Peri-partum scFOS supplementation modulates development and activity of the immune system of suckling piglets

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Background

Immune system in early life

Birth - Weaning

GESTATION  LACTATION  POST-WEANING

Immunature immune system

Mature immune system

Importance of Gut Associated Lymphoid Tissue (GALT)

Maternal microbial exposure  Colostrum and breast feeding  Exogenous antigens
Background
Prebiotics

Definition:
“A selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal microflora that confers benefits upon host well being and health” (Gibson et al. 2004)

Intestinal microbiota

↑Bifidobacteria and Lactobacilli

Intestinal effects

Improvement of barrier function
Reduction of intestinal infections
Modulation of intestinal peptide production
Modulation of immune system

Dietary components
scFOS
Short-chain fructo-oligosaccharides

G = glucose
F = fructose
Fructo-furanosidase
Sucrose
GF
scFOS

Bacteria metabolites

↑SCFA (butyrate, acetate, propionate)

Swanson et al., 2002
Howard et al., 1995
Berg et al., 2005
Tsukahara et al., 2003

Gibson et al., 2004; Cani et al., 2009
Background

Immunity modulation by scFOS

Effects on adults:

- augmentation of IgA concentration in serum (Swanson et al., 2002)
- increase of IgA secretion in intestinal mucosa (Hosono et al., 2002)
- improvement of cytokine responses by Peyer’s patch cells (Hosono et al., 2002)

Effects on mothers and offspring:

- augmentation of IgM level in colostrum and milk and modulation of Ig concentration in serum of puppies (Adogony et al., 2007)

Global trend for stimulating immunity following scFOS supplementation, but less is known about maternal immune transfer and effects on GALT in piglets
Hypothesis

MOTHER

Peri-partum scFOS supplementation

Microbiota

Transferred bacteria

Colostrum and milk

OFFSPRING GUT

Microbiota

Immune system

Lumen

Epithelium

Mucosa

B-cells

APC

T-cells

APC: Antigen-presenting cells
Objectives

Determine the impact of maternal dietary scFOS supplementation during gestation and lactation on:

1. Acquisition of passive immunity in the suckling piglets
2. Development of intestinal immune system in the suckling piglets
3. Response to vaccination in the weaned pigs
Protocol

Influenza vaccine (Gripovac 3®)
Performances of sows and piglets

**SOWS**

**Weight**

- **CTRL**
- **scFOS**

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**Back fat thickness**

- **CTRL**
- **scFOS**

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**PIGLETS**

**Weight**

- **CTRL**
- **scFOS**

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<td>8</td>
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scFOS supplementation tended to increase back fat thickness in sows during the lactation.

#: $p < 0.10$
Objectives

Determine the impact of maternal dietary scFOS supplementation during gestation and lactation on:

- Acquisition of passive immunity in the suckling piglets
- Development of intestinal immune system in the suckling piglets
- Response to vaccination in the weaned pigs
Colostrum and milk immune quality

scFOS supplementation improved IgA levels in colostrum = improvement of passive immunity

*: p < 0.05
Determine the impact of maternal dietary scFOS supplementation during gestation and lactation on:

- Acquisition of passive immunity in the suckling piglets
- Development of intestinal immune system in the suckling piglets
- Response to vaccination in the weaned pigs
Intestinal immune system of suckling piglets
(ileal PP d21)

NEONATES
Maturation of the GALT depends on:

**Humoral-mediated immunity**
- sIgA secretion

**Cell-mediated immunity**
- Balance Th1/Th2

Maternal scFOS diet improved maturation of GALT after birth
that confers a better response against pathogens

*i* *p*<0.05
** *p*<0.01

iLPP cells cultured in basal condition for 7d

iLPP cells stimulated with ConA (5µg/ml) for 72h
Objectives

Determine the impact of maternal dietary scFOS supplementation during gestation and lactation on:

- Acquisition of passive immunity in the suckling piglets
- Development of intestinal immune system in the suckling piglets
- Response to vaccination in the weaned pigs
Vaccine challenge in weaned pigs

*Influenza vaccine* (Gripovac 3®)

CTRL

scFOS

Birth

Weaning

No effect of maternal diet

CTRL

Standard

Standard

+ scFOS

+ scFOS

+ scFOS

1st injection: d35

Boost injection: d56

Serum collection: measure of specific anti-flu IgA and IgG

d28
Vaccine challenge in weaned pigs

*Influenza vaccine (Gripovac 3®)*

Direct scFOS supplementation improved the specific anti-flu IgG concentration in serum of weaned pigs.
Summary

Maternal scFOS supplementation during perinatal period:

- Tended to increase body reserves of sows: improvement of reproductive performances
- Higher [IgA] in colostrum: enhancement of passive immunity
- Increased sIgA and IFN\(\gamma\) secretion by ileal PP cells: better development and maturation of the mucosal immune system

Direct scFOS supplementation after weaning:

- Increased specific anti-flu [IgG] in serum: improvement of vaccine response
Thank you for your attention

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