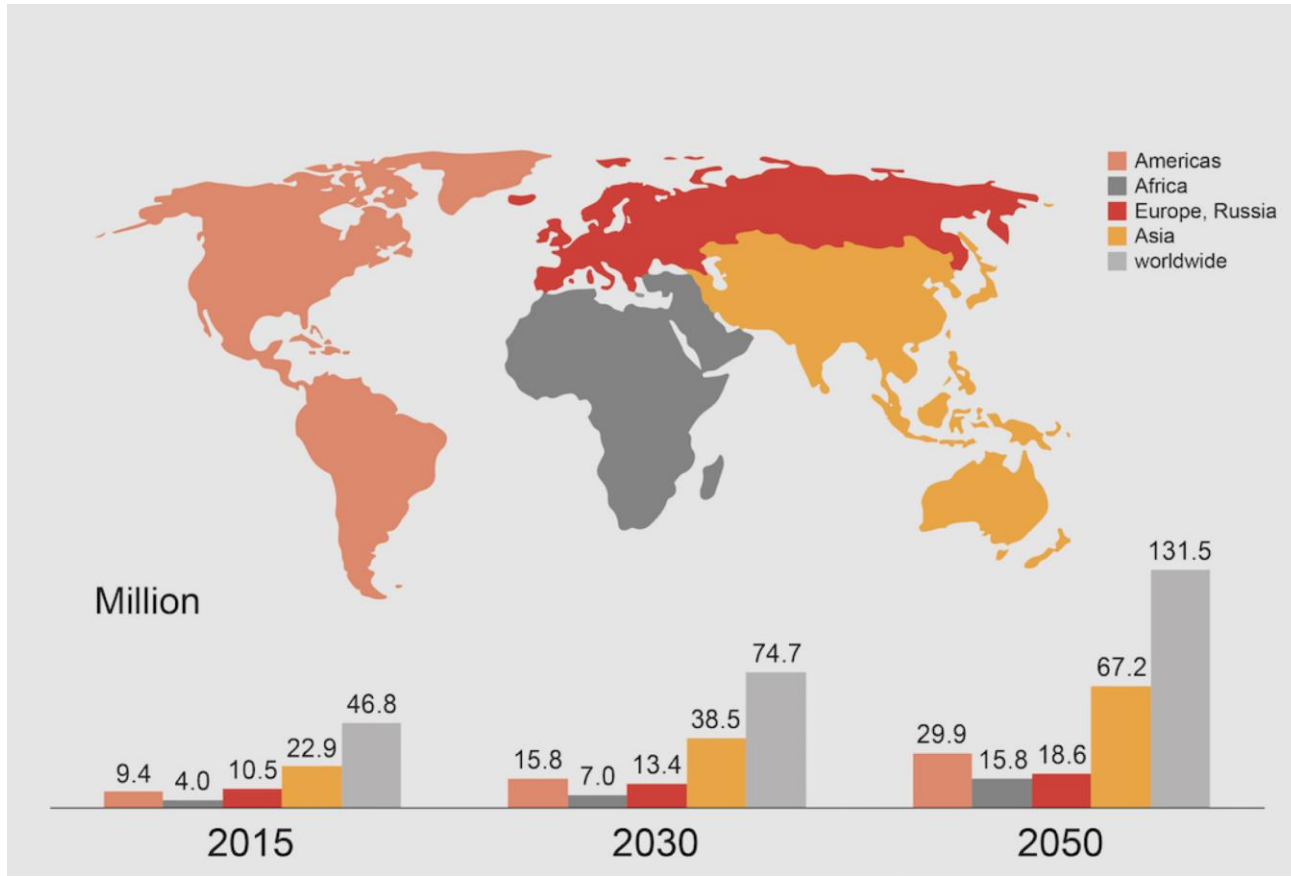


What are the beneficial effects of bacterial metabolites on cognitive and digestive functions in Alzheimer's disease ?

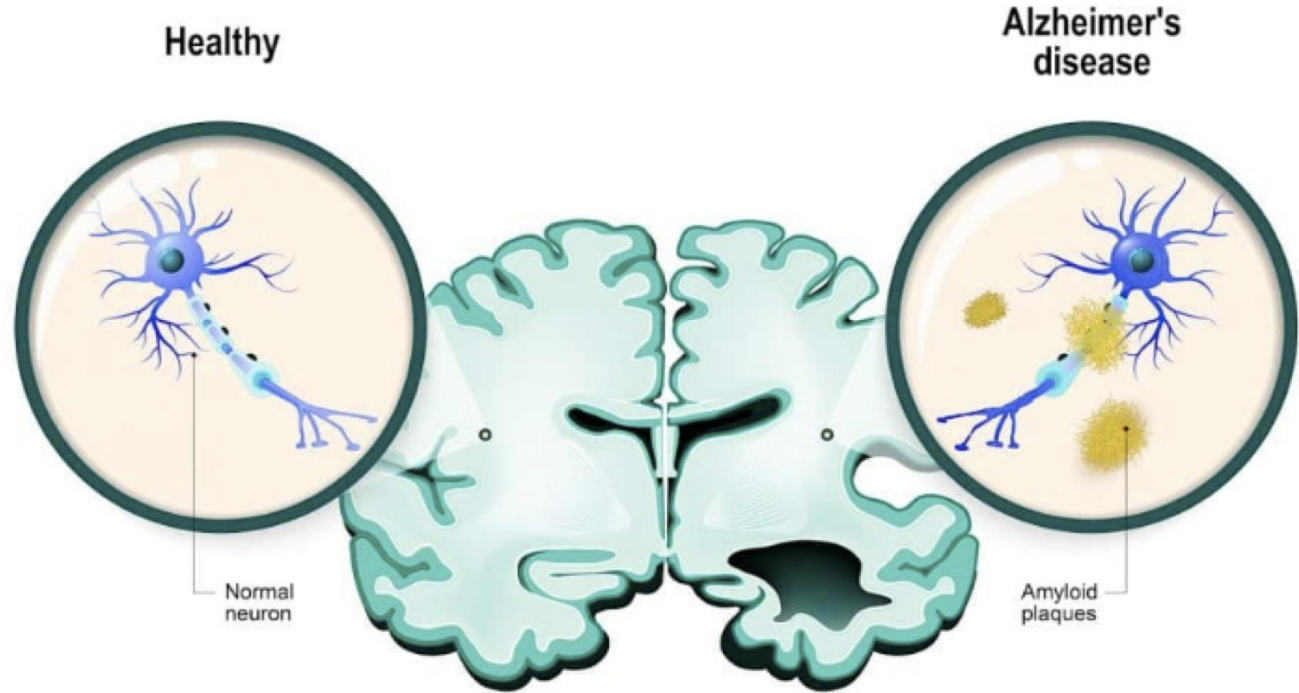
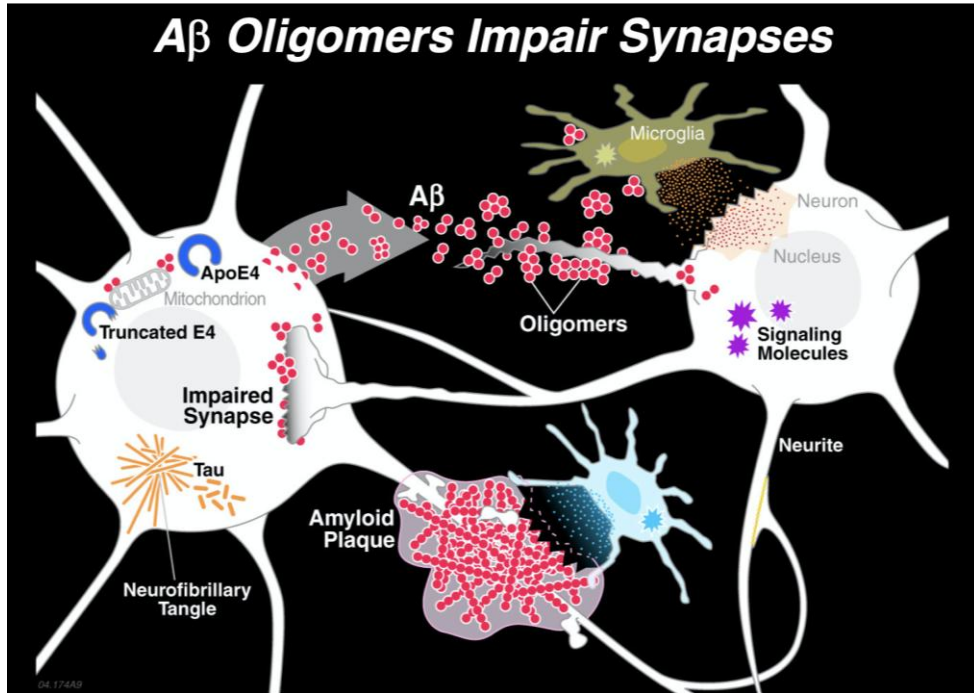


Rodrigue BROSSAUD
TENS & STLO laboratories

Alzheimer's disease : epidemiology and symptoms

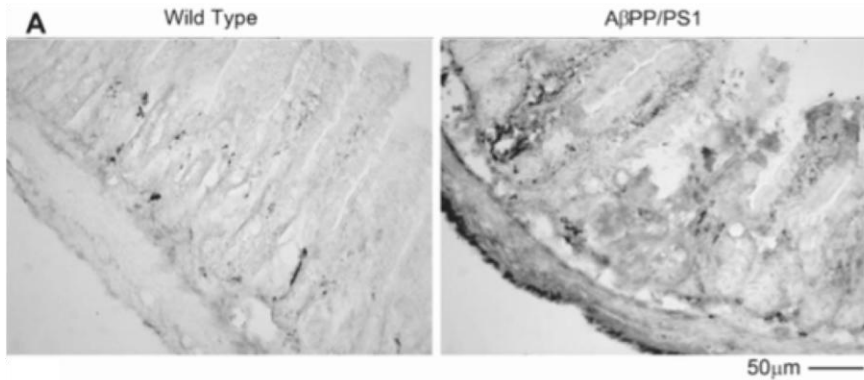


Alzheimer's disease : Amyloid- β toxicity

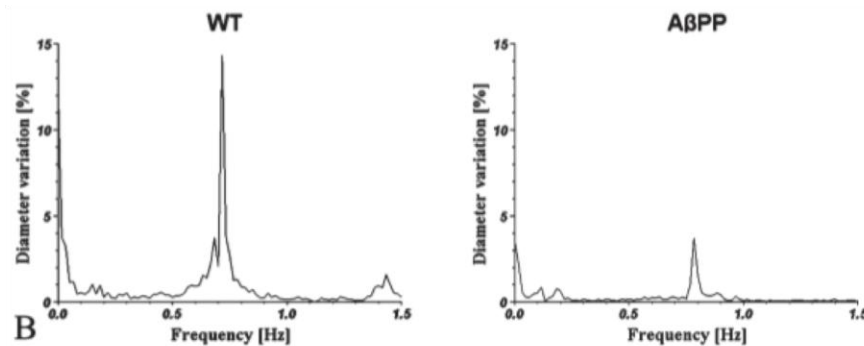


Alzheimer's disease : A gut-brain disease ?

Animal models

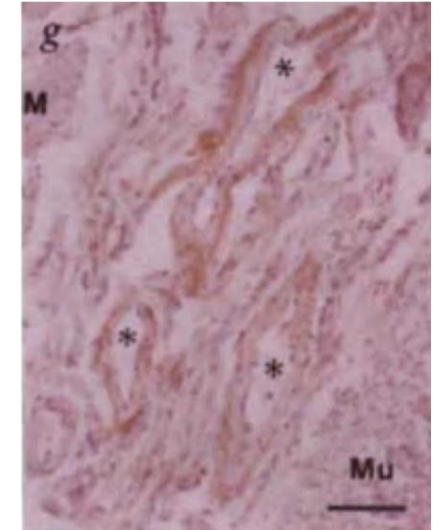
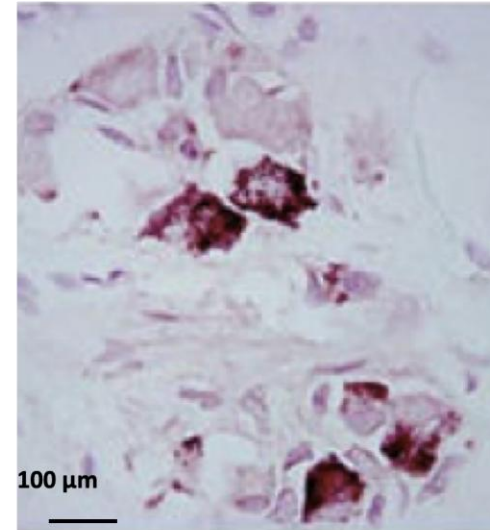


- Intestinal amyloid aggregates
(Puig et al., 2015)



- Impairments of digestive motricity
(Semar et al., 2013)

Humans



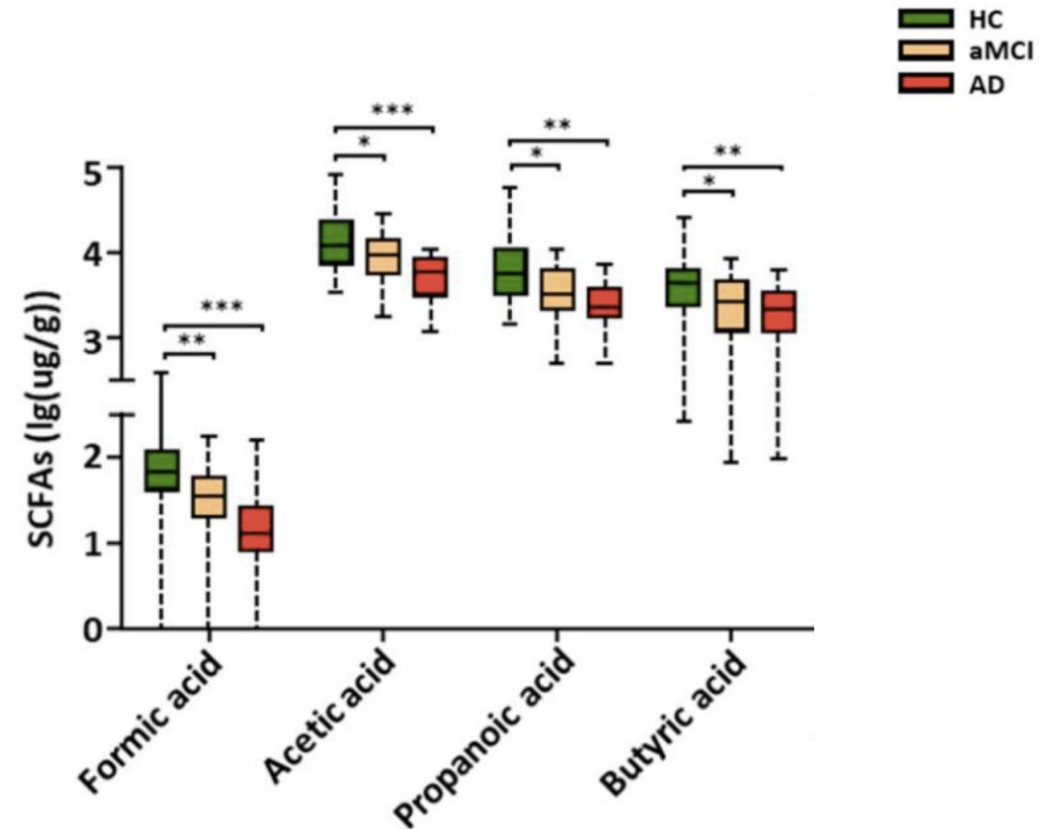
- Intestinal amyloid aggregates
(Joachim et al., 1989 ; Puig et al., 2015)

Alzheimer's disease : A gut-brain disease ?

	Diagnosis within 0-2 years				Diagnosis within 2-10 years			
	UK		France		UK		France	
	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value
Major depressive disorder, F32	2.14 (1.77-2.59)	<0.0001	3.41 (3.04-3.84)	<0.0001	1.34 (1.15-1.56)	<0.0001	1.73 (1.45-2.07)	<0.0001
Anxiety, F41	2.02 (1.69-2.41)	<0.0001	1.93 (1.71-2.17)	<0.0001	1.36 (1.18-1.56)	<0.0001	1.5 (1.26-1.78)	<0.0001
Reaction to severe stress and adjustment disorders, F43	2.34 (1.76-3.11)	<0.0001	2.1 (1.61-2.75)	<0.0001	1.4 (1.12-1.77)	<0.0001	1.83 (1.36-2.46)	<0.0001
Hearing loss, H91	1.28 (1.07-1.52)	0.0001	1.95 (1.35-2.82)	<0.0001	1.19 (1.04-1.36)	0.0006	1.51 (1.01-2.26)	0.033
Constipation, K59	1.41 (1.23-1.63)	<0.0001	1.66 (1.47-1.87)	<0.0001	1.31 (1.16-1.49)	<0.0001	1.59 (1.33-1.89)	<0.0001
Spondylosis, M47	1.25 (0.93-1.69)	0.933	1.45 (1.22-1.72)	<0.0001	1.26 (1.05-1.5)	0.0005	1.62 (1.32-1.98)	<0.0001
Memory loss symptom, R41	31.5 (24.18-41.05)	<0.0001	16.5 (10.39-26.19)	<0.0001	7.63 (5.95-9.79)	<0.0001	4.41 (2.3-8.48)	<0.0001
Malaise and fatigue, R53	1.36 (1.17-1.58)	<0.0001	1.78 (1.59-2.0)	<0.0001	1.23 (1.08-1.39)	<0.0001	1.59 (1.36-1.86)	<0.0001
Syncope and collapse, R55	1.95 (1.53-2.48)	<0.0001	2.49 (1.68-3.69)	<0.0001	1.23 (1.01-1.5)	0.034	1.57 (1.06-2.34)	0.007
Abnormal weight loss, R63	2.1 (1.68-2.62)	<0.0001	3.12 (2.41-4.02)	<0.0001	1.47 (1.22-1.77)	<0.0001	1.88 (1.35-2.62)	<0.0001

Both CIs and p values were corrected for multiple comparisons. OR=odds ratio. *Cannot be calculated because an insufficient number of presentations w

Table 2: ORs for all variables individually associated with a future diagnosis of Alzheimer's disease in the 2-10 years before diagnosis

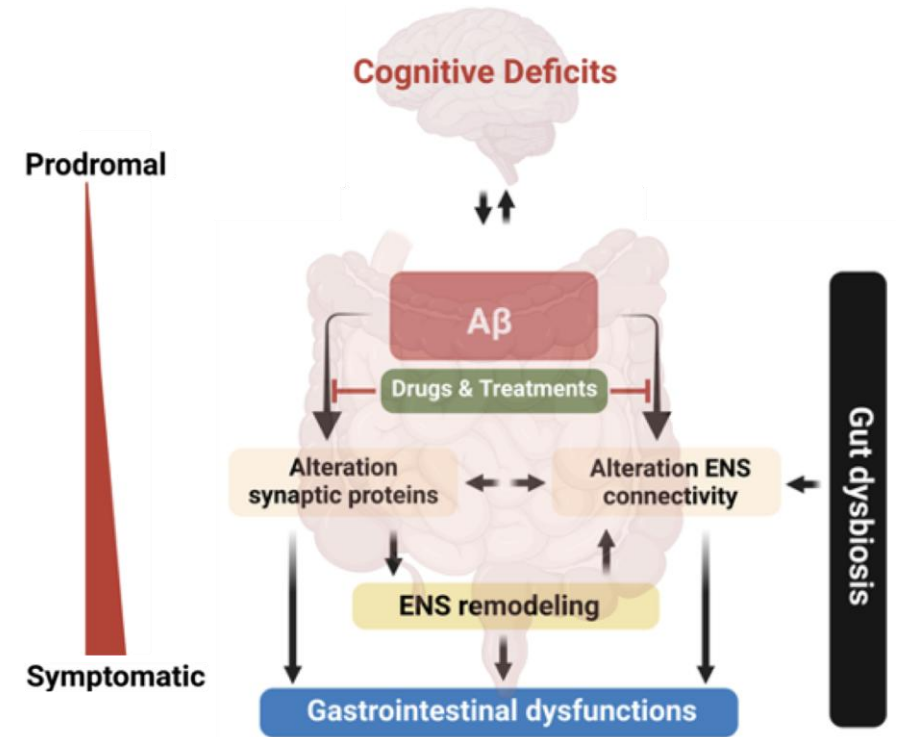
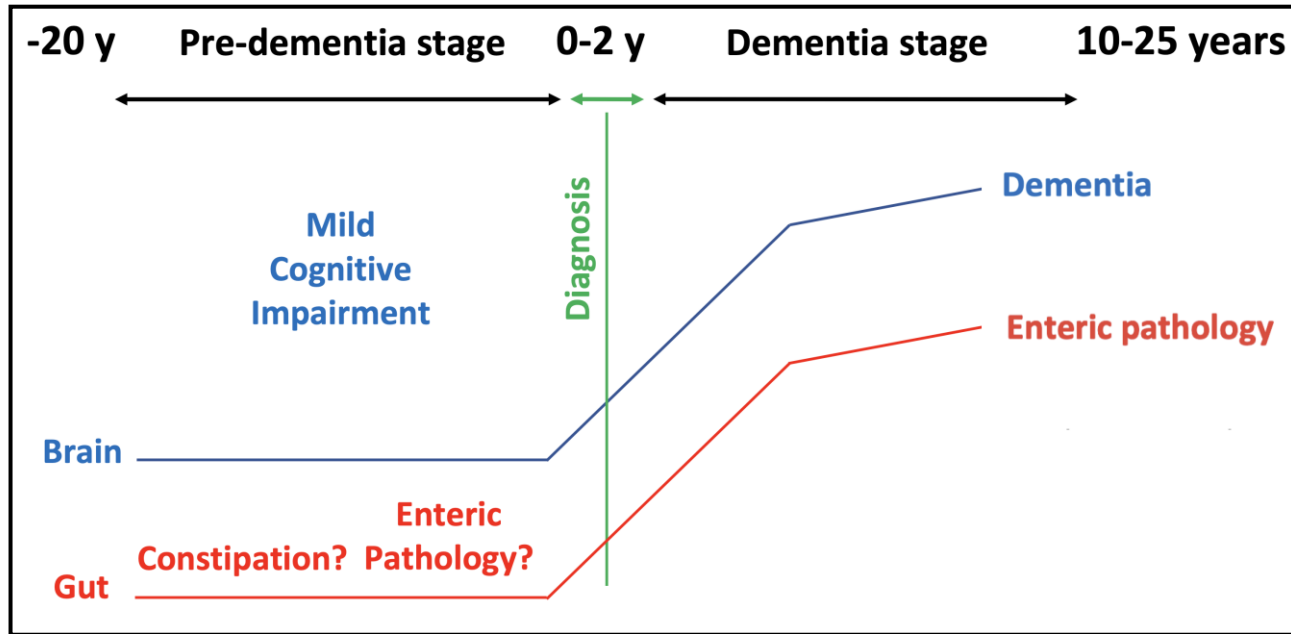


- Early GI disorders in AD patients (*Nedelec et al., 2022*)

- Early GI disorders ↑ the risk of developing severe AD (*Nakase et al., 2022*)

- Dysbiosis of intestinal microbiota in AD patients (*Liu et al., 2019*)

- Alteration in the composition of metabolites in AD patients (*Wu et al., 2021*)



What are the beneficial effects of bacterial metabolites on cognitive and digestive functions in Alzheimer's disease ?

Are there early digestive impairments in Alzheimer's mouse model ?



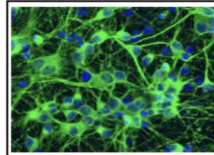
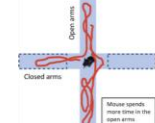
Are there early digestive impairments in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

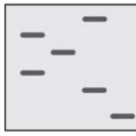
In vivo tests
+ Sacrifice
(6-month-old group)

Digestive characterization
TTT & FPO

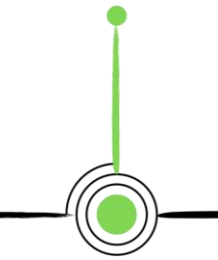
Cognitive characterization
Open field & NOR



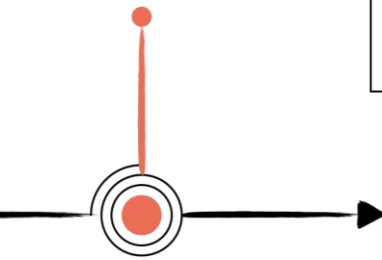
IHC
Neuronal density & connectivity
A β deposits
(A β , Hu, Tuj)



Western-Blot
Neuronal connectivity
(EphB2, SAPs)



young SAMP8



old SAMP8




Are there early digestive impairments in Alzheimer's mouse model ?

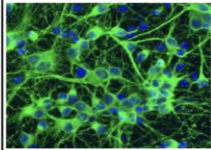
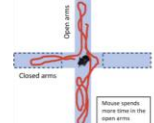
In vivo tests
+ Sacrifice
(2-month-old group)

In vivo tests
+ Sacrifice
(6-month-old group)

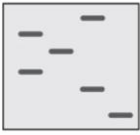
Digestive characterization
TTT & FPO



Cognitive characterization
Open field & NOR



IHC
Neuronal density & connectivity
A β deposits
(*AB*, *Hu*, *Tuj*)



Western-Blot
Neuronal connectivity
(*EphB2*, *SAPs*)


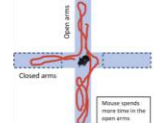


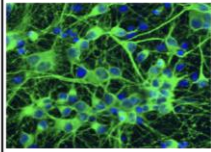
- Constipation and alterations in transit velocity as early as 2 months of age (*in vivo*)
- Memory impairments only appear only from the age of 6 months (*in vivo*)
- Amyloid- β deposits in the gut at 2 months of age and only from the age of 6 months in the brain (*ex vivo*)
- Synaptic alterations in the ENS at 2 months of age, while they appear in the brain at the age of 6 months (*in vitro*)

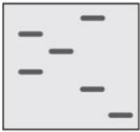
Are there early digestive impairments in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

In vivo tests
+ Sacrifice
(6-month-old group)

Digestive characterization	Cognitive characterization
TTT & FPO	Open field & NOR
	

IHC
Neuronal density & connectivity A β deposits (A β , Hu, Tuj)


Western-Blot
Neuronal connectivity (EphB2, SAPs)




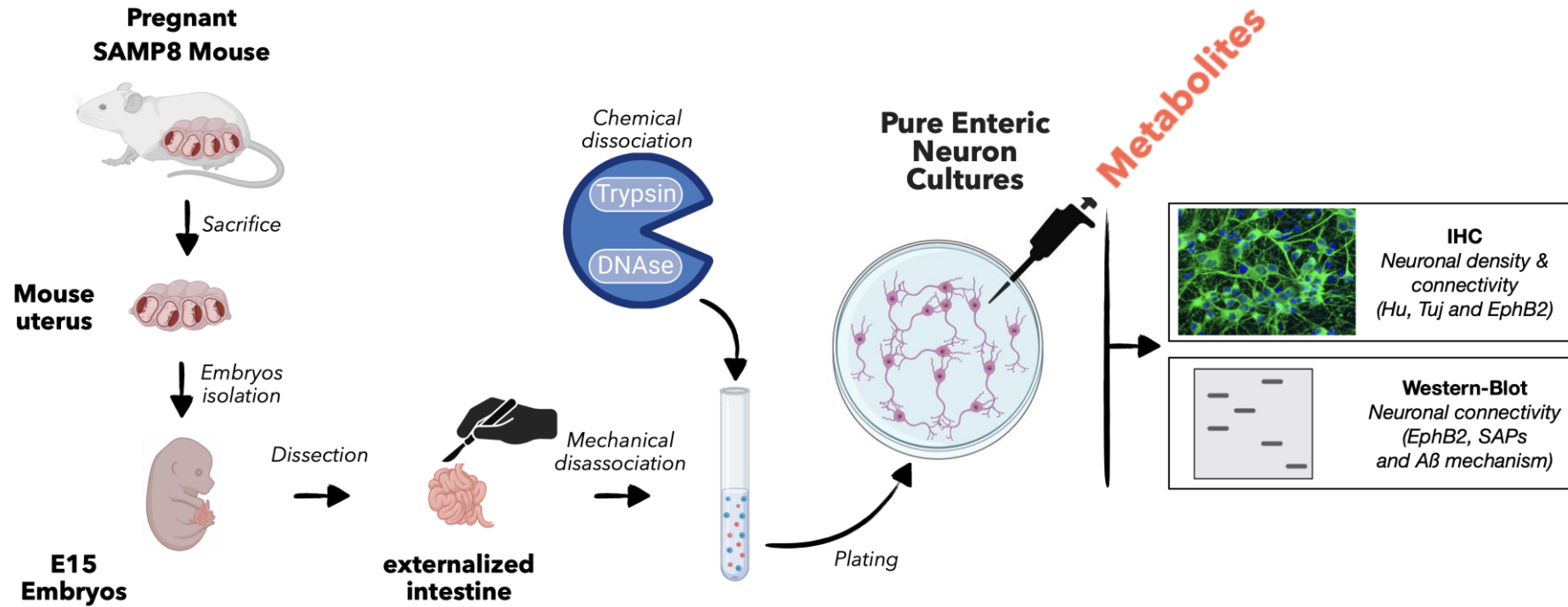
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- Synaptic alterations in the ENS at 2 months of age, while they appear in the brain at the age of 6 months (*in vitro*)

There are early digestive impairments in SAMP8 mouse

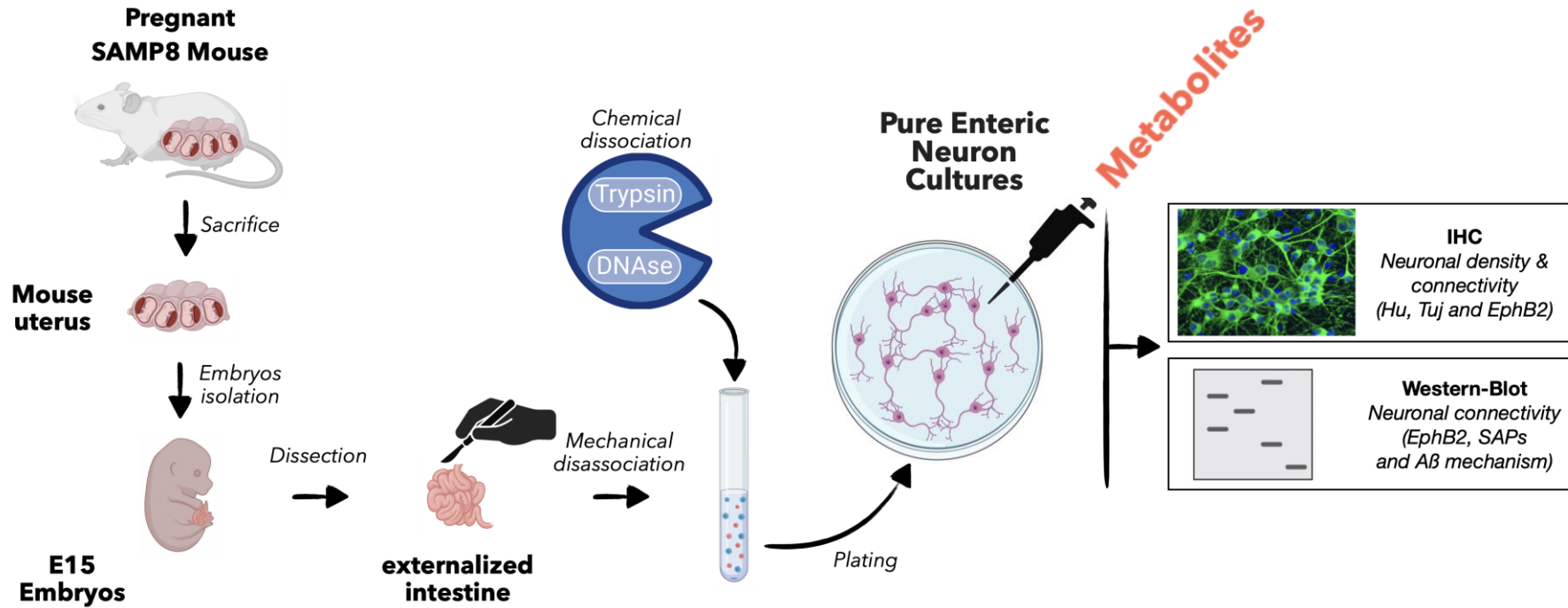
Which metabolites are capable of improving the enteric neuronal connectivity ?



Which metabolites are capable of improving the enteric neuronal connectivity ?



Which metabolites are capable of improving the enteric neuronal connectivity ?



METABOLITE	BENEFICIAL EFFECTS ?
Acétate	NO
Propionate	NO
Butyrate	YES
Lactate	NO
GABA	NO
Spermine	NO
Spermidine	NO
Kynurénine	NO
Vitamine B9	NO
Vitamine B12	NO

Butyrate treatment improves the enteric neuronal connectivity *in vitro*

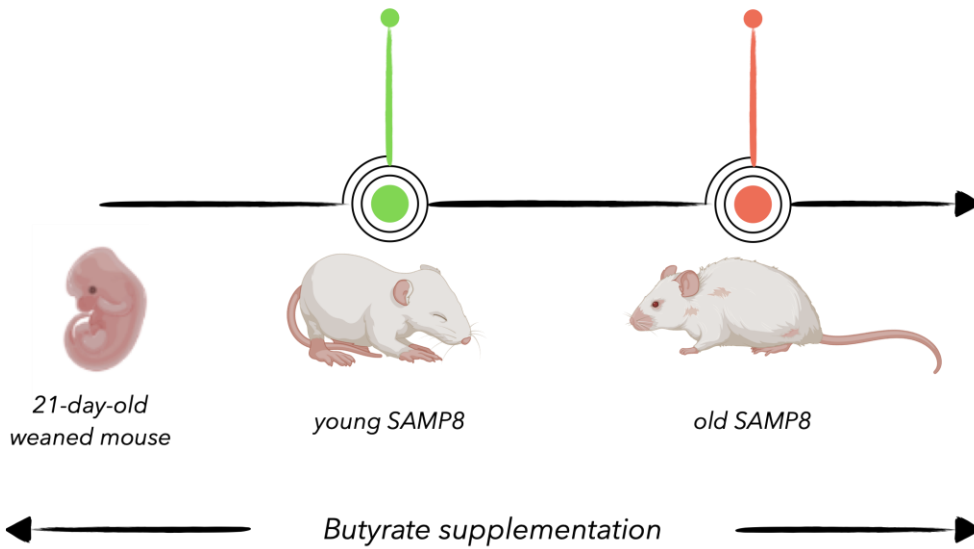
Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?



Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

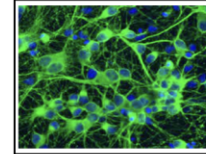
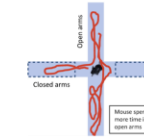
In vivo tests
+ Sacrifice
(6-month-old group)



Digestive characterization
TTT & FPO



Cognitive characterization
Open field & NOR



IHC
Neuronal density & connectivity
Aβ deposits
(*Aβ*, *Hu*, *Tuj*)

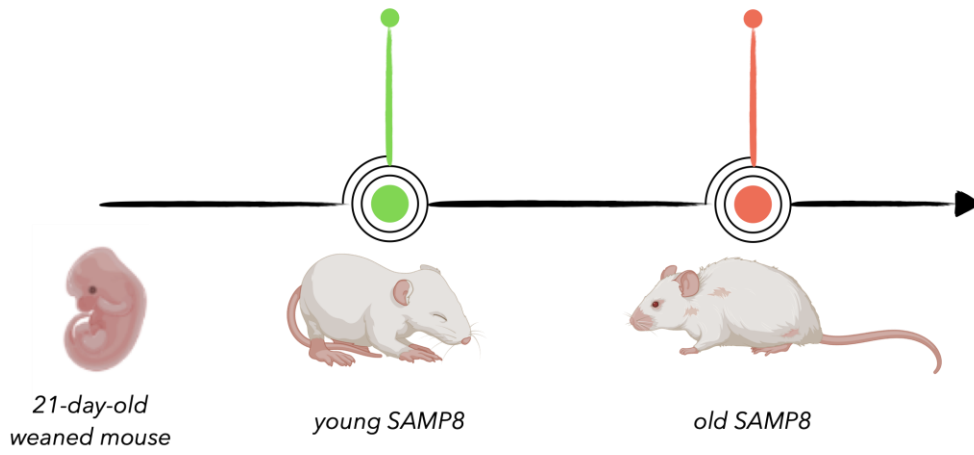


Western-Blot
Neuronal connectivity
(*EphB2*, *SAPs*)

Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?


In vivo tests
+ Sacrifice
(2-month-old group)

In vivo tests
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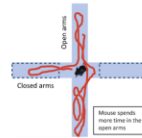


← Butyrate supplementation →

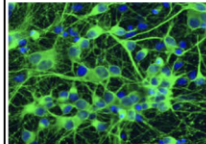
Digestive characterization
TTT & FPO




Cognitive characterization
Open field & NOR



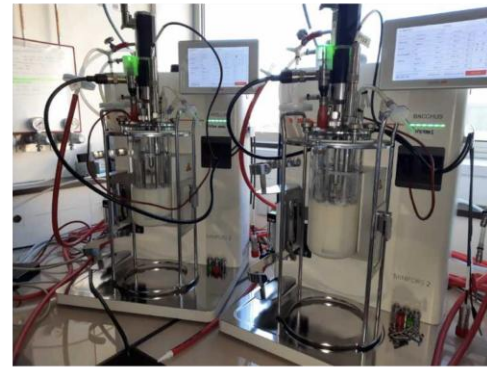
Mouse spends more time in the open arms



IHC
Neuronal density & connectivity
Aβ deposits
(*Aβ*, *Hu*, *Tuj*)



Western-Blot
Neuronal connectivity
(*EphB2*, *SAPs*)



Dr. Hélène Falentin



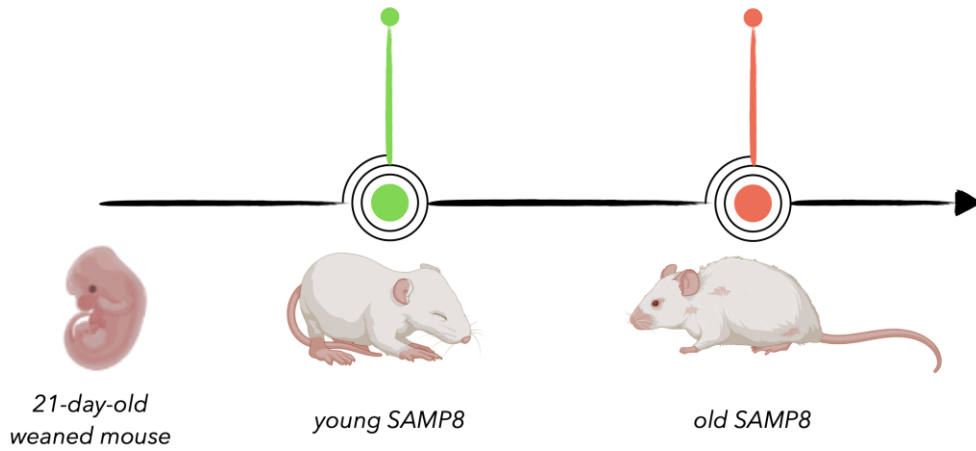
Marina Gibraine

Butyrate production through milk fermentation
using a bacterial consortium

Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

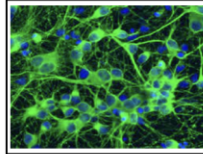
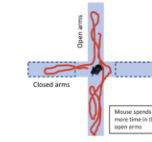
In vivo tests
+ Sacrifice
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Digestive characterization
TTT & FPO



Cognitive characterization
Open field & NOR



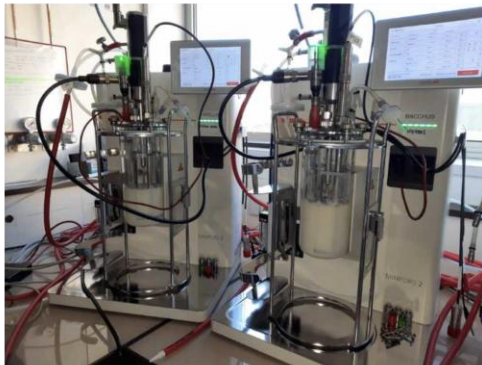
IHC
Neuronal density & connectivity
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(A β , Hu, Tuj)



Western-Blot
Neuronal connectivity
(EphB2, SAPs)



Work in progress ...



Dr. H el ene Falentin



Marina Gibraine

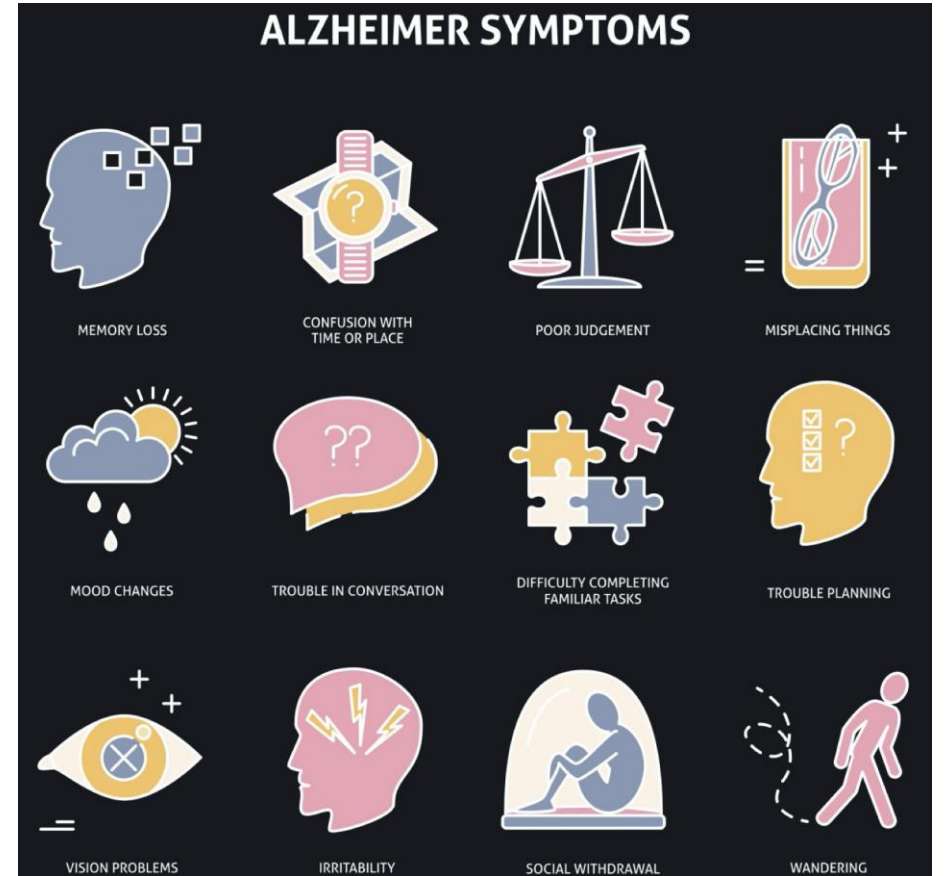
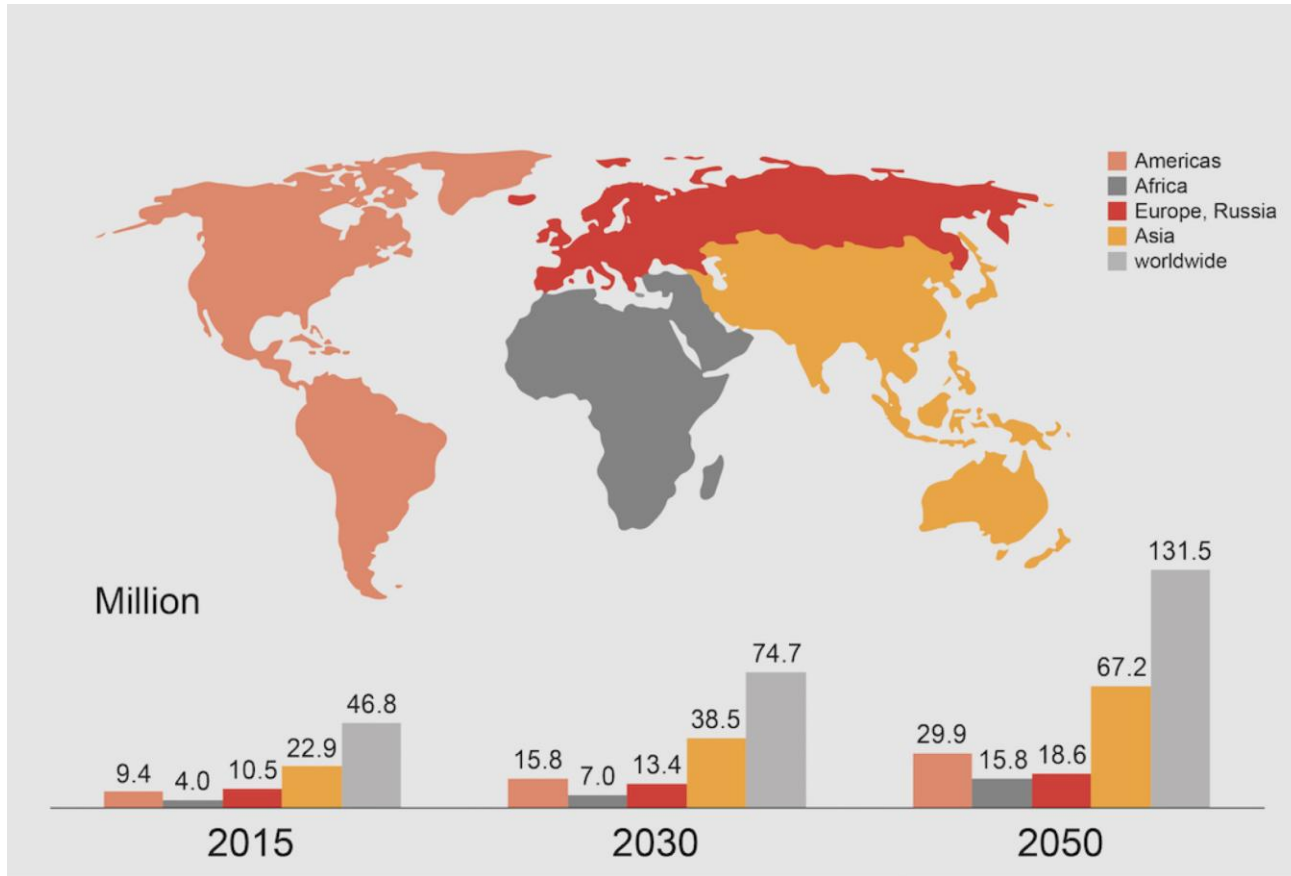
Butyrate production through milk fermentation
using a bacterial consortium

What are the beneficial effects of bacterial metabolites on cognitive and digestive functions in Alzheimer's disease ?

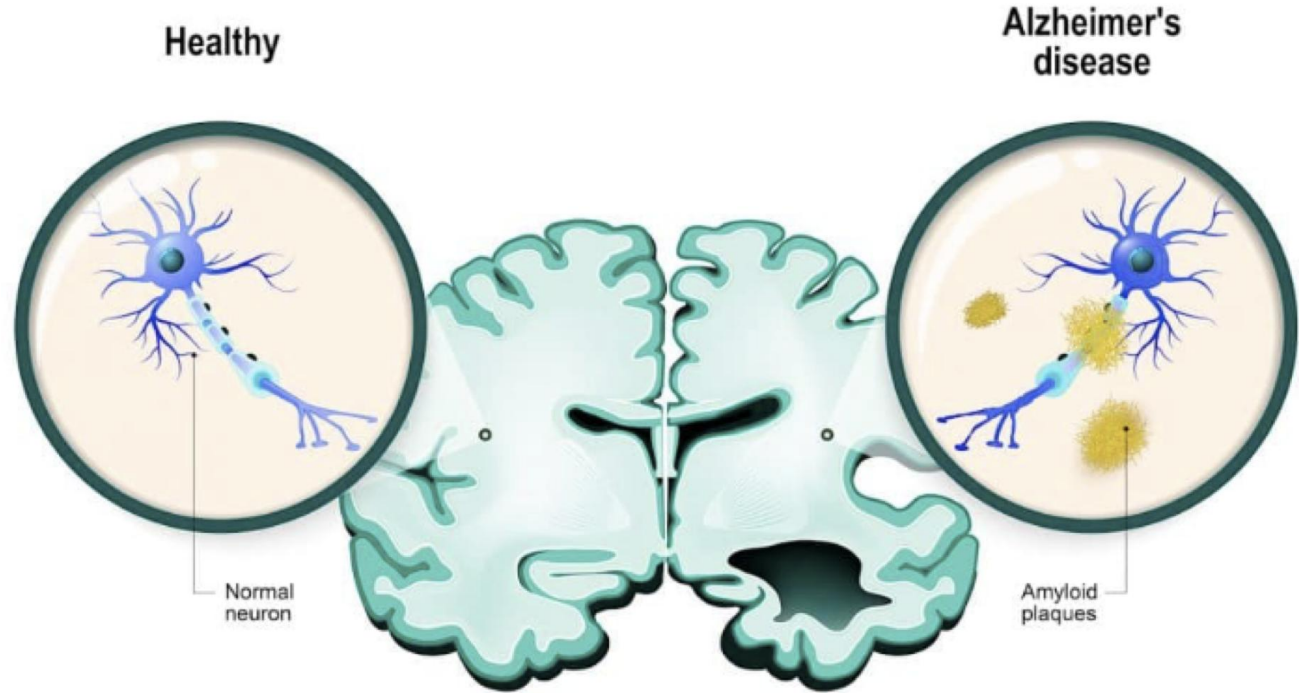
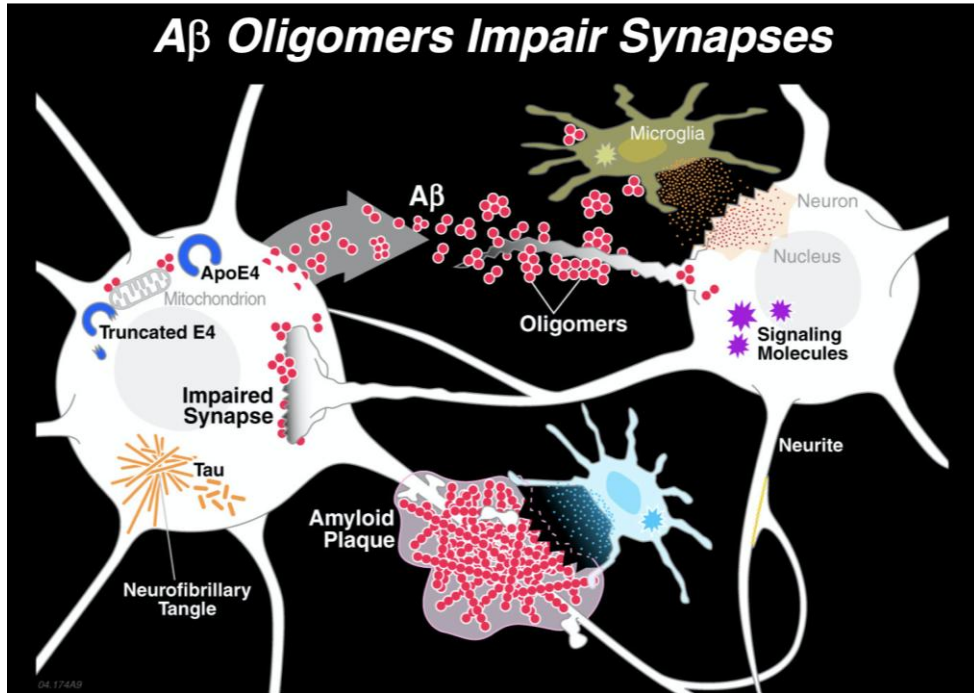


Rodrigue BROSSAUD
TENS & STLO laboratories

Alzheimer's disease : epidemiology and symptoms

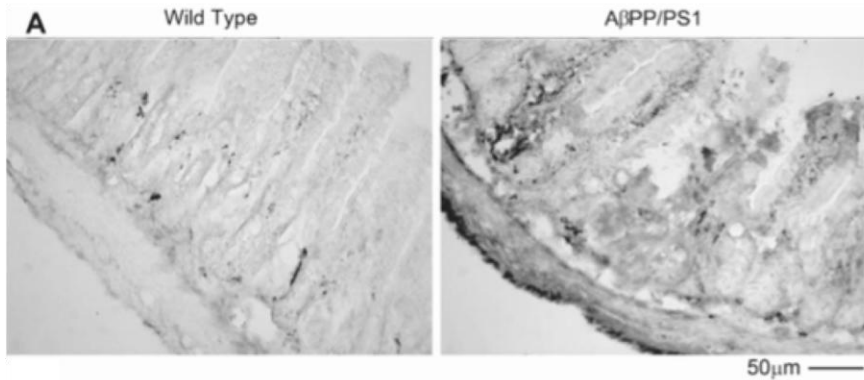


Alzheimer's disease : Amyloid- β toxicity

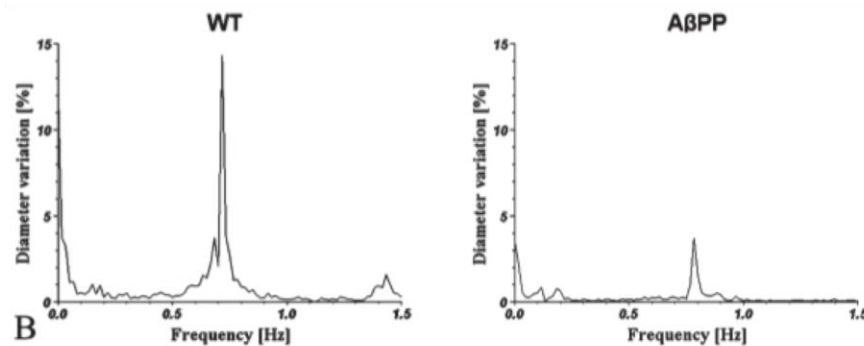


Alzheimer's disease : A gut-brain disease ?

Animal models

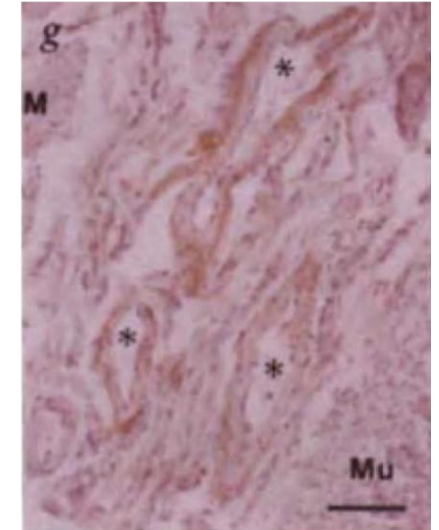
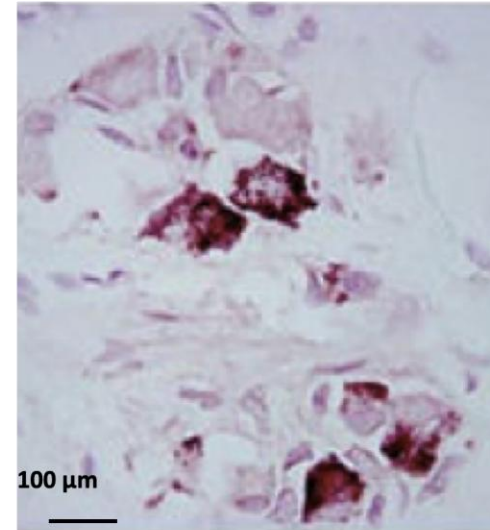


- Intestinal amyloid aggregates
(Puig et al., 2015)



- Impairments of digestive motricity
(Semar et al., 2013)

Humans



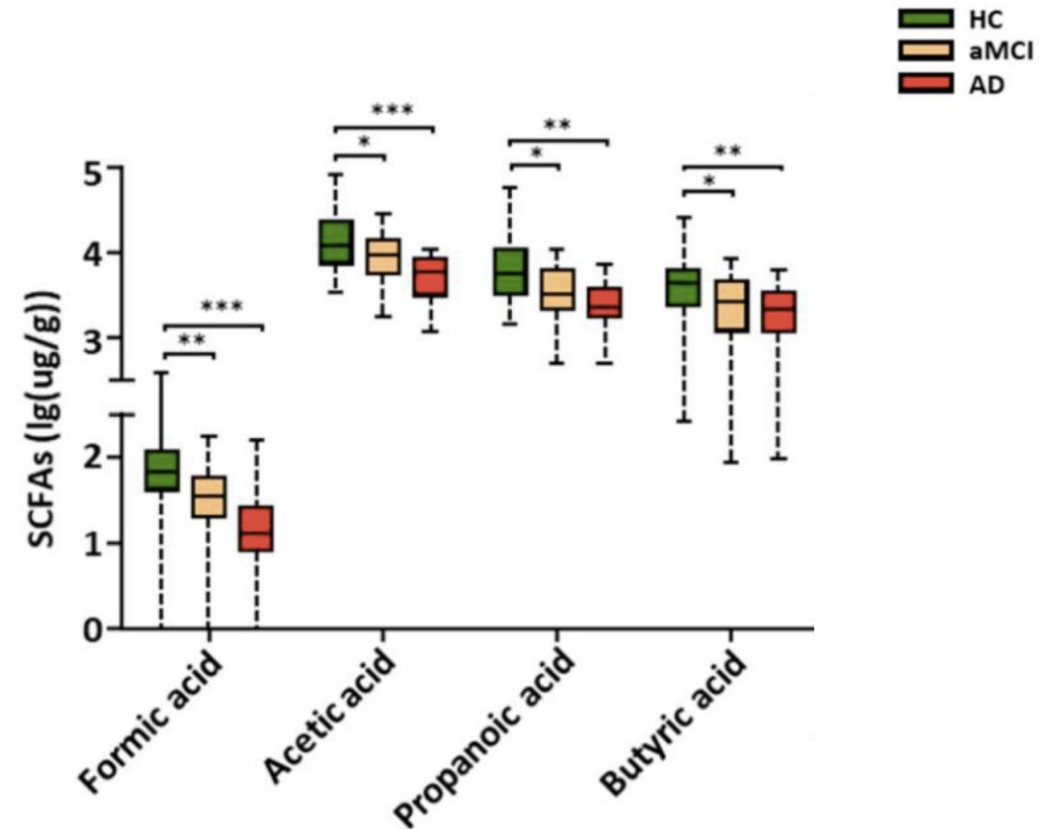
- Intestinal amyloid aggregates
(Joachim et al., 1989 ; Puig et al., 2015)

Alzheimer's disease : A gut-brain disease ?

	Diagnosis within 0-2 years				Diagnosis within 2-10 years			
	UK		France		UK		France	
	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value	OR (corrected 95% CI)	Corrected p value
Major depressive disorder, F32	2.14 (1.77-2.59)	<0.0001	3.41 (3.04-3.84)	<0.0001	1.34 (1.15-1.56)	<0.0001	1.73 (1.45-2.07)	<0.0001
Anxiety, F41	2.02 (1.69-2.41)	<0.0001	1.93 (1.71-2.17)	<0.0001	1.36 (1.18-1.56)	<0.0001	1.5 (1.26-1.78)	<0.0001
Reaction to severe stress and adjustment disorders, F43	2.34 (1.76-3.11)	<0.0001	2.1 (1.61-2.75)	<0.0001	1.4 (1.12-1.77)	<0.0001	1.83 (1.36-2.46)	<0.0001
Hearing loss, H91	1.28 (1.07-1.52)	0.0001	1.95 (1.35-2.82)	<0.0001	1.19 (1.04-1.36)	0.0006	1.51 (1.01-2.26)	0.033
Constipation, K59	1.41 (1.23-1.63)	<0.0001	1.66 (1.47-1.87)	<0.0001	1.31 (1.16-1.49)	<0.0001	1.59 (1.33-1.89)	<0.0001
Spondylosis, M47	1.25 (0.93-1.69)	0.933	1.45 (1.22-1.72)	<0.0001	1.26 (1.05-1.5)	0.0005	1.62 (1.32-1.98)	<0.0001
Memory loss symptom, R41	31.5 (24.18-41.05)	<0.0001	16.5 (10.39-26.19)	<0.0001	7.63 (5.95-9.79)	<0.0001	4.41 (2.3-8.48)	<0.0001
Malaise and fatigue, R53	1.36 (1.17-1.58)	<0.0001	1.78 (1.59-2.0)	<0.0001	1.23 (1.08-1.39)	<0.0001	1.59 (1.36-1.86)	<0.0001
Syncope and collapse, R55	1.95 (1.53-2.48)	<0.0001	2.49 (1.68-3.69)	<0.0001	1.23 (1.01-1.5)	0.034	1.57 (1.06-2.34)	0.007
Abnormal weight loss, R63	2.1 (1.68-2.62)	<0.0001	3.12 (2.41-4.02)	<0.0001	1.47 (1.22-1.77)	<0.0001	1.88 (1.35-2.62)	<0.0001

Both CIs and p values were corrected for multiple comparisons. OR=odds ratio. *Cannot be calculated because an insufficient number of presentations w

Table 2: ORs for all variables individually associated with a future diagnosis of Alzheimer's disease in the 2-10 years before diagnosis

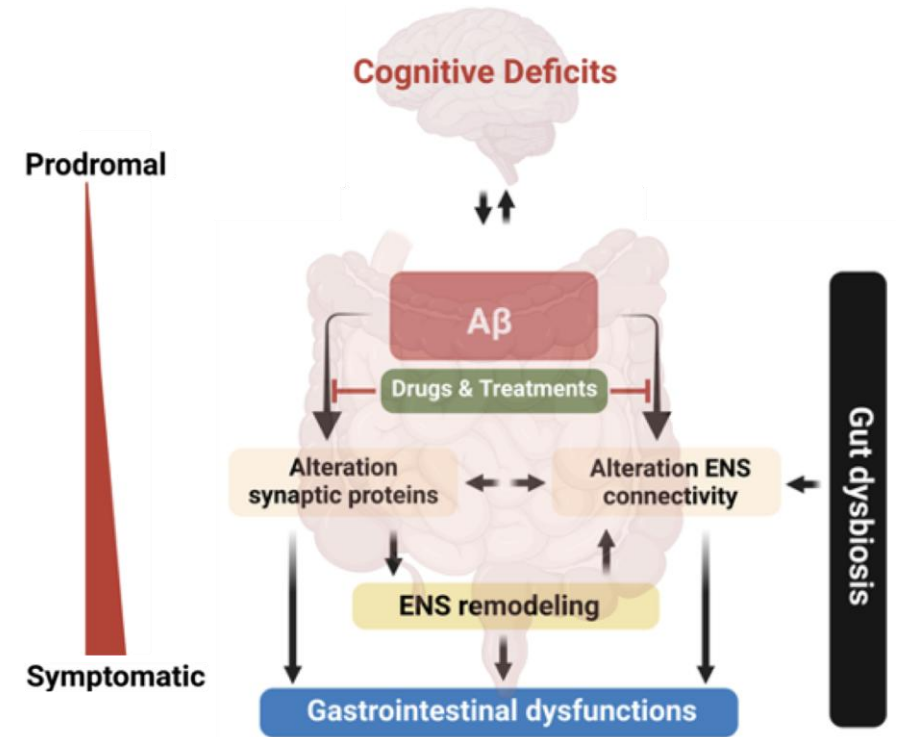
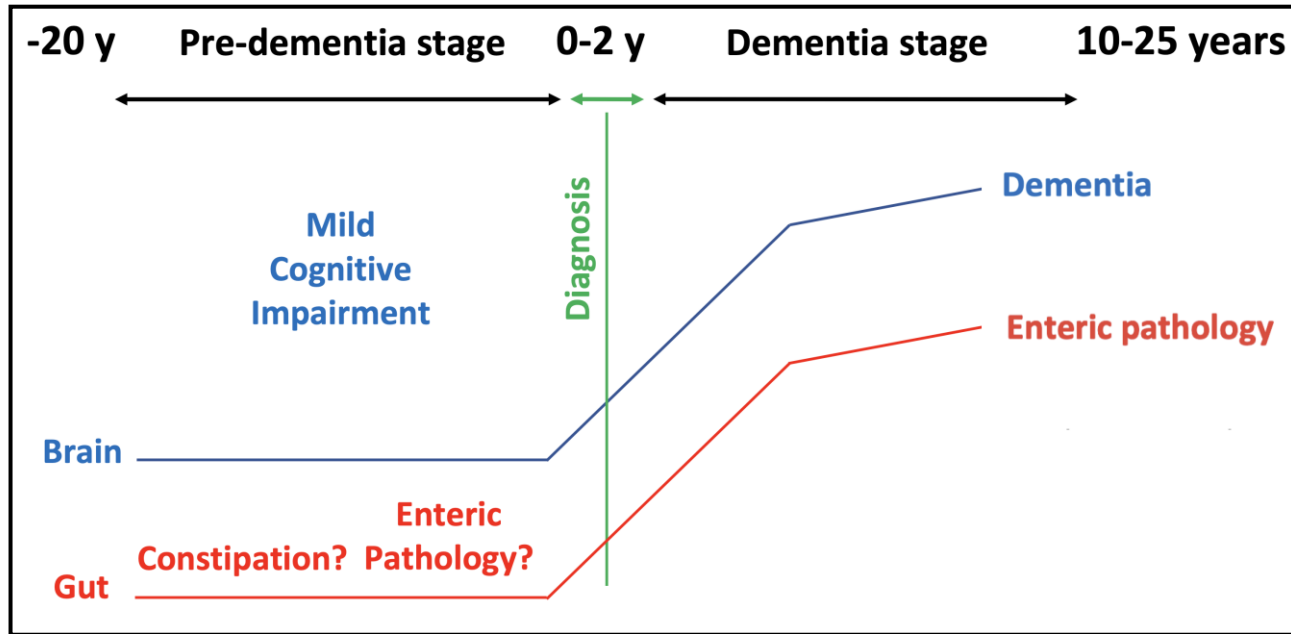


- Early GI disorders in AD patients (*Nedelec et al., 2022*)

- Early GI disorders ↑ the risk of developing severe AD (*Nakase et al., 2022*)

- Dysbiosis of intestinal microbiota in AD patients (*Liu et al., 2019*)

- Alteration in the composition of metabolites in AD patients (*Wu et al., 2021*)



What are the beneficial effects of bacterial metabolites on cognitive and digestive functions in Alzheimer's disease ?

Are there early digestive impairments in Alzheimer's mouse model ?



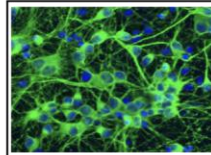
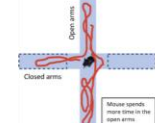
Are there early digestive impairments in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

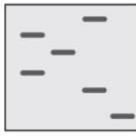
In vivo tests
+ Sacrifice
(6-month-old group)

Digestive characterization
TTT & FPO

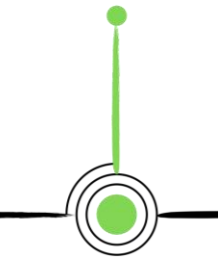
Cognitive characterization
Open field & NOR



IHC
Neuronal density & connectivity
A β deposits
(A β , Hu, Tuj)




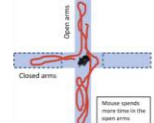
Western-Blot
Neuronal connectivity
(EphB2, SAPs)

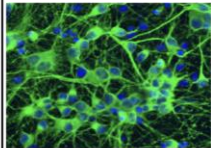



Are there early digestive impairments in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

In vivo tests
+ Sacrifice
(6-month-old group)

Digestive characterization	Cognitive characterization
TTT & FPO	Open field & NOR
	

	IHC Neuronal density & connectivity A β deposits (A β , Hu, Tuj)
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	Western-Blot Neuronal connectivity (EphB2, SAPs)
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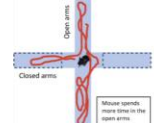


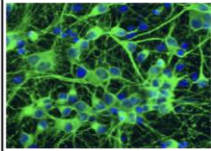
- Constipation and alterations in transit velocity as early as 2 months of age (*in vivo*)
- Memory impairments only appear only from the age of 6 months (*in vivo*)
- Amyloid- β deposits in the gut at 2 months of age and only from the age of 6 months in the brain (*ex vivo*)
- Synaptic alterations in the ENS at 2 months of age, while they appear in the brain at the age of 6 months (*in vitro*)

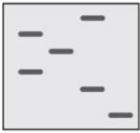
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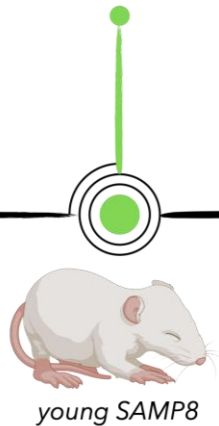
In vivo tests
+ Sacrifice
(2-month-old group)

In vivo tests
+ Sacrifice
(6-month-old group)

Digestive characterization	Cognitive characterization
TTT & FPO	Open field & NOR
	

IHC
Neuronal density & connectivity A β deposits (A β , Hu, Tuj)


Western-Blot
Neuronal connectivity (EphB2, SAPs)




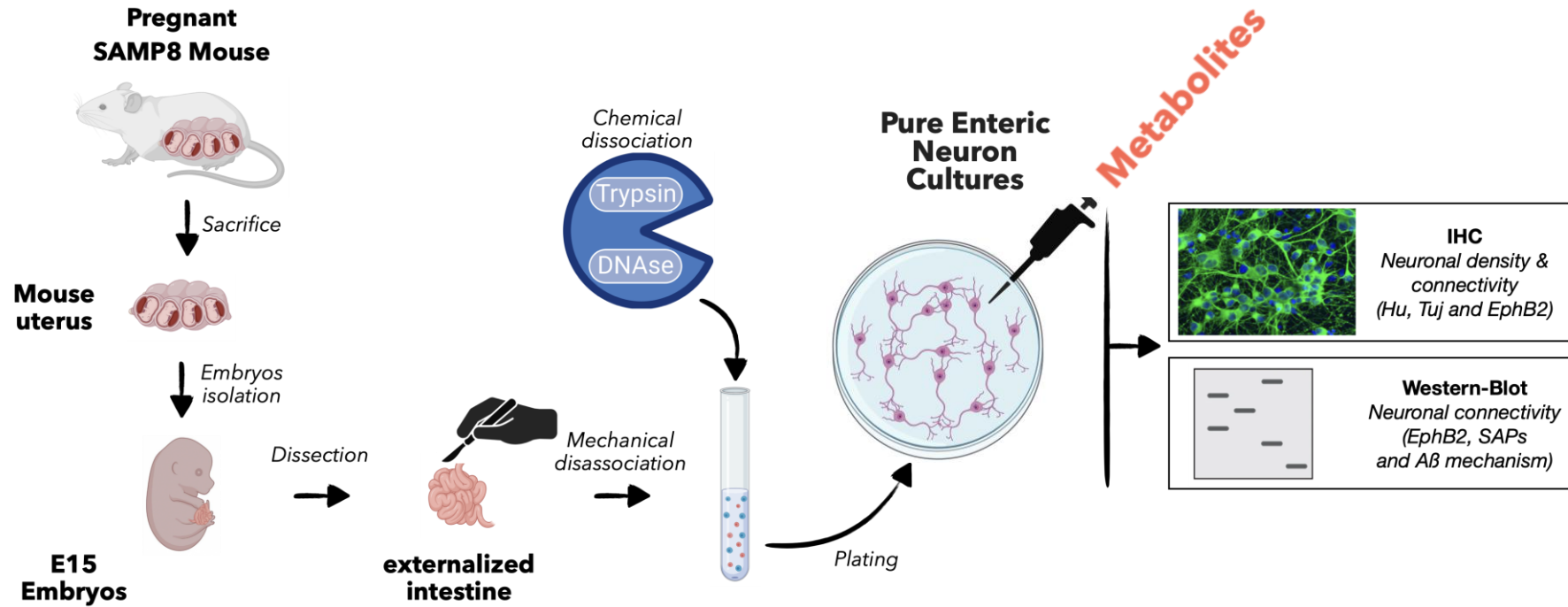
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There are early digestive impairments in SAMP8 mouse

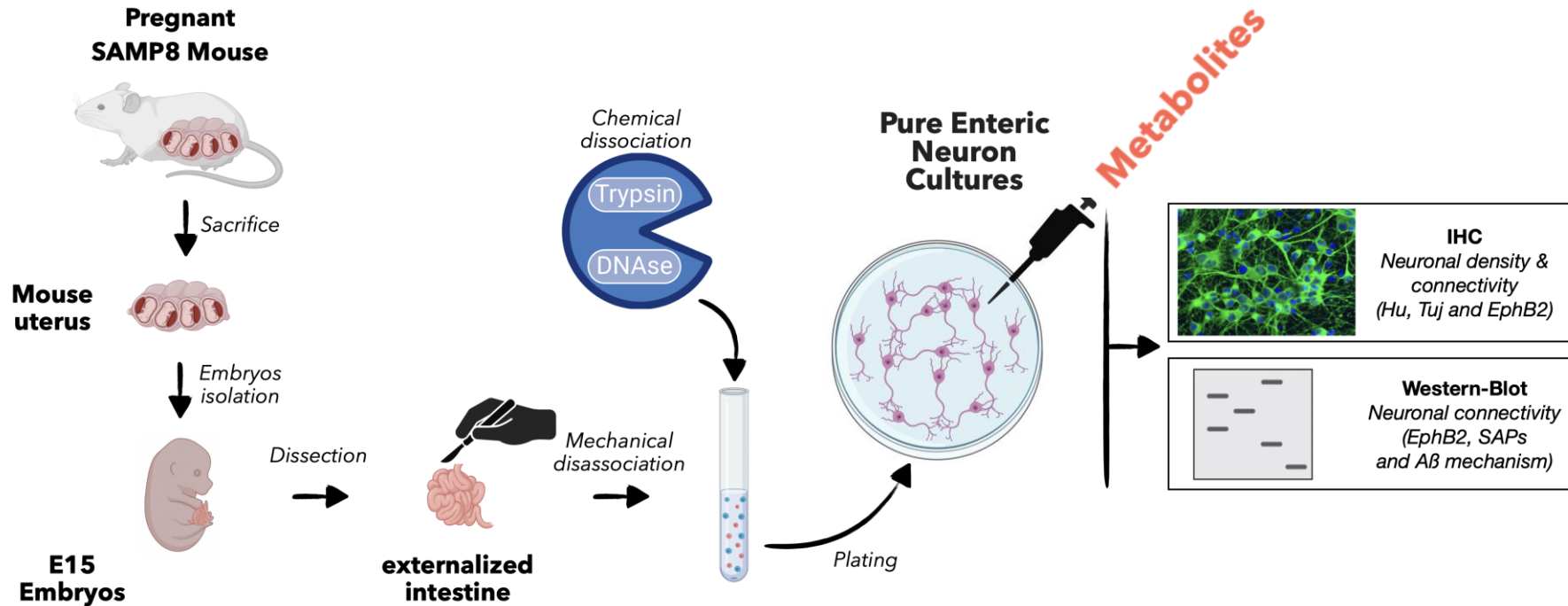
Which metabolites are capable of improving the enteric neuronal connectivity ?



Which metabolites are capable of improving the enteric neuronal connectivity ?



Which metabolites are capable of improving the enteric neuronal connectivity ?



METABOLITE	BENEFICIAL EFFECTS ?
Acétate	NO
Propionate	NO
Butyrate	YES
Lactate	NO
GABA	NO
Spermine	NO
Spermidine	NO
Kynurénine	NO
Vitamine B9	NO
Vitamine B12	NO

Butyrate treatment improves the enteric neuronal connectivity *in vitro*

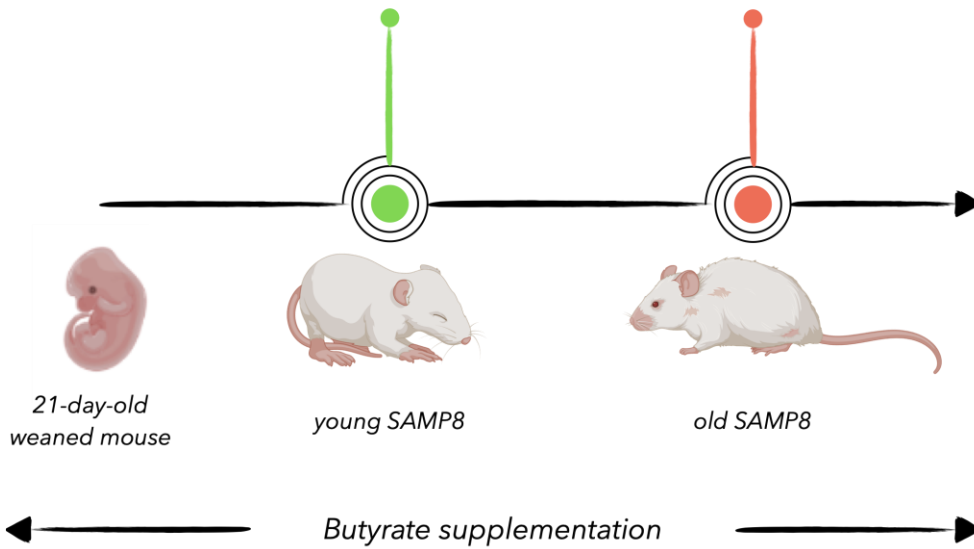
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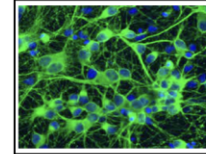
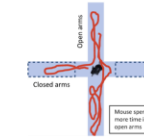
In vivo tests
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Digestive characterization
TTT & FPO



Cognitive characterization
Open field & NOR



IHC
Neuronal density & connectivity
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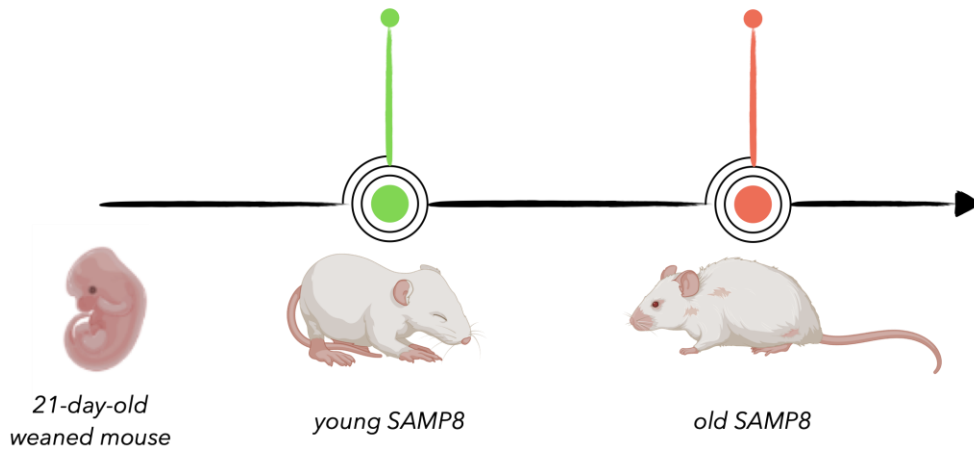


Western-Blot
Neuronal connectivity
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Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?

In vivo tests + Sacrifice (2-month-old group)

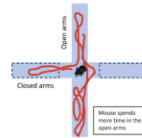
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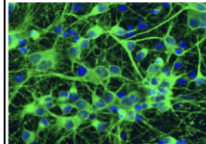
Digestive characterization
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Cognitive characterization
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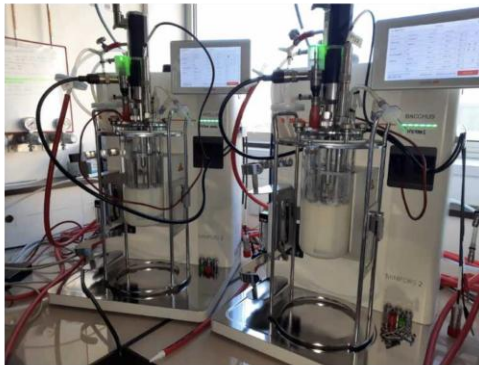
Mouse spends more time in the open arms



IHC
Neuronal density & connectivity
 $A\beta$ deposits
(*A\beta*, *Hu*, *Tuj*)



Western-Blot
Neuronal connectivity
(*EphB2*, *SAPs*)



Dr. H el ene Falentin



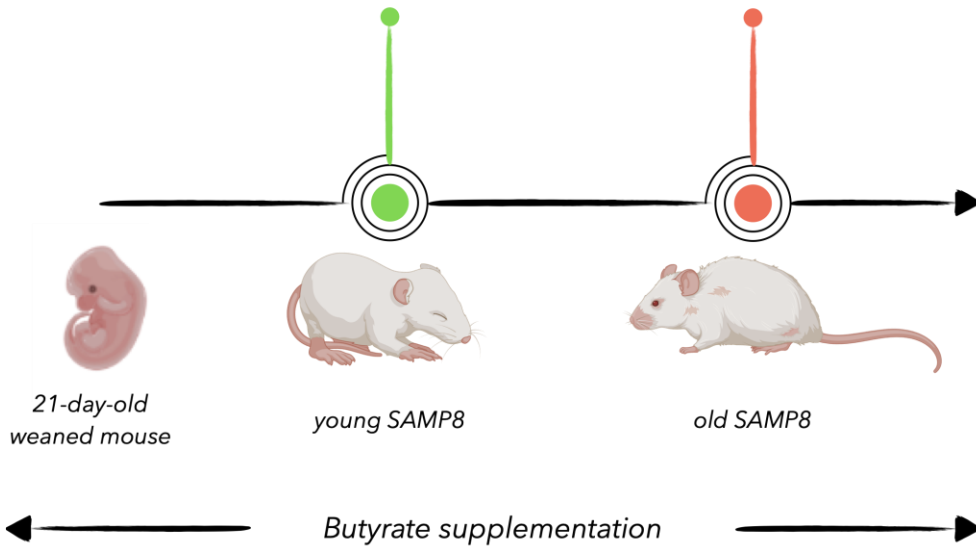
Marina Gibraine

Dairy product enriched with butyrate

Could butyrate enhance cognitive and digestive functions in Alzheimer's mouse model ?

In vivo tests
+ Sacrifice
(2-month-old group)

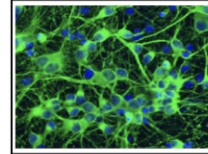
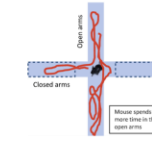
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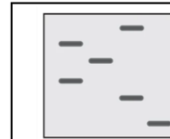
Digestive characterization
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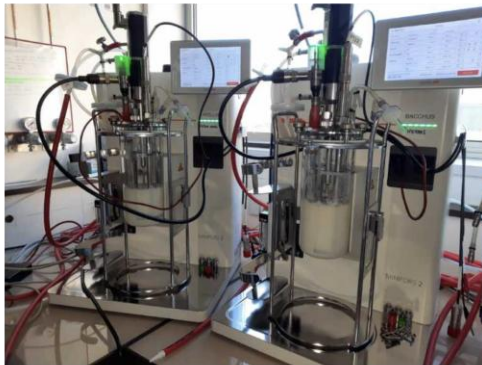
IHC
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Western-Blot
Neuronal connectivity
(*EphB2*, *SAPs*)



Work in progress ...



Dr. Hélène Falentin



Marina Gibraine

Butyrate production through milk fermentation
using a bacterial consortium

Questions & Answers



Fermentation as a lever for improving Infant Formulas : Design of a fermented formula improving brain development in newborns

Sarah BLANCHET

Directed by Sophie BLAT and by Sergine
EVEN



Context



Human milk

→ Optimal post-natal nutrition for the newborn.



Context



Human milk



Infant Formula



Context



Human milk



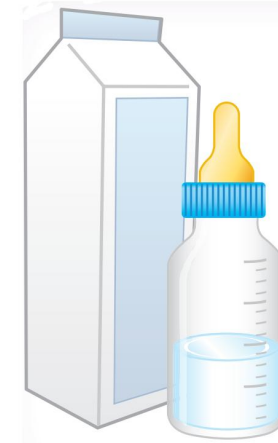
Infant Formula

Meet the nutritional needs of the newborn by:

Macronutrients : Proteins, Carbohydrates, Lipids

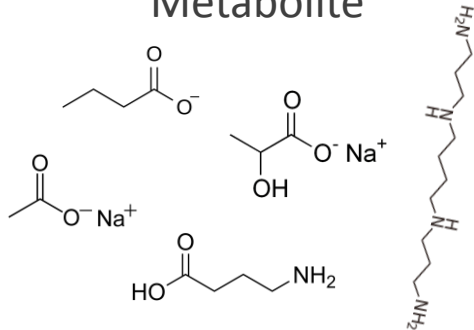
Micronutrients : Minerals, vitamins

Context



Human milk

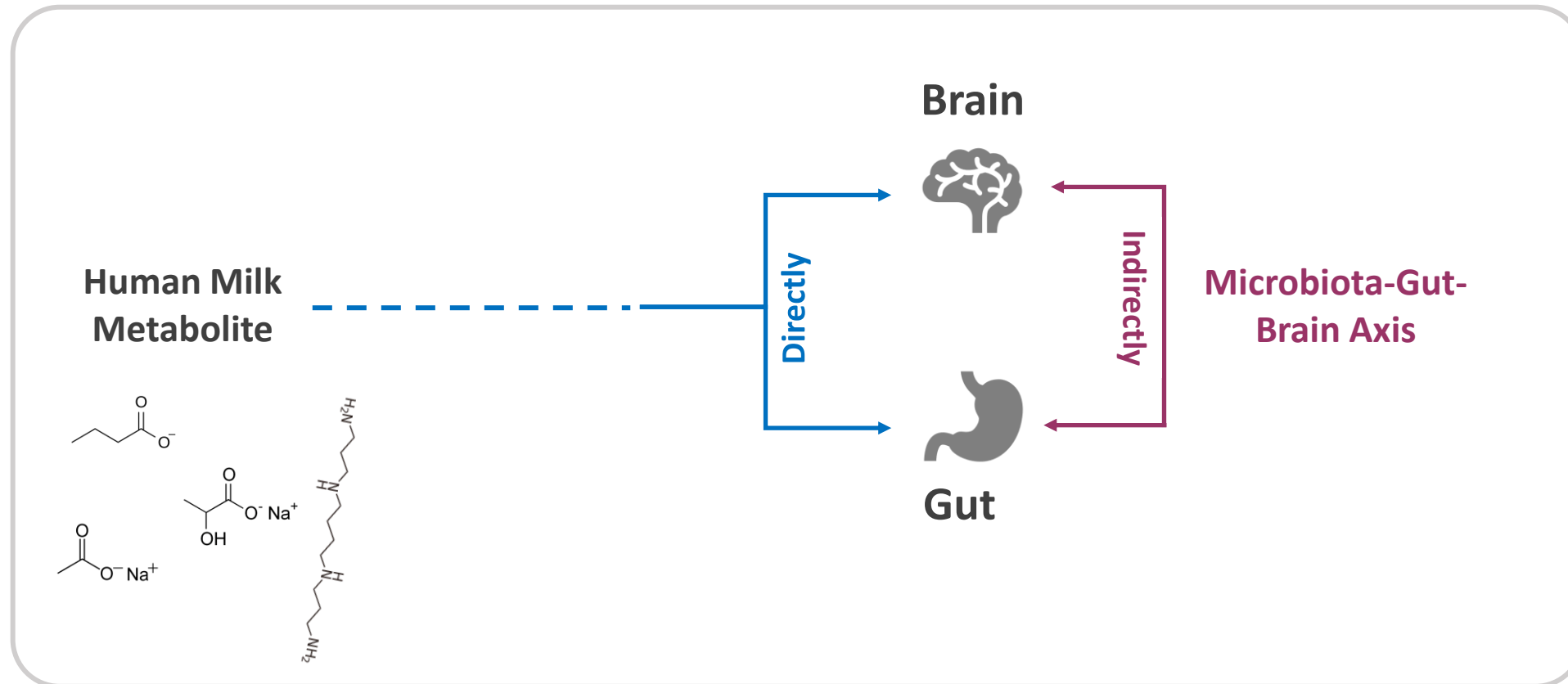
Human Milk
Metabolite



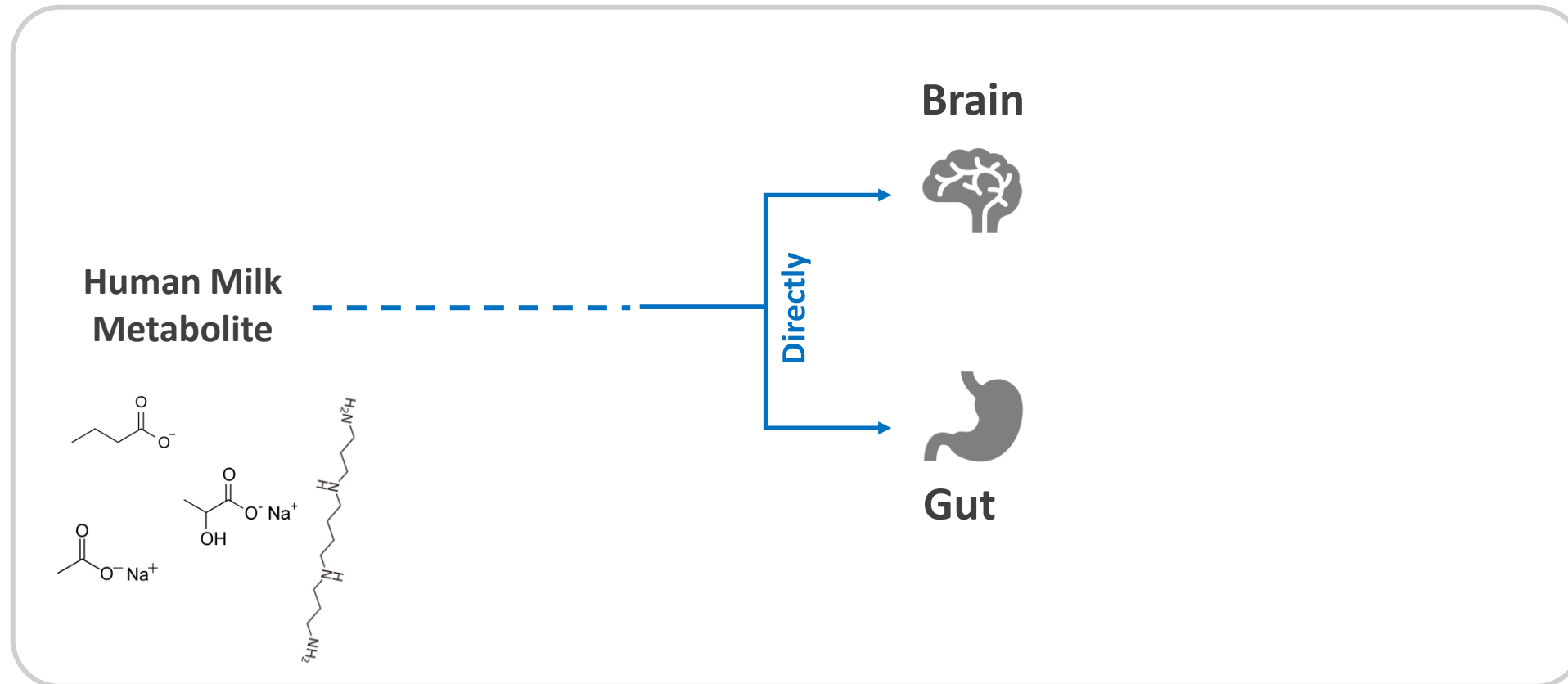
Infant Formula



Research questions

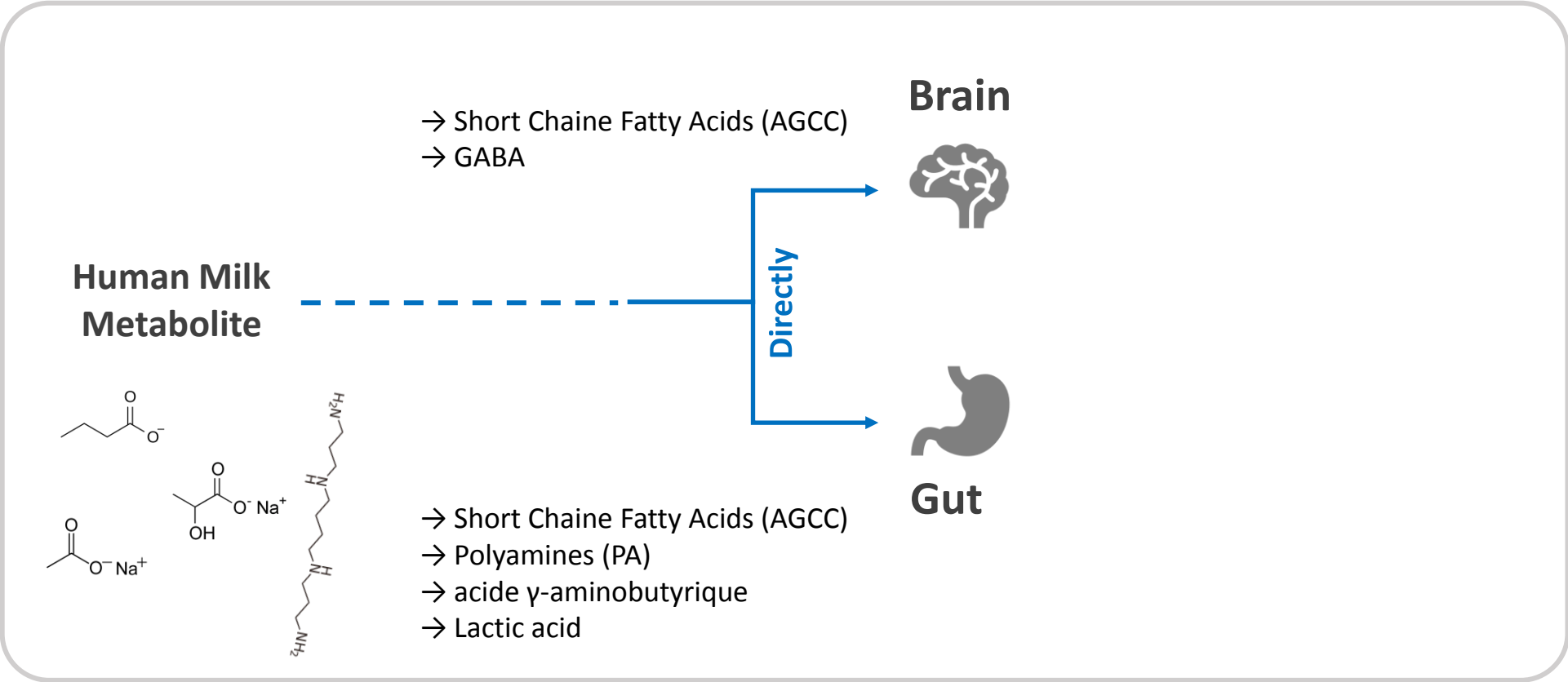


In vitro study of the metabolites



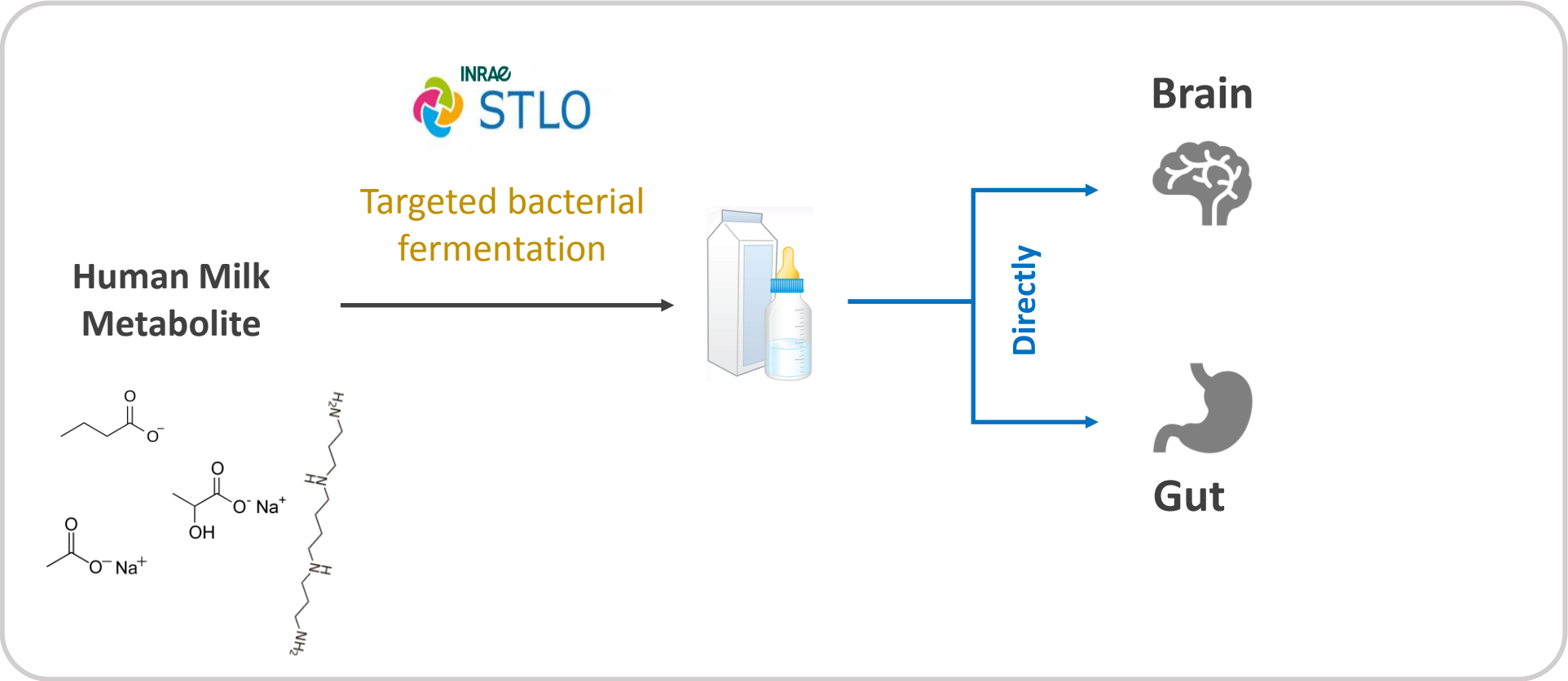
in vitro : cellular models of intestinal epithelium and central neurons (screening of relevant metabolites)

In vitro study of the metabolites

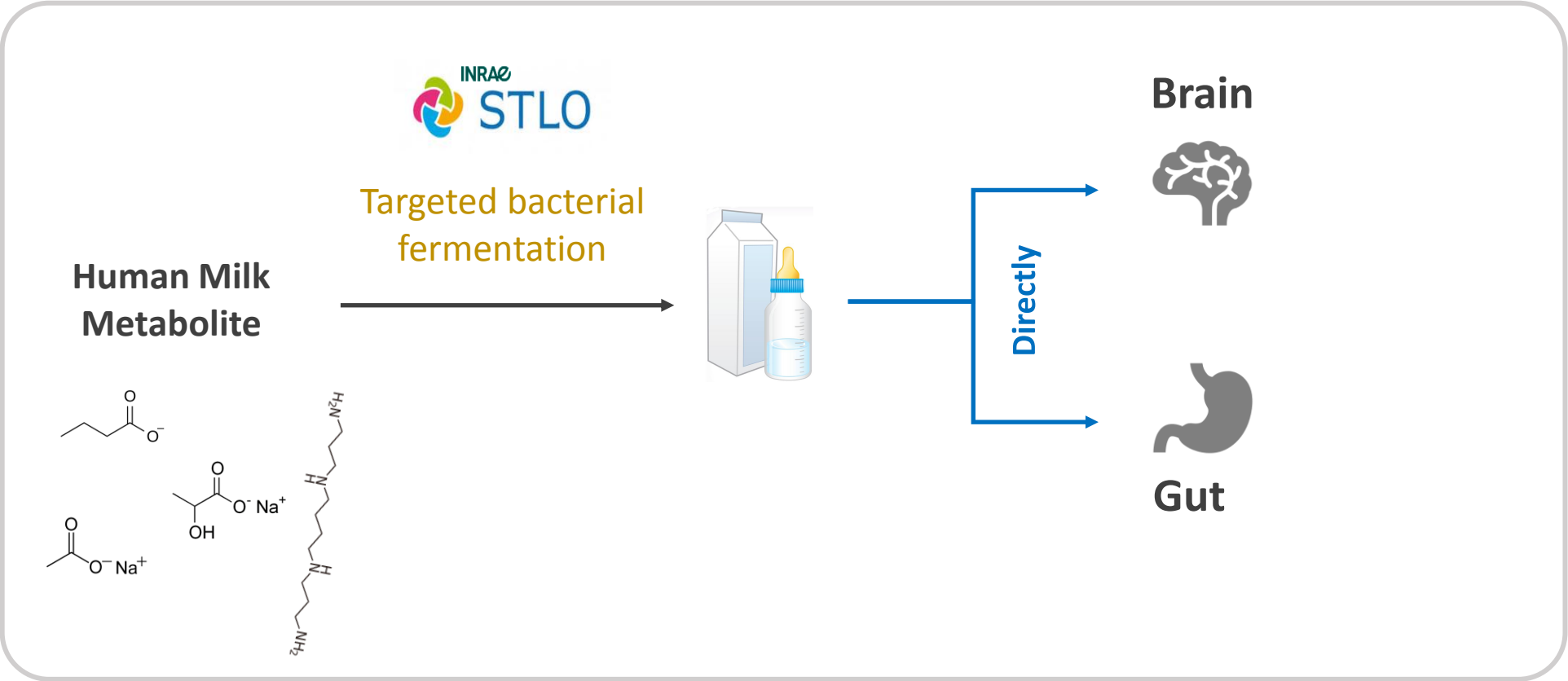


in vitro : cellular models of intestinal epithelium and central neurons (screening of relevant metabolites)

In vivo study of metabolites produced by targeted bacterial fermentation

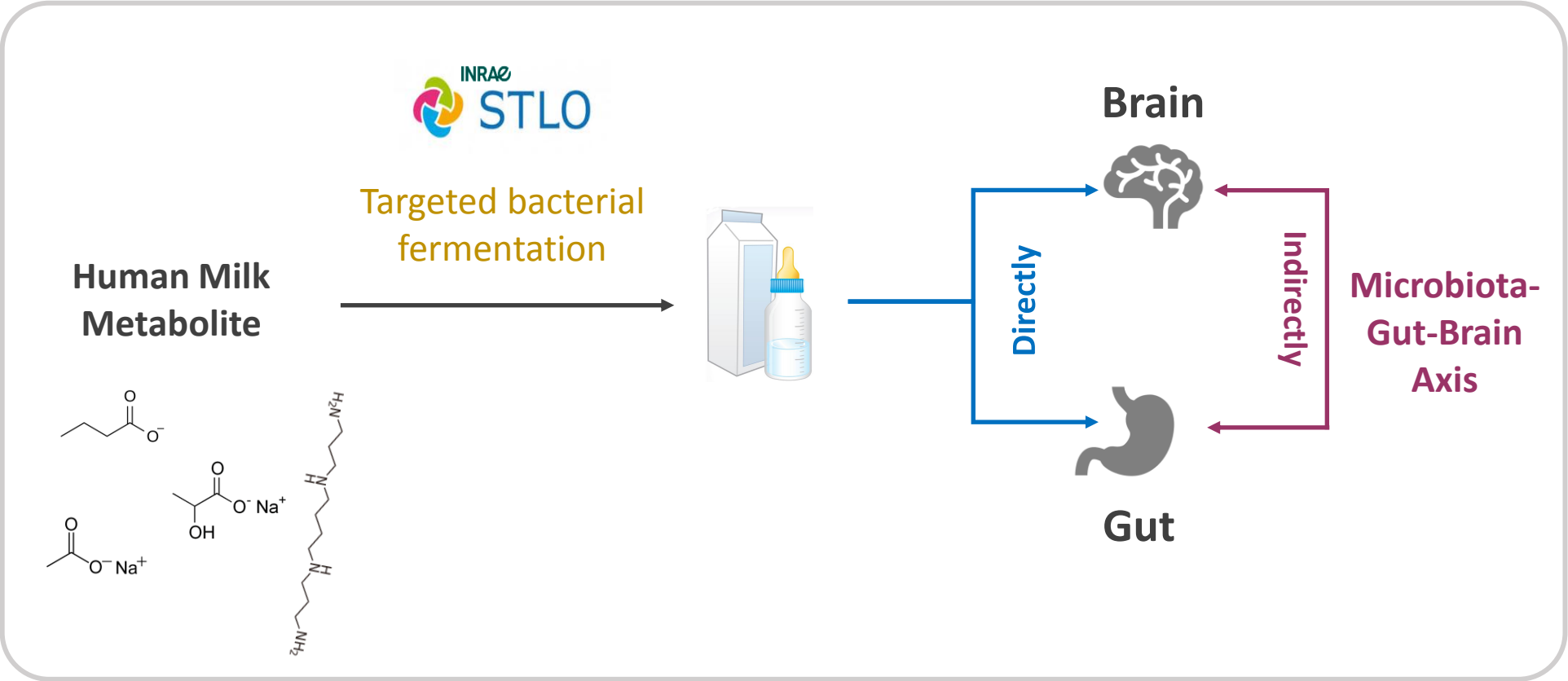


In vivo study of metabolites produced by targeted bacterial fermentation



in vivo : piglet ; the Yucatan mini-pig (preclinical model)

In vivo study of metabolites produced by targeted bacterial fermentation



in vivo : piglet ; the Yucatan mini-pig (preclinical model)

Thank you for your
attention



Questions & Answers





Thank you for attending our session

Need more information? Contact:

- Hervé LE DEIT : herve.le-deit@ouest-valorisation.fr
- Candice LAMOUREUX : candice.lamoureux@ouest-valorisation.fr
- Clair-Yves BOQUIEN : clair-yves.boquien@univ-nantes.fr
- Pierre-Etienne SADO : pierre-etienne.sado@univ-nantes.fr