



# Early prebiotic supplementation induces long-lasting consequences on microbiota composition and metabolic health of adult pigs consuming an unbalanced diet.

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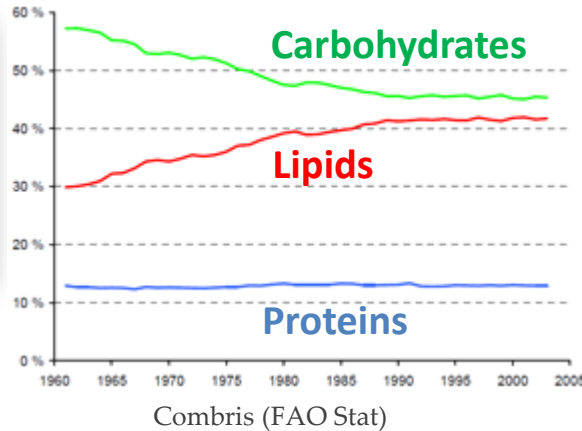
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# Food transition and evolution of non-communicable chronic diseases

## Quantity, quality and structure of food



## Lack of exercise



## Family environment

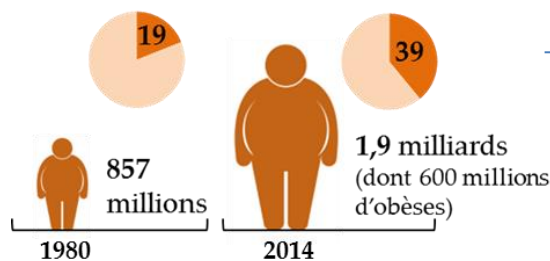


International Diabetes Federation

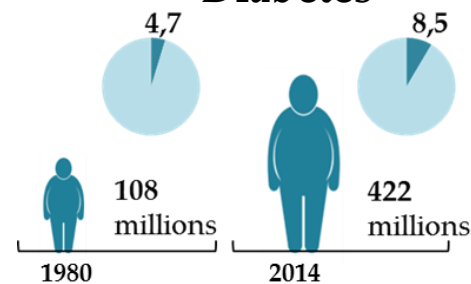
**Perinatal nutrition**

## Increased prevalence of obesity and associated metabolic disorders

### Overweight and obesity



### Diabetes



(% world population ; INSEE & OMS)

# Developmental origins of health and disease (DOHaD): Barker's hypothesis



## Importance of the early nutritional environment

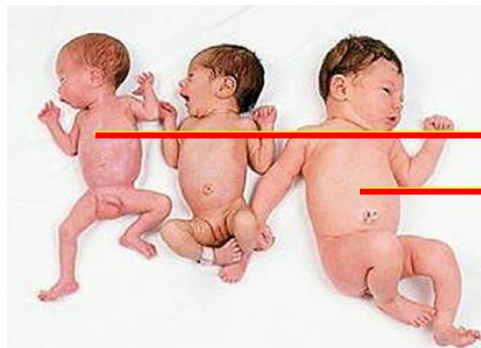
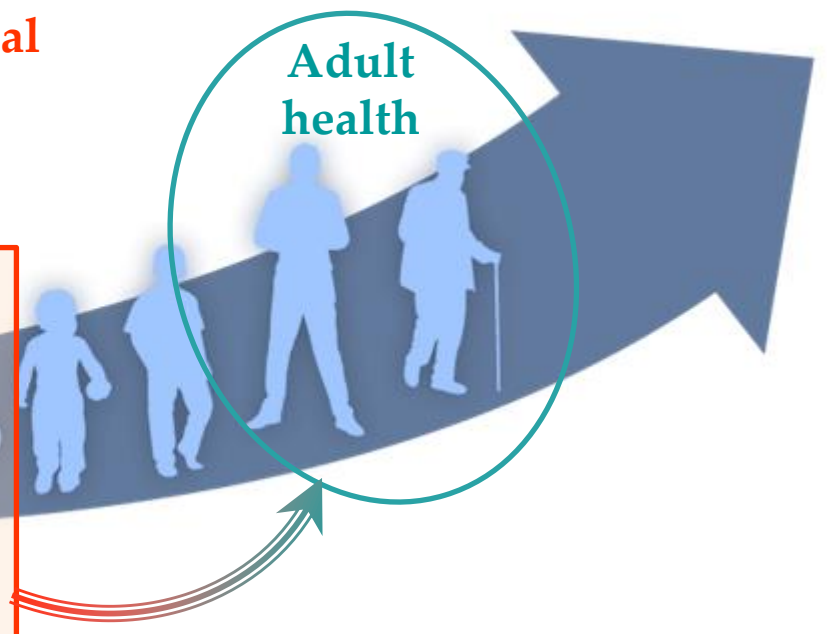


Critical developmental window



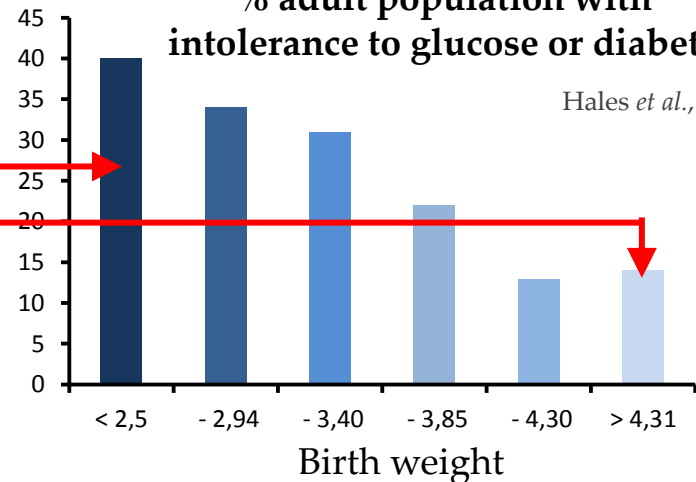
Conception – Gestation – Birth – 2 years  
= 1000 days

Adult health



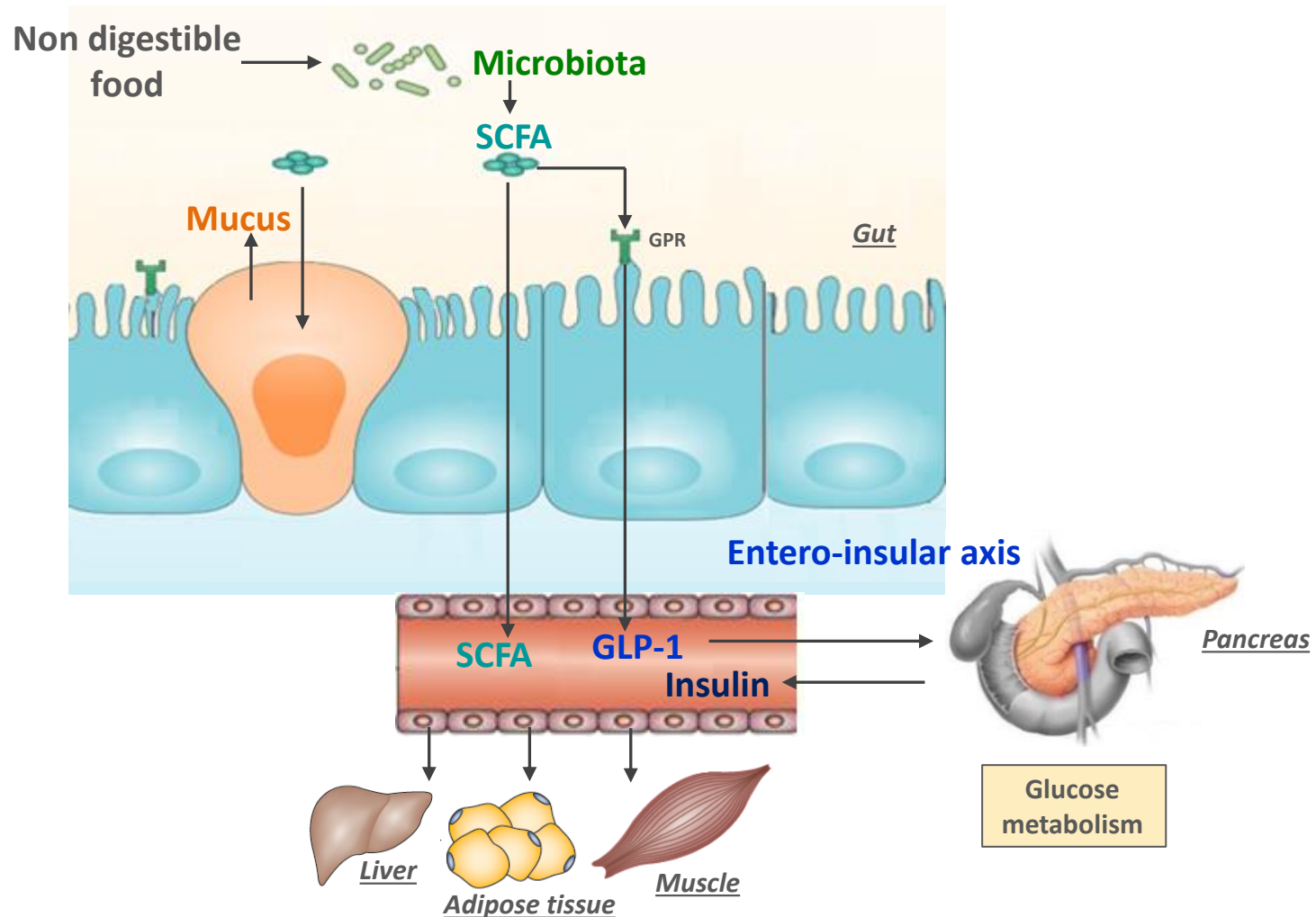
## % adult population with intolerance to glucose or diabetes

Hales *et al.*, 1991



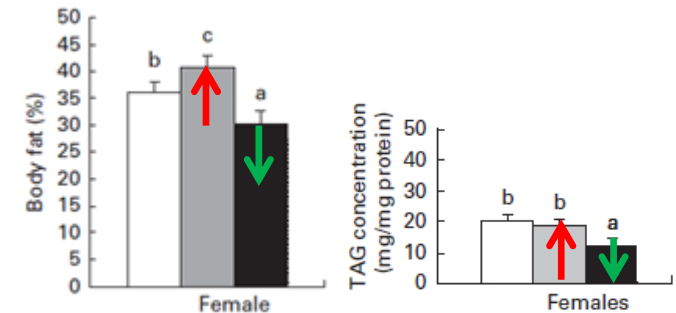
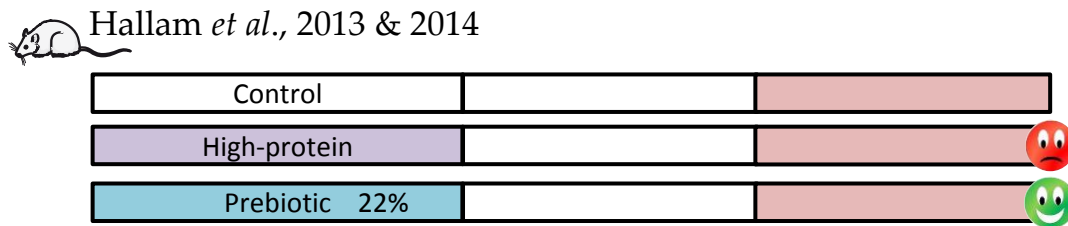
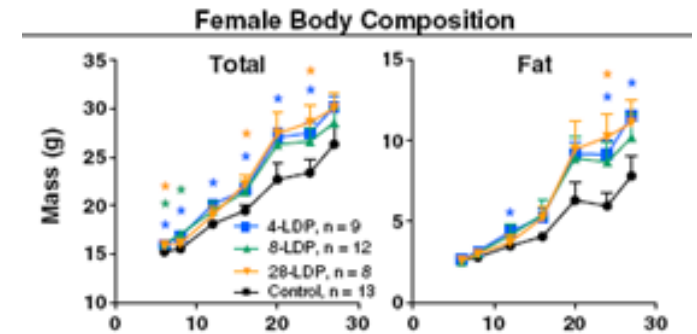
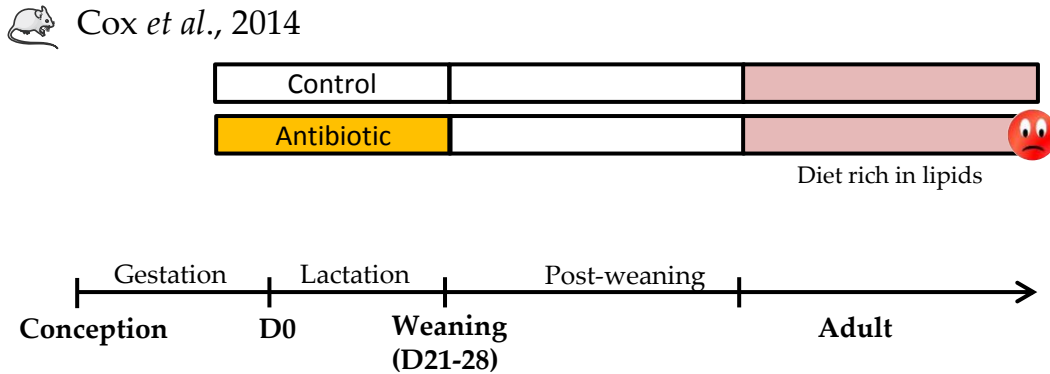
# The gut microbiota: an actor of metabolic programming

## ➤ Complex interactions with host



# The gut microbiota: an actor of metabolic programming

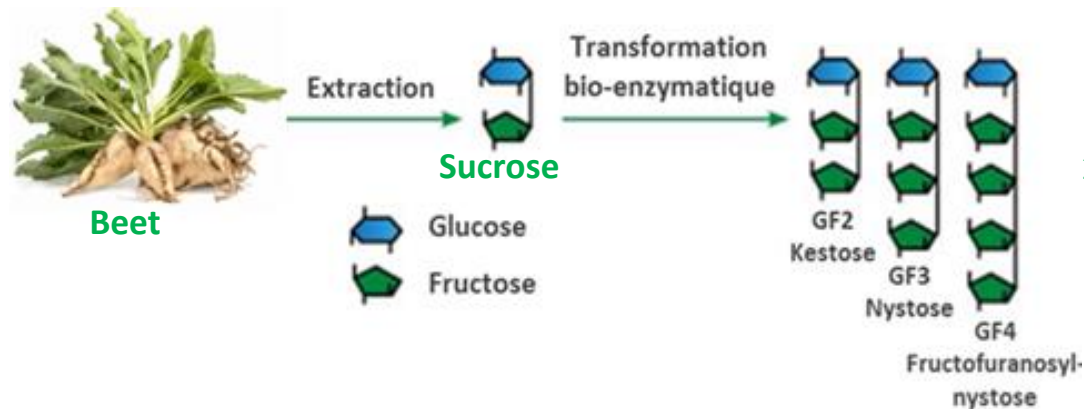
## ➤ Establishment during early life and consequences later in life



➔ **Prebiotics** : A beneficial nutritional strategy for adult health ?

# Prebiotics – scFOS

« The selective stimulation of growth and/or activity of one or a limited number of bacteria in the gut microbiota that confers health benefits to the host » (Roberfroid et al. 2010)



Short-chain  
fructo-oligosaccharides  
(scFOS)

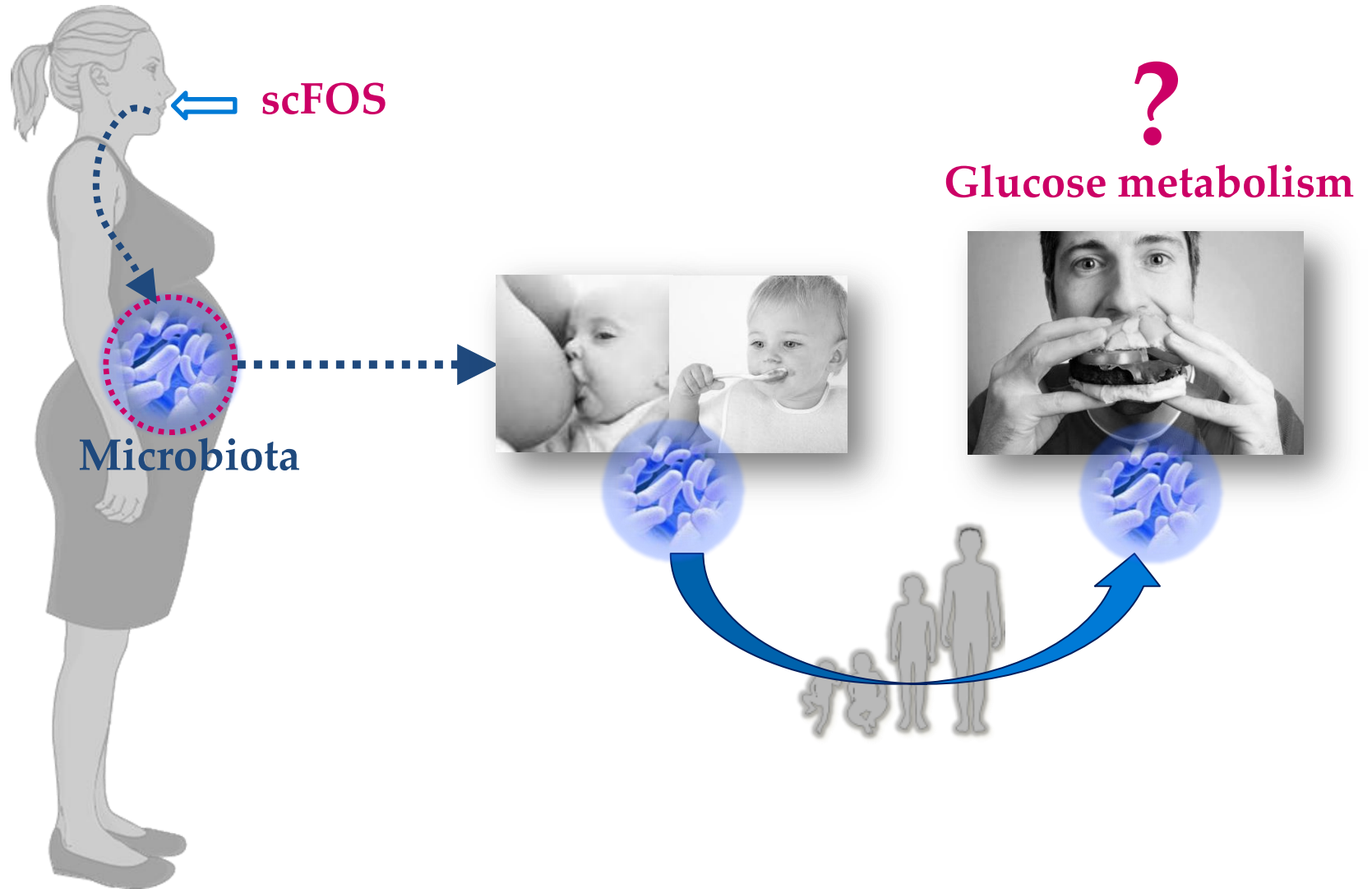
Direct effects of scFOS :

- ↑ Beneficial bacteria Bifidobacteria & Lactobacilli, and SCFA production (Saulnier et al., 2008; Le Blay et al., 2003)
- ↓ Adiposity and inflammatory markers (Shinoki et al., 2011)
- ↑ GLP-1 secretion (Kaji et al., 2011) and insulin sensitivity (Respondek et al., 2008 and 2010)

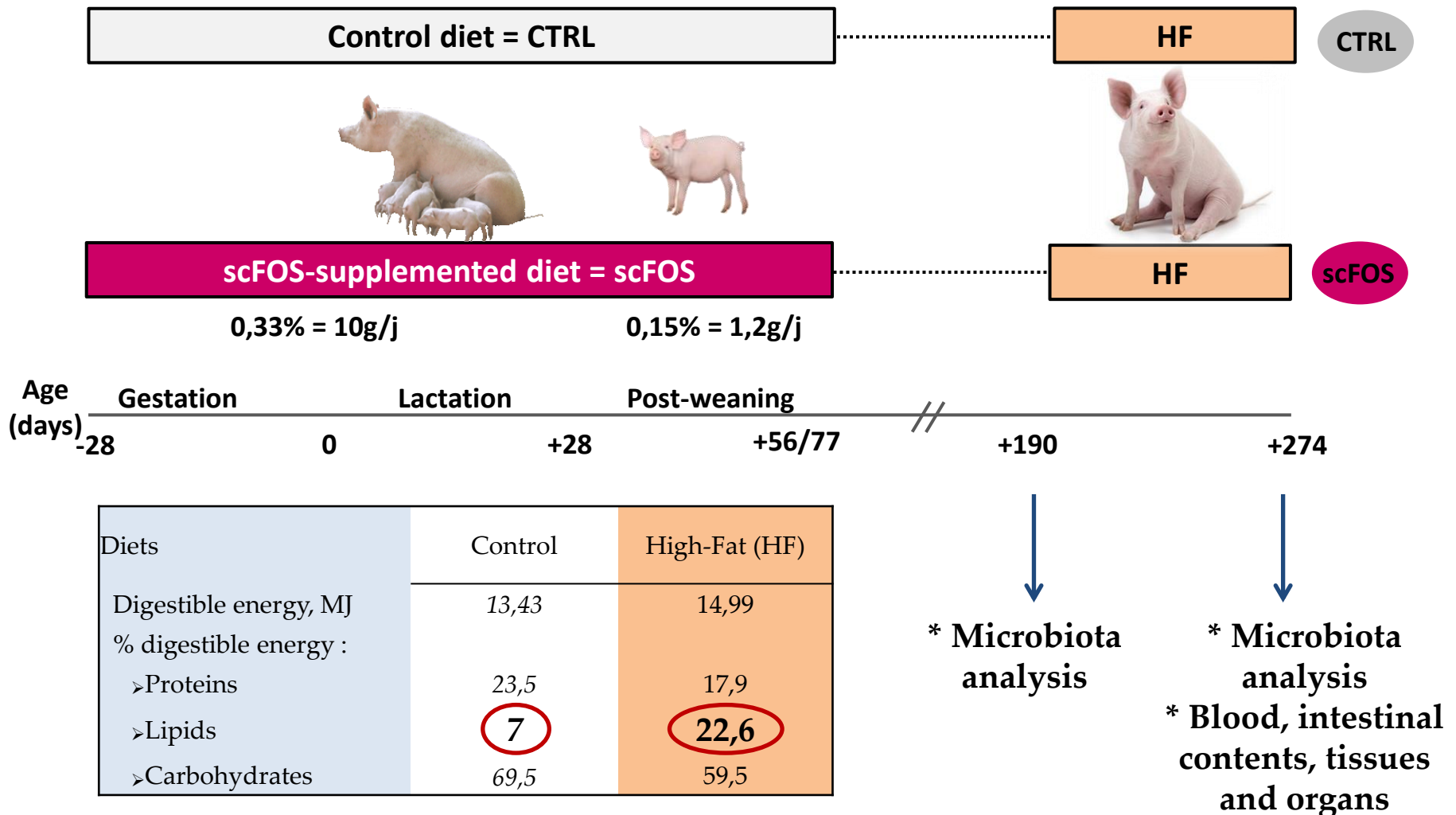
➔ **scFOS: Long-term effects when consuming during early life ?**

# Objective

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# Experimental design







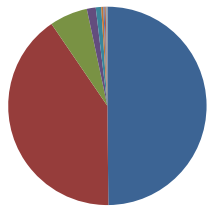
# Microbiota – Bacterial composition

## Phylum

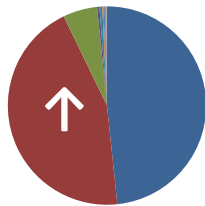
16S rRNA sequencing

## Genus

### D+190: Standard diet



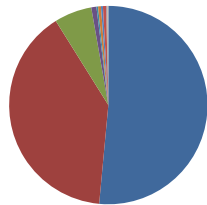
CTRL  
n=6



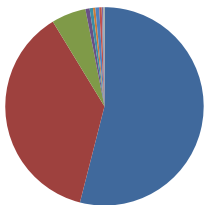
scFOS  
n=6

- Firmicutes
- Bacteroidetes** ↑
- Bacteria\_unclassified
- Spirochaetae
- Tenericutes
- Cyanobacteria
- Proteobacteria
- Lentisphaerae
- SHA-109
- Verrucomicrobia
- Actinobacteria

### D+253: HF diet

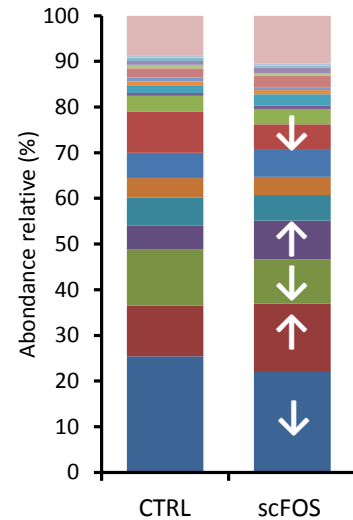
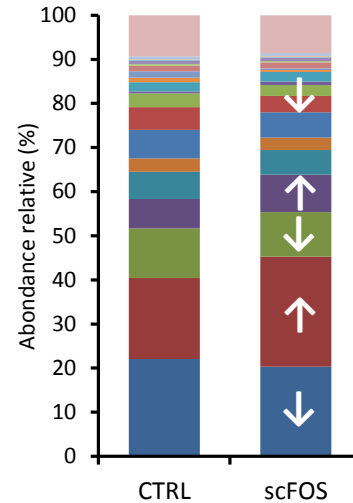


CTRL  
n=6



scFOS  
n=6

- Firmicutes
- Bacteroidetes
- Bacteria\_unclassified
- Spirochaetae
- Tenericutes
- Cyanobacteria
- Proteobacteria
- Lentisphaerae
- SHA-109
- Verrucomicrobia
- Actinobacteria



- Autres
- Alloprevotella
- Oscillospira
- Treponema
- Lactobacillus
- Firmicutes\_unclassified
- Streptococcus
- Christensenellaceae\_unclassified
- S24-7\_unclassified** ↓
- Clostridiales\_unclassified
- RC9\_gut\_group
- Bacteria\_unclassified
- Lachnospiraceae\_unclassified** ↑
- Bacteroidales\_unclassified** ↓
- Prevotella** ↑
- Ruminococcaceae\_unclassified** ↓

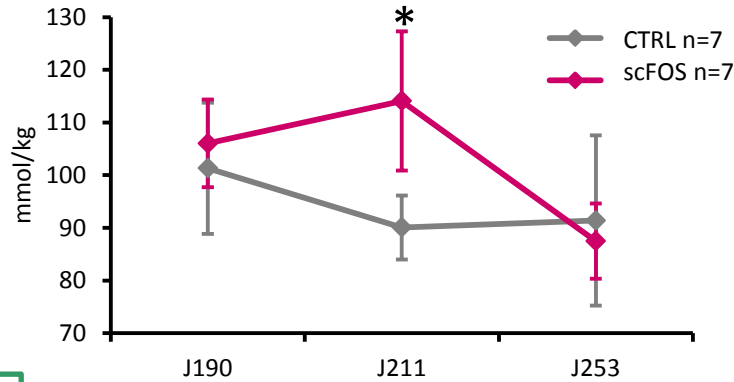
**Perinatal scFOS: ↑ Prevotella**



# Microbiota – Metabolic activity

## Faecal SCFA

Gaz chromatography

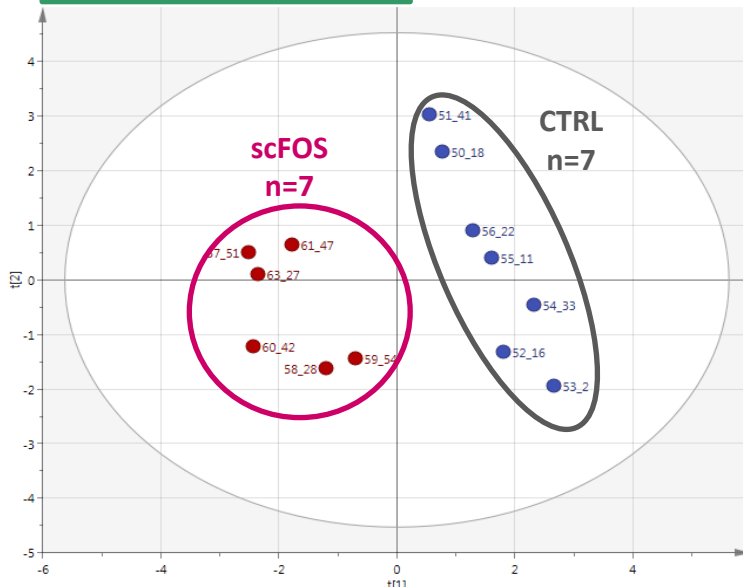


↑ Acetate : + 28,6%

↑ Propionate : + 21,7%

\* P < 0,05

## Faecal metabolome



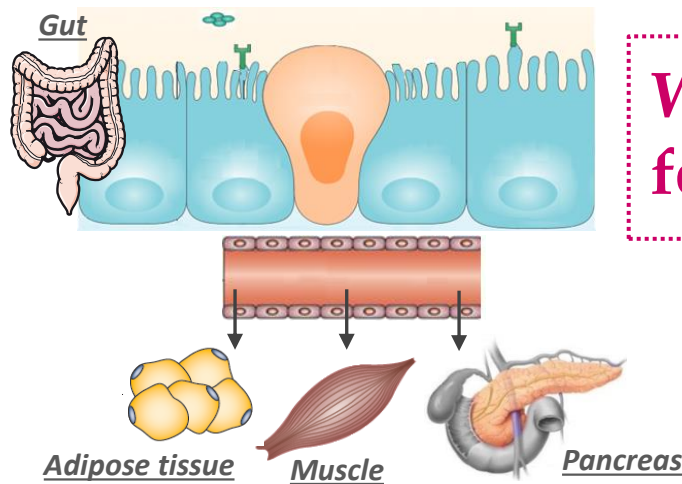
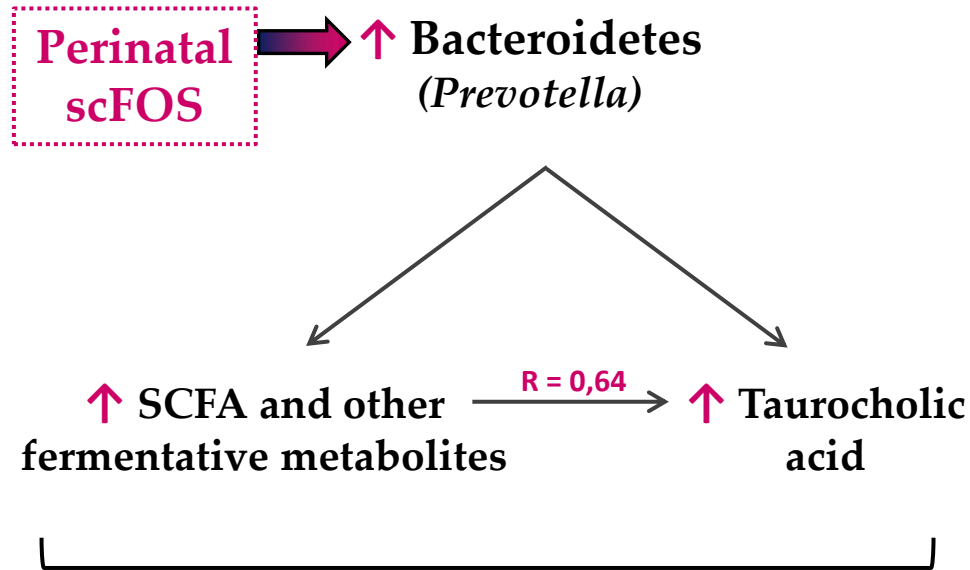
Liquid chromatography coupled to mass spectrometry (LC/MS)

scFOS vs CTRL		
Isobutyric acid	↑	Fermentative metabolites
Hydroxy-methyl butyric acid	↑	
Taurocholic acid	↑	Bile acid
L-Threonine	↑	Amino acid
Glycerol	↑↓	Energy metabolism



**Perinatal scFOS: ↑ Fermentative metabolites and bile acids**

# Microbiota

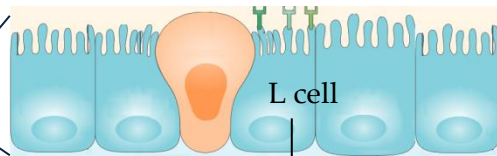
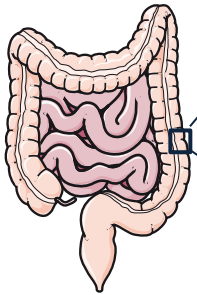
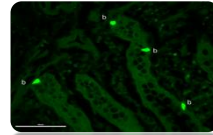
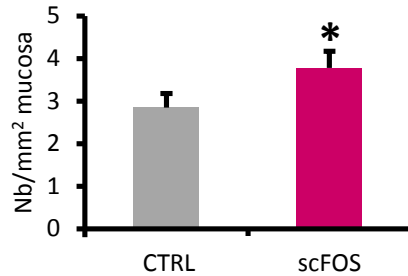


**What are the consequences for adult metabolic health?**

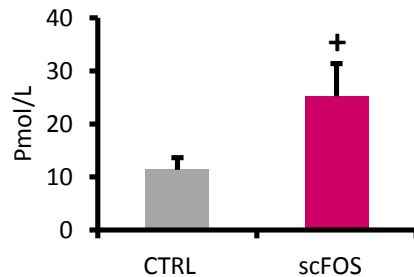


# Entero-insular axis and glucose homeostasis

Nb GLP-1 secreting L cells  
(caecum)



GLP-1  
Plasma GLP-1

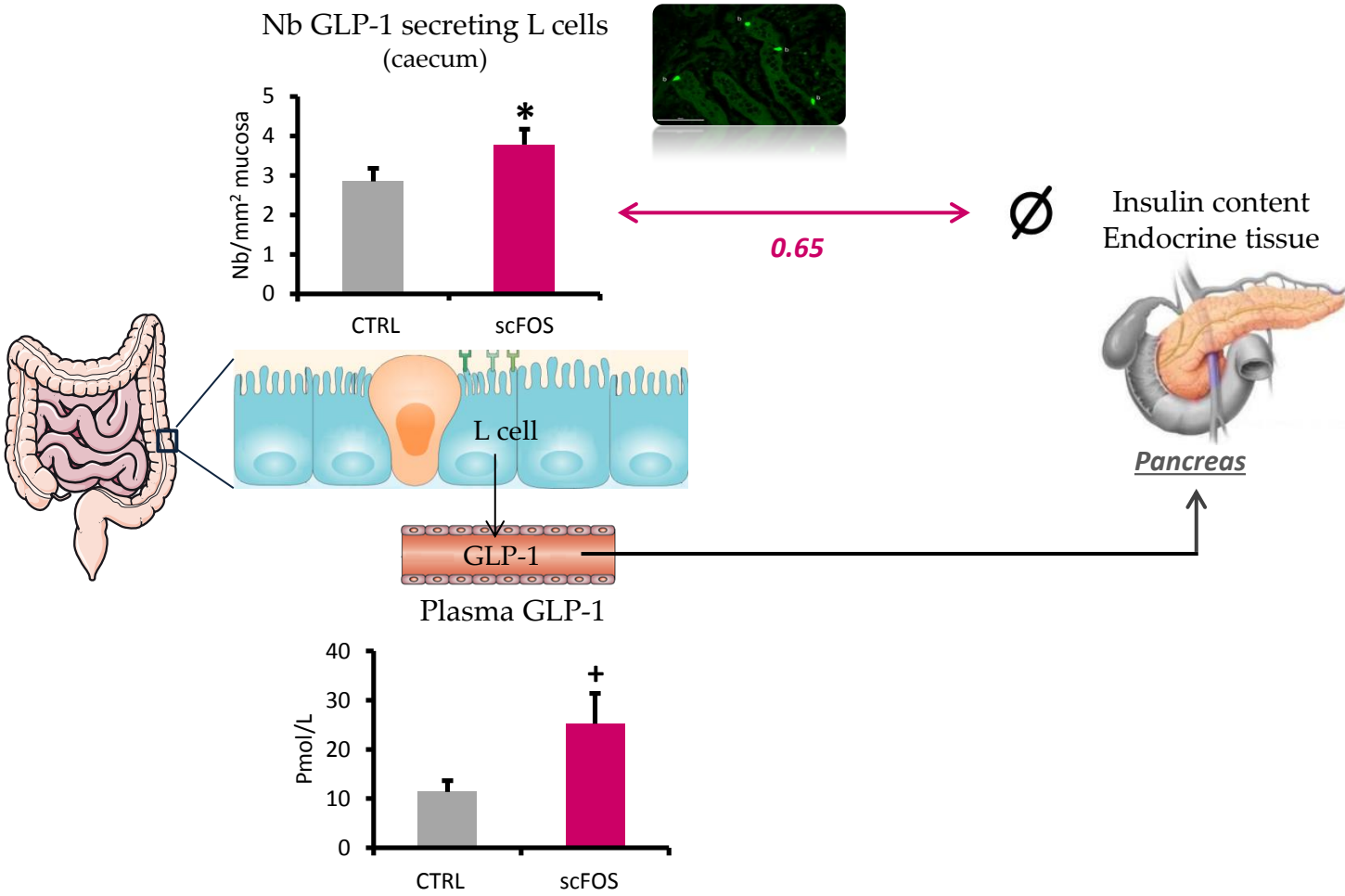


0.47

n=11 CTRL  
n=13 scFOS  
\* P < 0,05  
+ P < 0,10



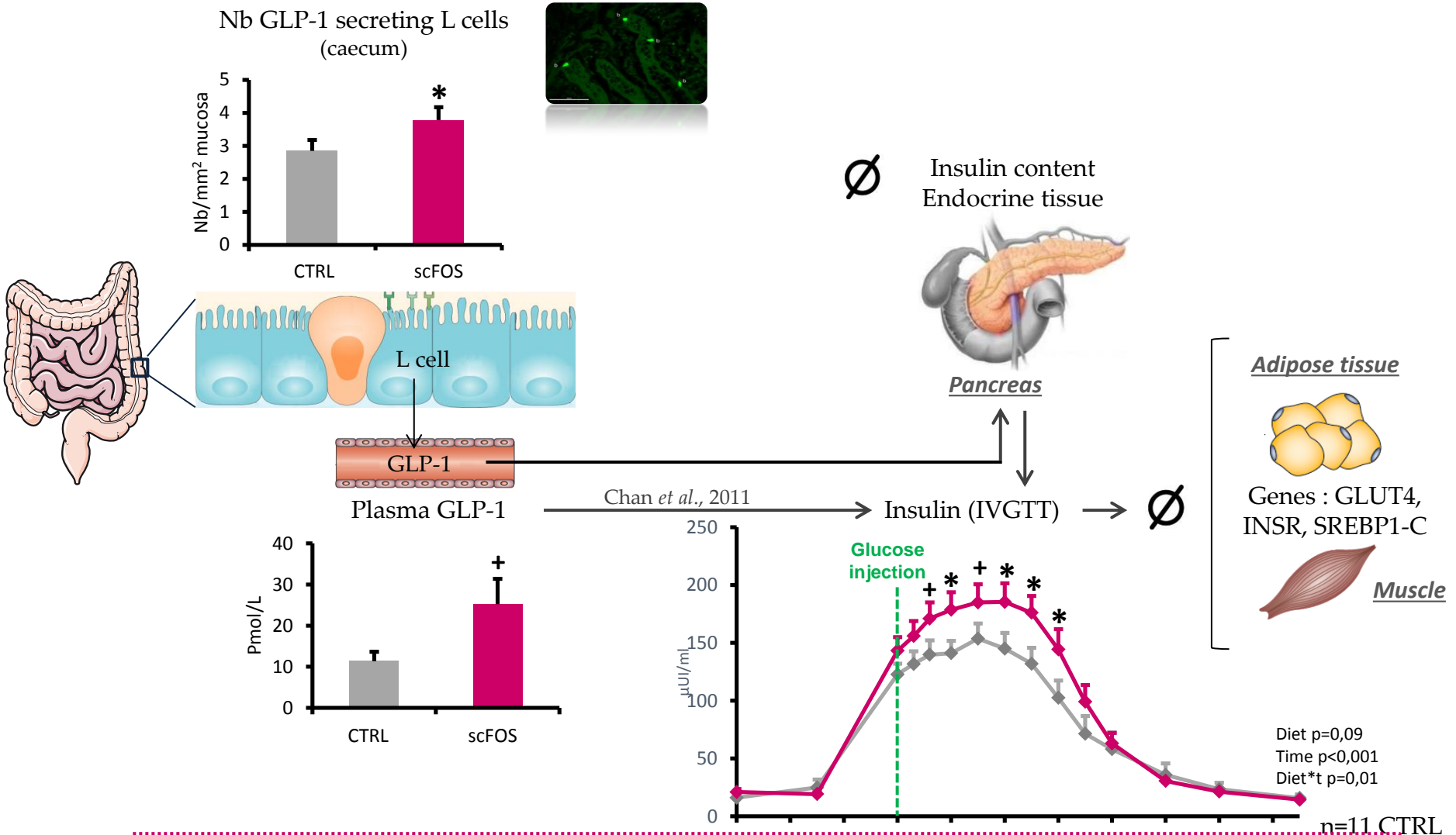
# Entero-insular axis and glucose homeostasis



n=11 CTRL  
n=13 scFOS  
\* P < 0,05  
+ P < 0,10



# Entero-insular axis and glucose homeostasis

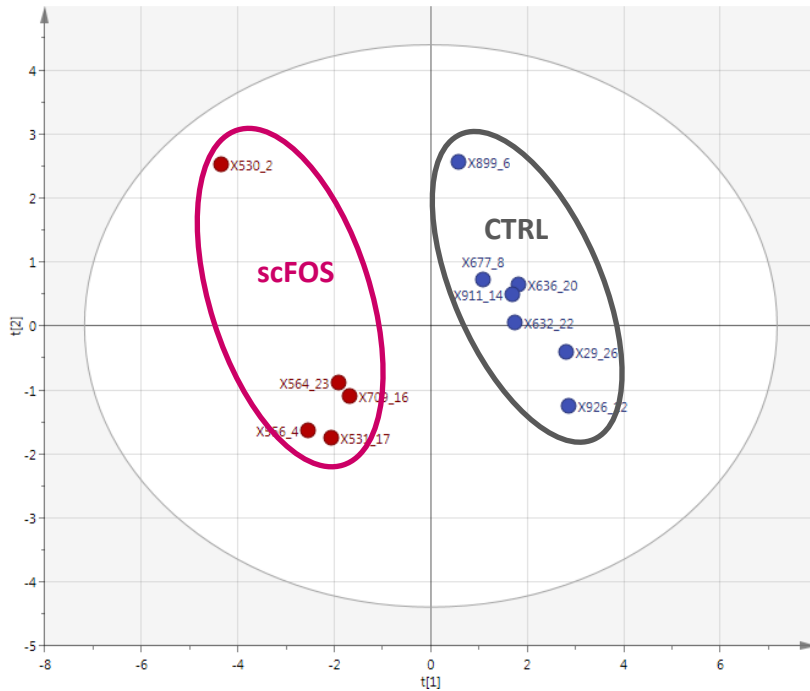


**Perinatal scFOS: Stimulation of capacity to secrete GLP-1 and improvement of pancreas sensitivity to glucose** (Le Bourgot *et al.*, in preparation)



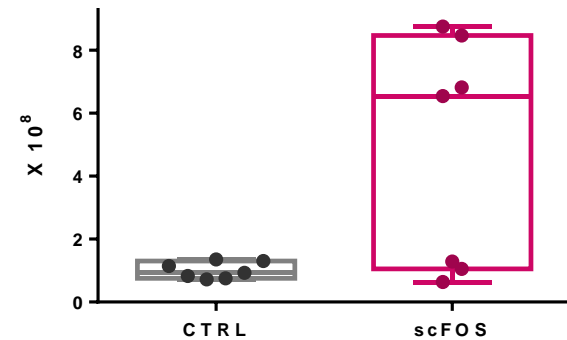
# Plasmatic metabolome

- PLS-DA discriminating both groups (*LC/MS*)



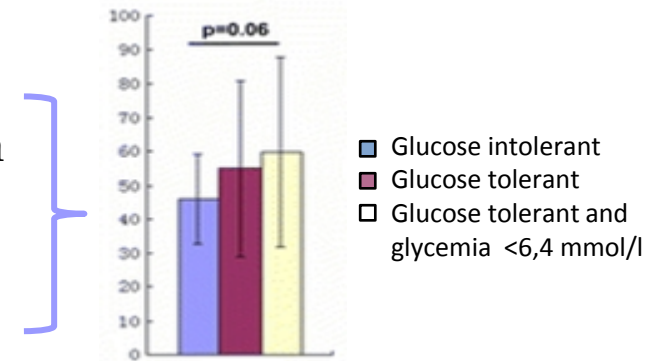
Lysophosphatidylcholine (18:0)

(LysoPC)



- LysoPC : identified as a potential plasma marker of obesity and metabolic disorders (↓)

(Zhao *et al.*, 2010; Barber *et al.*, 2012; Yea *et al.*, 2009)



**Perinatal scFOS: ↑ LysoPC (18:0) = improvement of glucose control**

# Conclusion

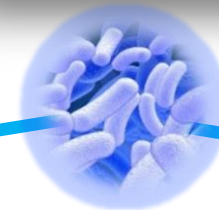
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scFOS : 0.15 to 0.33% of the diet  
= physiological dose



Metabolic adaptation



Sustained effect on microbiota



Stimulation of entero-insular  
axis (GLP-1)





Thank you for your attention



QUESTIONS ?

*What happens  
in the womb lasts  
a lifetime*

