Impact of Interventions during the Neonatal development of Piglets

Annemarie Rebel

annemarie.rebel@wur.nl

WAGENINGEN
UNIVERSITY & RESEARCH

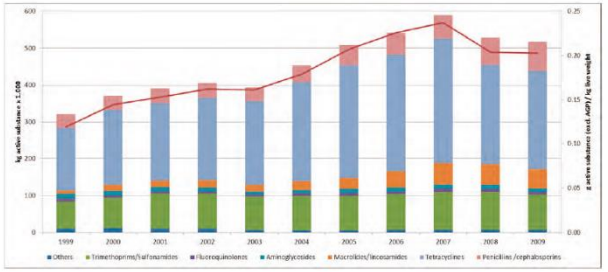
100years
1918 — 2018

Strategies to reduce antibiotic usages

- "All Disease begins in the Gut"
  - Hippocrates ca. 460 – ca. 370 BC

- Antibiotics are frequently used to treat intestinal problems.

Figure 3.1. Veterinary therapeutic antibiotic sales from 1999-2009 (FIDIN, 2010; vertical bars). The line presents the trends in grams of active ingredients used per kg live weight.



- Influence intestinal health without usage of antibiotics?

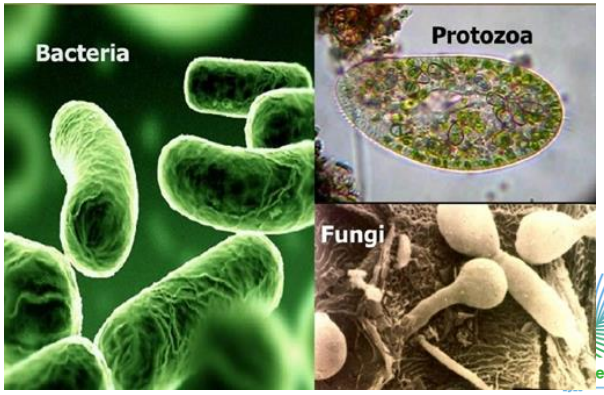
Gut is the gatekeeper of health

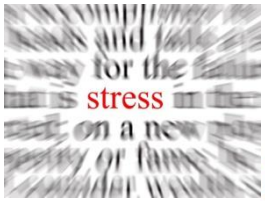
Host

GUT

Microbiota

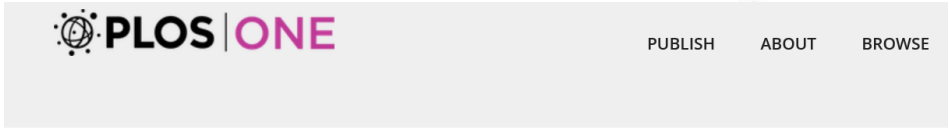
Environment





Earlier results intestinal development, immune and microbiome

- Critical transition moments for microbiota development
  - Prenatal
  - Birth
  - Weaning
- Interventions
  - Feed(-additives)
  - Management
- Effects
  - Intestinal immune development
  - Long lasting
  - Due to early colonisation


PLOS ONE

PUBLISH ABOUT BROWSE

OPEN ACCESS PEER-REVIEWED

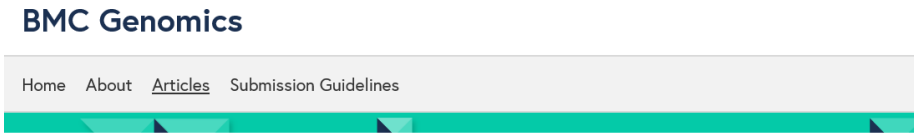
RESEARCH ARTICLE

Early-Life Environmental Variation Affects Intestinal Microbiota and Immune Development in New-Born Piglets

Dirkjan Schokker, Jing Zhang, Ling-li Zhang, Stéphanie A. Vastenhouw, Hans G. H. J. Heilig, Hauke Smidt, Johanna M. J. Rebel, Mari A. Smits

Long-Lasting Effects of Early-Life Antibiotic Treatment and Routine Animal Handling on Gut Microbiota Composition and Immune System in Pigs

Dirkjan Schokker, Jing Zhang, Stéphanie A. Vastenhouw, Hans G. H. J. Heilig, Hauke Smidt, Johanna M. J. Rebel, Mari A. Smits


BMC Genomics

Home About Articles Submission Guidelines

Research article | Open Access | Published: 23 May 2019

Plasticity of intestinal gene expression profile signatures reflected by nutritional interventions in piglets

Dirkjan Schokker, Ina Hulsegge, Henri Woelders & Johanna M. J. Rebel

WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

Feed4 Foodure

Hypothesis

Long-lasting effects of intestinal health are due to different programming of the gut immune system early in life

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Experimental set-up

- **GOAL:** To determine the effect of dietary intervention on intestinal development in piglets
- Two different feeding strategies to apply intervention:
  - Maternal administration
  - Neonatal administration by oral gavage

Day 1:
- Intestinal gene expression
- Microbiota composition
- Intestinal morphology

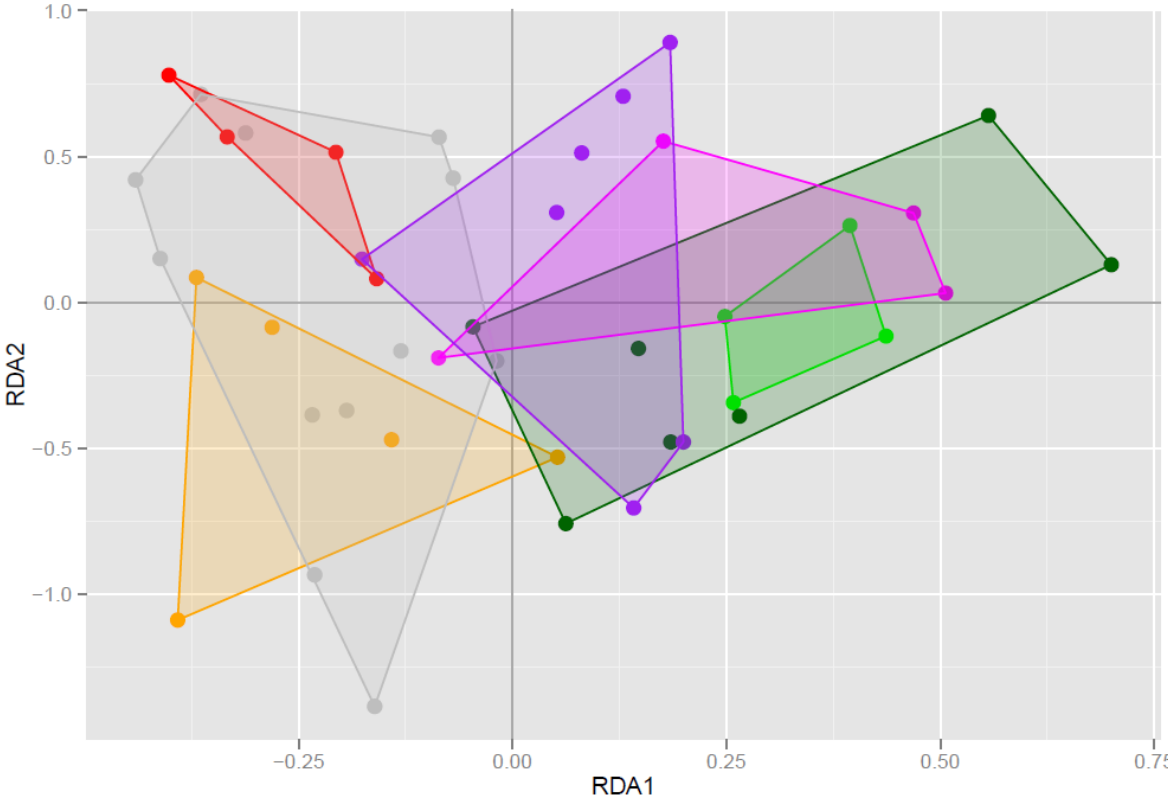
Day 1 – 31:
Performance

3 days post weaning:
- Intestinal gene expression
- Microbiota composition
- Intestinal morphology

interventions

- Medium Chain Fatty acids: Probably affects microbiota composition proximal intestine
- Beta-glucan: Immunomodulatory effects
- Galacto-oligosaccharides: beneficial effects on humans → bifidogenic effect colon
- Control

Microbiota composition depends on administration route



- Small differences in microbiota
- Microbiota composition depends on administration route
- ~ 10 differences on family level between treatment and control

maternal_d.1_Jejunum_CONTROL
maternal_d.1_Jejunum_MCFA
maternal_d.31_Jejunum_CONTROL
maternal_d.31_Jejunum_MCFA
neonatal_d.1_Jejunum_CONTROL
neonatal_d.31_Jejunum_CONTROL
neonatal_d.31_Jejunum_MCFA

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

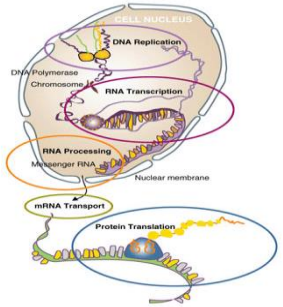
Effect on microbiota

- Number of statistical changes in microbiota composition on family level

Intervention	Day	Number of statistically significant differences compared to control
1	1	45
	31	19
2	1	2
	31	0
3	1	5
	31	0

- MCFA induce changes in composition
  - Strongest effect on day 1, early life colonization
  - Suggestive for transmission effect via other routes than milk

Intestinal development depends on administration route

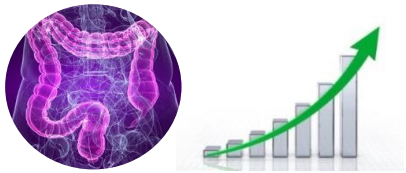


Maternal MCFA	%	Neonatal MCFA	
Lipid digestion, mobilization and transport	7/71 (10%)	Regulation of complement cascade	4/26 (15%)
Chylomicron-mediated lipid transport	4/17 (23%)	Immune system	37/1547 (2%)
Retinoid metabolism and transport	5/42 (12%)	Chemokine receptors bind chemokines	5/56 (9%)
Metabolism of fat soluble vitamins	5/51 (10%)	Interferon alpha/beta signalling	5/68 (7%)
Reversible hydration of carbon oxide	3/12 (25%)	Metabolism of AA and derivatives	12/335 (4%)
Lipoprotein metabolism	4/34	IRN3 mediated activation of type 1 IFN	2/6 (33%)
Chemokine receptors bind chemokines	4/56 (7%)	Metabolism	42/1908 (2%)
Digestion of dietary carbohydrate	2/8 (25%)	Complement cascade	5/80 (6%)
Erythrocytes take up O_2 and release CO_2	2/8 (25%)	ZBP1 mediated induction type I IFNs	3/26 (12%)
Visual phototransduction	5/97 (5%)	Innate immune system	21/807 (3%)

Conclusion

- Administration route determines the outcome of intestinal development and on microbiota composition
- Large differences in intestinal development of new-born piglets between the 3 maternal dietary interventions
- Neonatal administration of MCFAs induces immunological changes

Overall conclusions



- Feed in early life has consequences for the programming of the host immune system
- Administration timing of importance for result
- Hereby it is possible to change gut health

- And therefore this is an antibiotic reduction strategy.

WUR Gut health team

dr. JMJ (Annemarie) Rebel

Head of department Animal health and welfare

Contact

dr. D (Dirkjan) Schokker

DLO Onderzoeker

Contact

dr. A (Astrid) de Greeff

DLO Onderzoeker

Contact

dr.ir. AJM (Alfons) Jansman

Senior scientist

Contact

SK (Soumya) Kar

DLO Onderzoeker

Contact