Early-life fructooligosaccharides supplementation changes later pig immune and growth response

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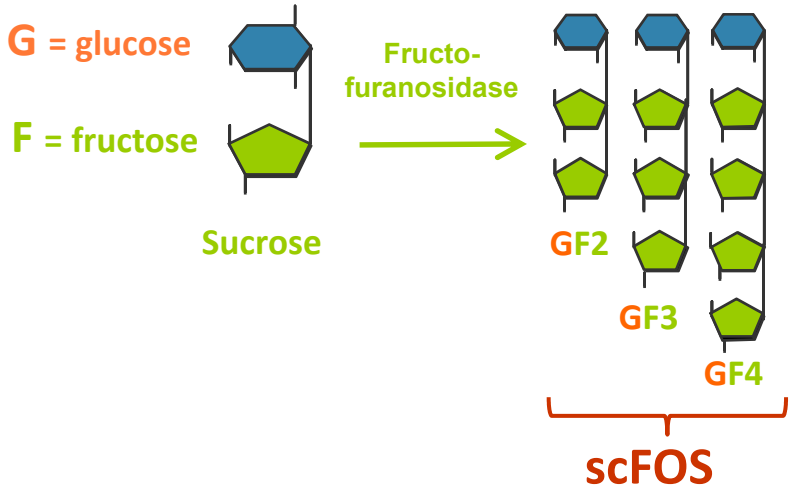
August 2014, Copenhaguen

What are short-chain Fructo-Oligo-Saccharides (scFOS)?

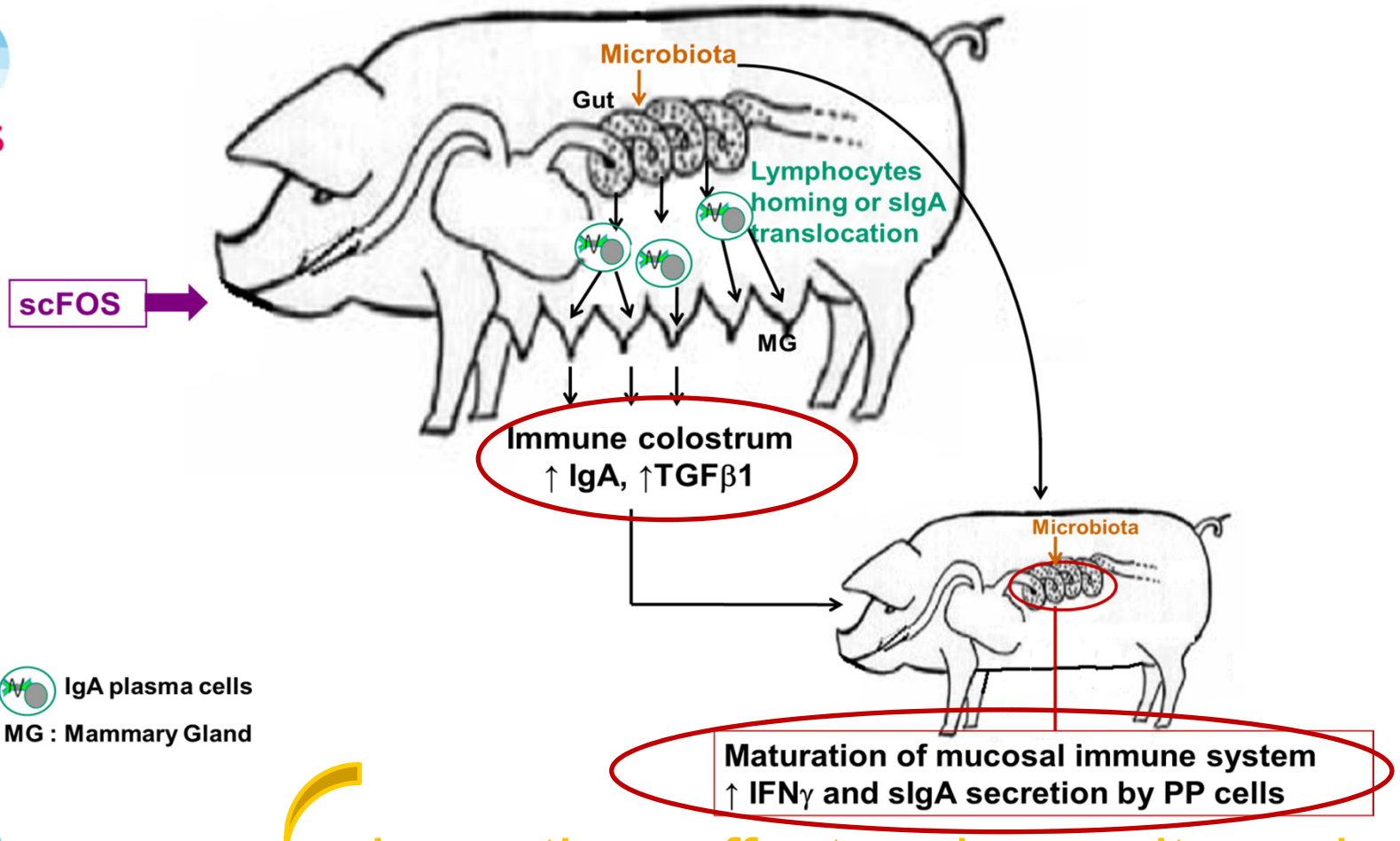
- Non viscous and soluble fibre defined as prebiotic
- Obtained from sugar beet, by a bioenzymatic reaction:



"A dietary prebiotic is a selectively fermented ingredient that results in specific changes, in the composition and/or for activity in the gastrointestinal microbiota, thus conferring benefit(s) upon host health" (ISAPP, 2008)

scFOS in early-life: recent insights

Le Bourgot et al., in press, PlosOne:



Long-time effect on immunity and performance?

Immupig in farm: objectives

To investigate in a **commercial farm**

- Effects of a scFOS dietary supplementation on
  - reproductive performance of sows

- Effects of a scFOS early dietary supplementation on
  - adaptative immunity of weaning piglets
  - performance of pigs from birth to slaughtering

Materials and methods

Sows:
n=65/group,
2 replicates

Farrowing

Weaning

Slaughtering

Gestation: 5 days

Lactation: 21 days

Post-weaning

...

Maltodextrins 10 g/d

scFOS 10 g/d

Maltodextrins, scFOS, 1.2 g/d

Maltodextrins, scFOS, 1.2 g/d

Common conventional diets

Colostrum
D0, n = 30

Vaccin D49, n = 40

Serum D48

Vaccin D70

Serum D70

Serum D91

Reproductive performance: present cycle and cycle n+1 → ANOVA and ANCOVA

Age, fat and muscle percentage at slaughtering → ANOVA
Blood specific IgG titration → FCA

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scFOS improve reproductive performance of sows

- No effect on litter characteristics but:

N = 104 to 129	CTRL		scFOS	SD	scFOS effect
Farrowing duration, h	3.23	↘	2.59	1.18	0.01
Backfat thickness at weaning, mm*	14.1	↗	14.9	4.40	0.09
Prolificity on the next reproductive cycle	14.9	↗	16.2	3.31	0.06

Positive indicators of health of sows

Trend for more born piglets on the next reproductive cycle

* Result also observed by Le Bourgot et al., in press

Potential effects of scFOS on Intestinal transit? On insulin resistance of sows?

scFOS do not modify immune quality of colostrum

	Diet			p-value
Item	CTRL	scFOS	SD	scFOS
Number of sows	16	17		
IgG, mg/mL	72.6	78.8	17.8	0.409
IgA, mg/mL	10.1	10.9	2.11	0.664

- Not in accordance with Le Bourgot et al. (in press)
- Supplementation duration at the end of gestation (5 vs 28 days)?

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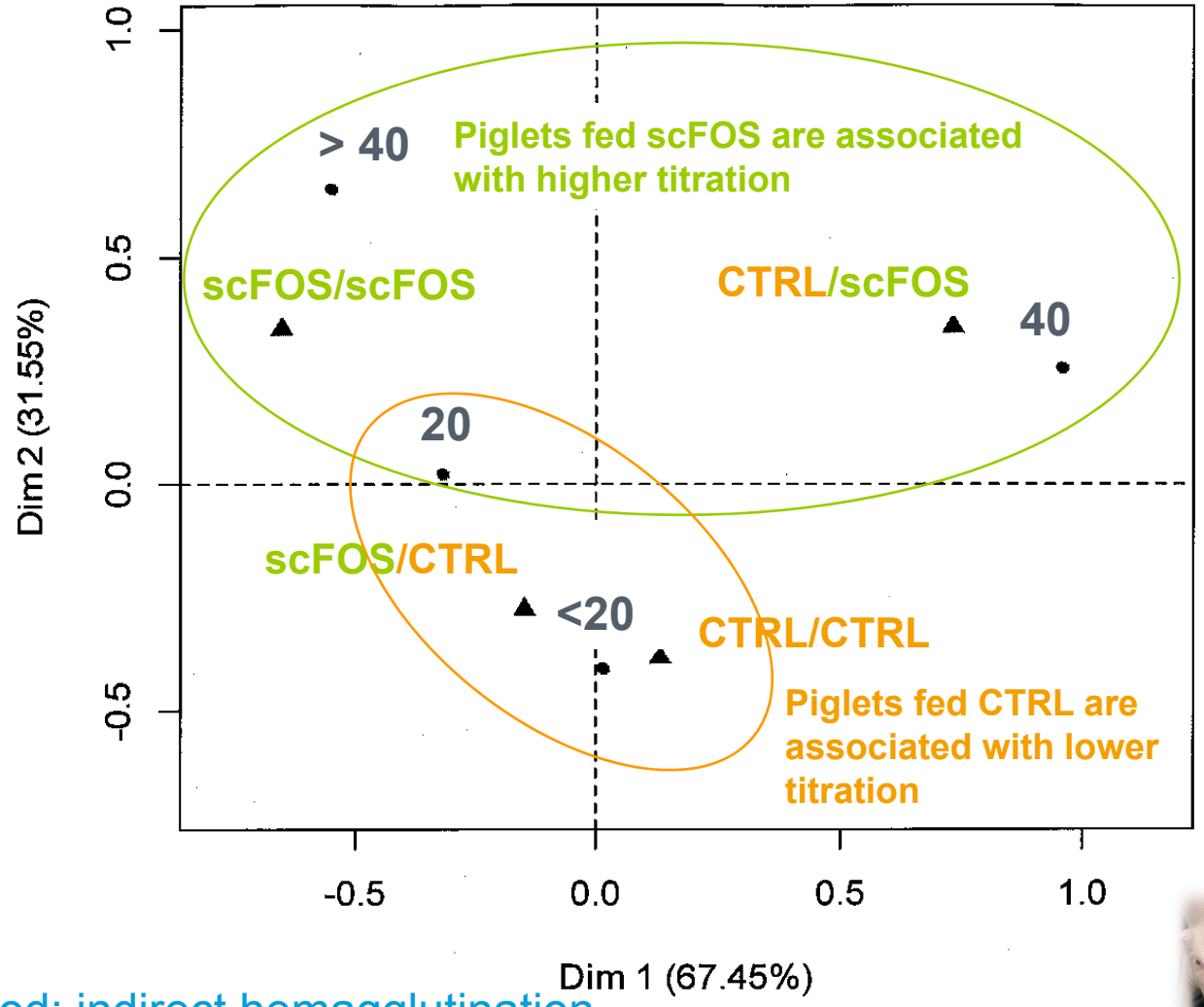
The immune response after vaccination of piglets fed with scFOS is stimulated

D91-D48: Chi-square: p = 0.05; No effect of sow supplementation

Higher titration: immune response is **boosted**

Lower titration



Titration method: indirect hemagglutination

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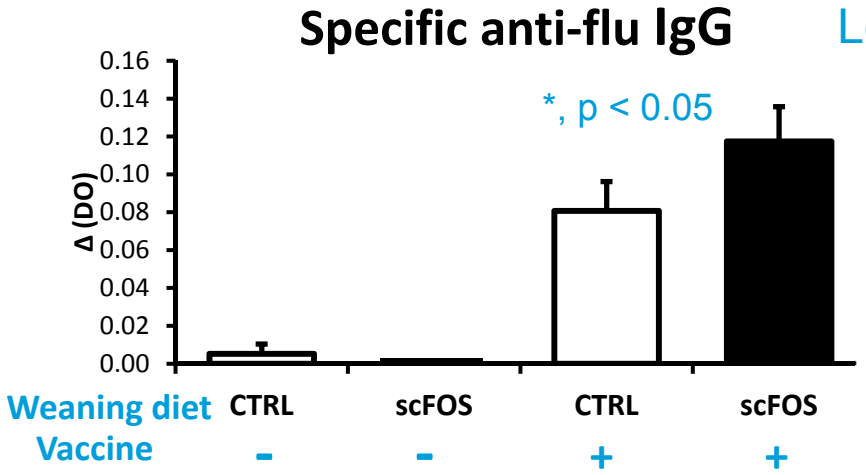


Le Bourgot et al., 2013

scFOS

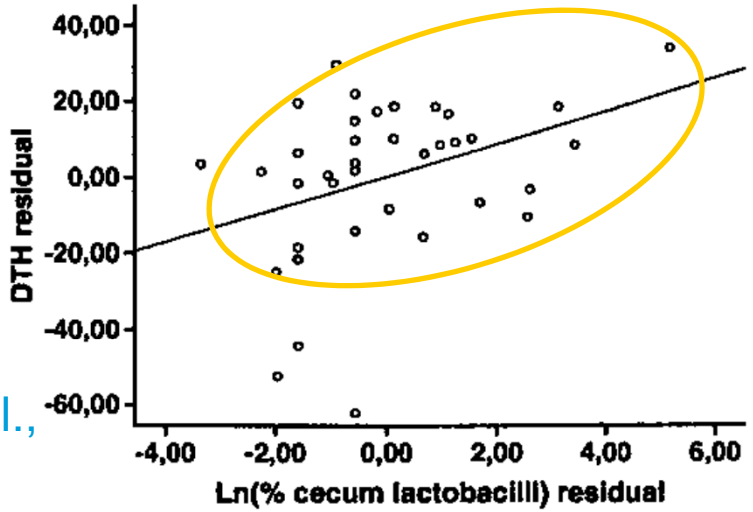
↓

Microbiota

↕

Immune response ??

Relationship between immune response and Lactobacilli in mice



Vos et al., 2010

Fig. 3. Partial correlation plot of the cecal lactobacilli and the DTH response. The relationship between the relative amount of cecal lactobacilli and the magnitude of the DTH response, corrected for antigen dose and supplementation group, was visualized by plotting the residuals of both parameters against each other.

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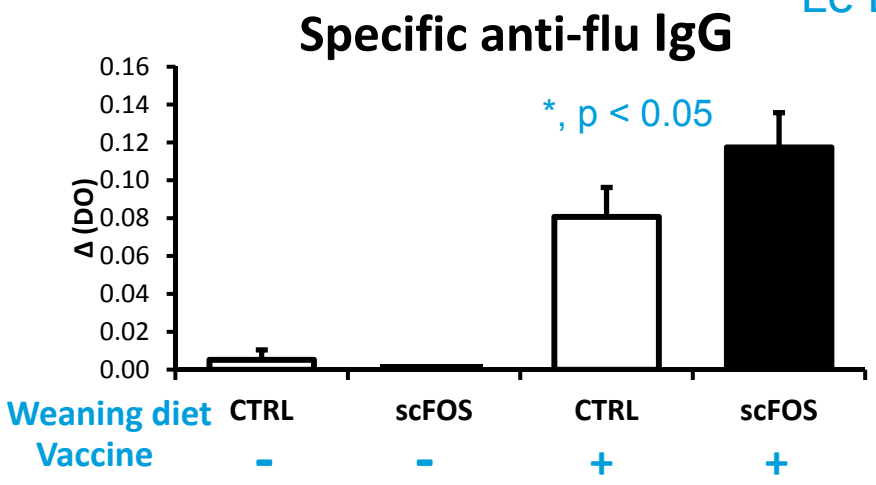
The immune response after vaccination of piglets fed with scFOS is stimulated

Le Bourgot et al., 2013



Increased SCFA in caecum of pigs when their dams fed scFOS

scFOS

↓

Microbiota

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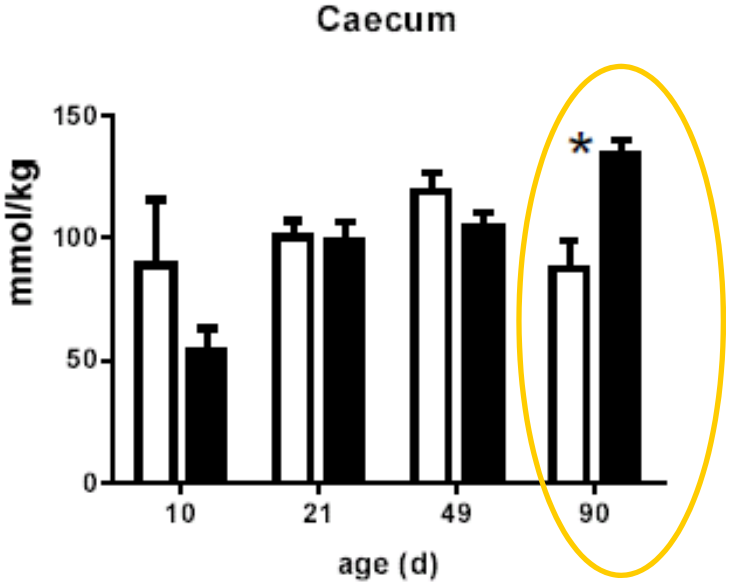
Immune response ??

Le Bourgot et al., in press



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Early-life supplementation with scFOS affects performance at slaughtering

(N = 769)	Treatments				
Item	**CTRL/ CTRL**	**CTRL/ scFOS**	**scFOS/ CTRL**	**scFOS/ scFOS**	SD
Age at slaughtering, d.	191.6[a]	185.0[b]	186.5[b]	184.1[c]	5.48
Muscle, %	63.9	65.1	63.7	64.6	0.32
Fat*, %	16.2	15.9	16.7	16.0	0.53

Not same metabolic pathways between maternal and young scFOS supplementation?

* Piglet scFOS: P = 0.064

Sustainable effects of early-life nutrition with scFOS

→ epigenetic modifications?

→ Importance of early colonisation of microbiota?

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Apper et al., submitted in JAPAN

Immupig in farm: conclusions

- Dietary scFOS supplementation tend to improve physiological status of sows
- Dietary scFOS supplementation in early life of piglets
  - Boosts adaptative immune response of weaning piglets
  - Increases performance of pigs at slaughtering
- Mechanisms involved remain unclear but are probably related to precoce microbiota colonisation and epigenetic effect

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Thank you for your attention!

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Questions?

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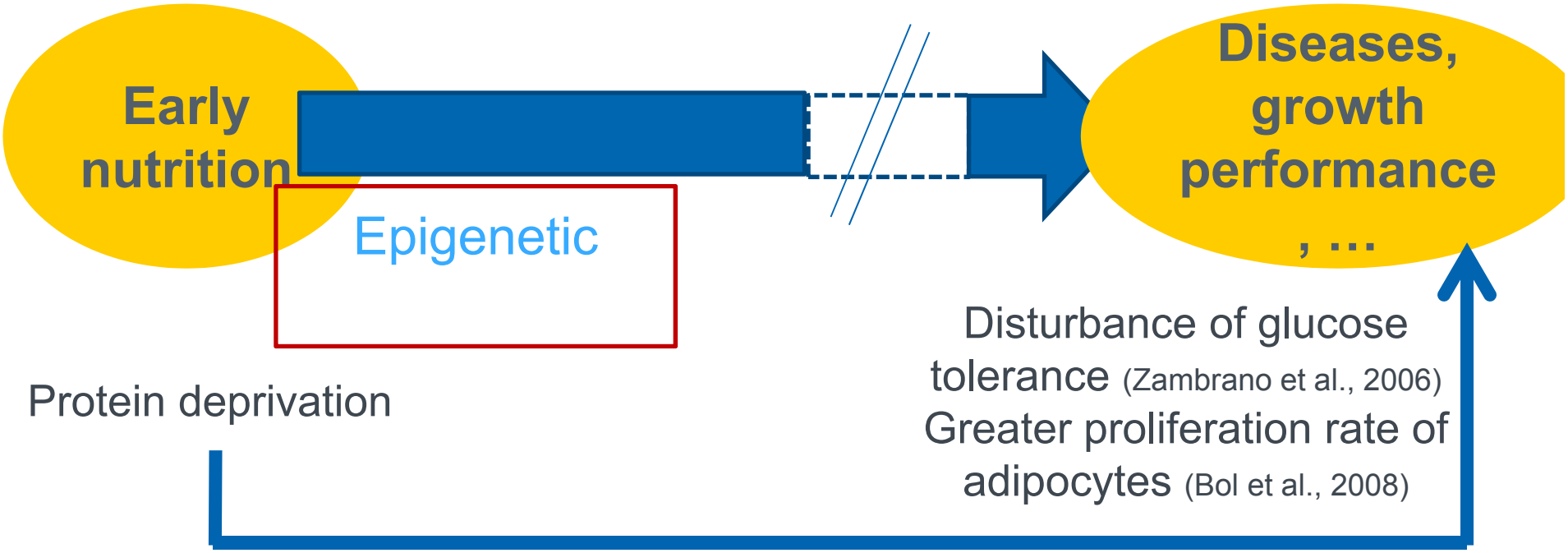
Importance of *peri-partum* nutrition for the entire life



No data on prebiotic short-chain fructooligosaccharides

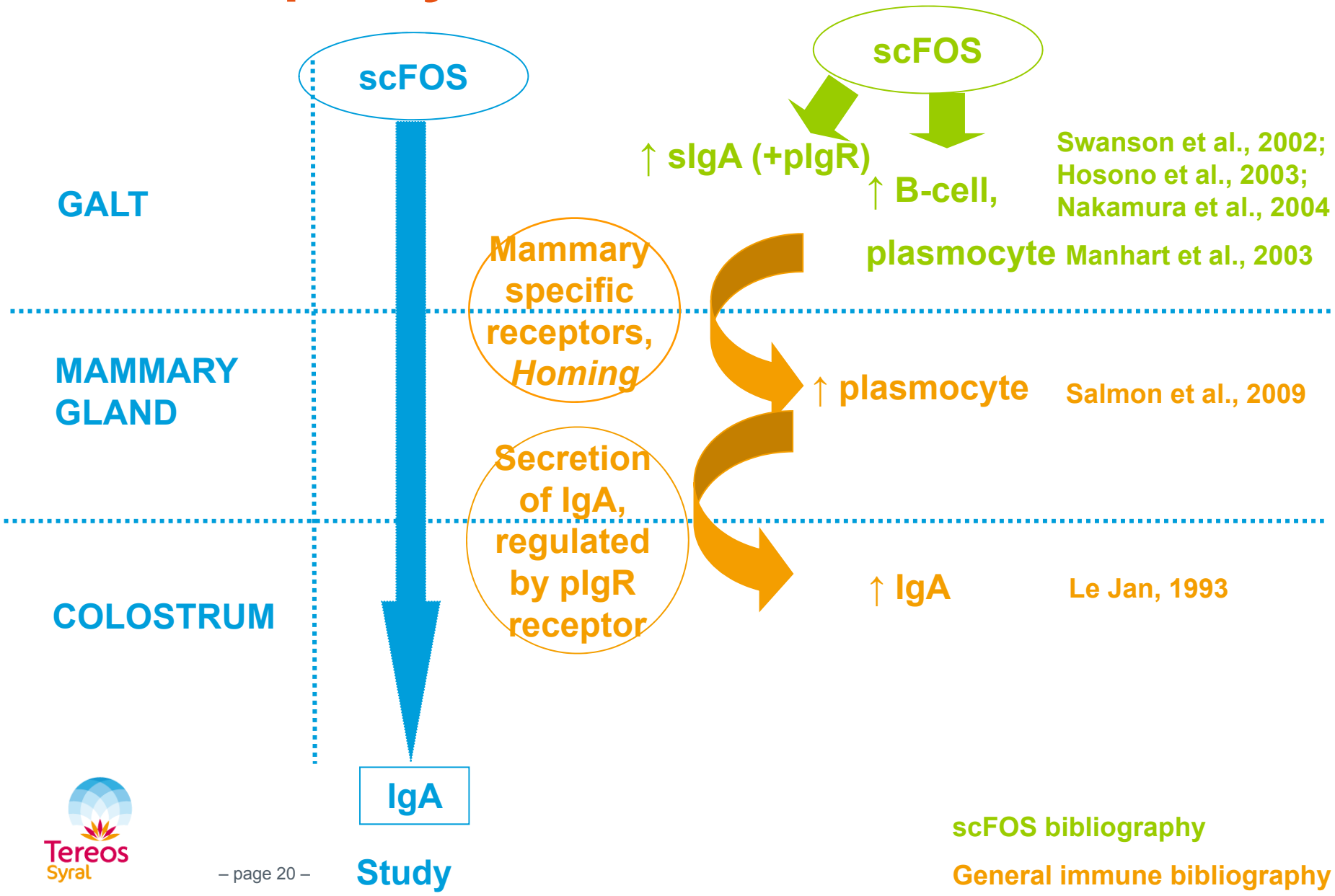
Diets used in the experiment

Item	Gestation diet	Lactation diet
Chemical Analysis, % as DM		
CP	15.9	**19.8**
Fat	3.0	**4.8**
Crude fiber	6.8	**3.5**
Ash	6.5	**8.0**
DM, % as fed	87.3	**87.4**
DE, MJ/kg of DM	15.0	**16.4**
Lys	0.70	**1.16**
Daily allowance, kg	**d 1 to d 36: 3.0**	**Ad libitum**
	d 37 to d 80: 2.5	
	d 81 to d 112: 3.5	

Diets used in the experiment

Period	Pre-starter	Starter	Pre-growing	Growing	Finishing
Age of pigs, day	20-40	41-64	65-103	104-148	**148-Slaughter**
DM, % as fed	88.7	86.9	87.0	87.2	**86.9**
Chemical Analysis, % as DM					
CP	21.0	21.4	20.9	19.8	**18.8**
Fat	7.4	2.0	2.7	3.0	**3.6**
Crude fiber	4.0	4.2	4.5	5.6	**4.4**
Ash	8.0	7.5	6.5	6.1	**5.9**
DE, MJ/kg of DM	16.7	15.2	15.3	15.3	**15.6**
NE, MJ/kg of DM	11.8	10.7	10.8	10.9	**11.2**
Lys	1.59	1.40	1.20	1.11	**0.94**
Daily allowance, kg	**0.38**	**0.92**	**1.75**	**2.60**	**2.45**

Results:
Immune quality of colostrum and milk



scFOS bibliography

General immune bibliography