Feed4Foodure; Literature study ‘neonatal’

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Acknowledgements

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Feed4 Foodure

Voeding, Darmgezondheid, en Immuniteit

Ministerie van Economische Zaken
Productschap Diervoeder (PDV)
Productschap Pluimvee en Eieren (PPE)
Productschap Vee en Vlees (PVV)
Agrifirm Group
ForFarmers Hendrix
De Heus
Nutreco
VION Food Group
MSD - Animal Health
VanDrie Group
Denkavit

Background

- Neonatal period, defined as:

 Day 0–14

 Day 0–25(weaning)

- Hallmarked by the development and differentiation of the intestine
  - Morphological
  - Functional
  - Immunological

- Life long effect (programming of immune system)

Nutritional factors

- Macronutrients
  - Carbohydrates (sugars / saccharides)
  - Fats (vegetable, animal)
  - Proteins (polymeric chains of amino acids, peptides)
- Micronutrients
  - Vitamins (e.g. A, B, C, and E)
  - Minerals (e.g. zinc, copper, selenium, and iodine)
- Functional ingredients
  - Examples are flavonoids and calcium

Objective

- Generate an overview of published studies that investigated the effect of nutritional factors during the neonatal period in chicken and pigs, focusing on immune competence

Immune competence

- The ability of the immune system to react to a stimulus by means of an efficient, well-balanced immune response

Strategy

1) general or specific nutritional factor

2) immune competence related words, i.e. intestinal/gut health, immune system, or immunity

3) species (e.g. pig, Sus scrofa OR chicken, broiler, Gallus gallus)

3 case studies

Nutrient – β-glucan

Prebiotic – Polydextrose

Spray-dried animal plasma

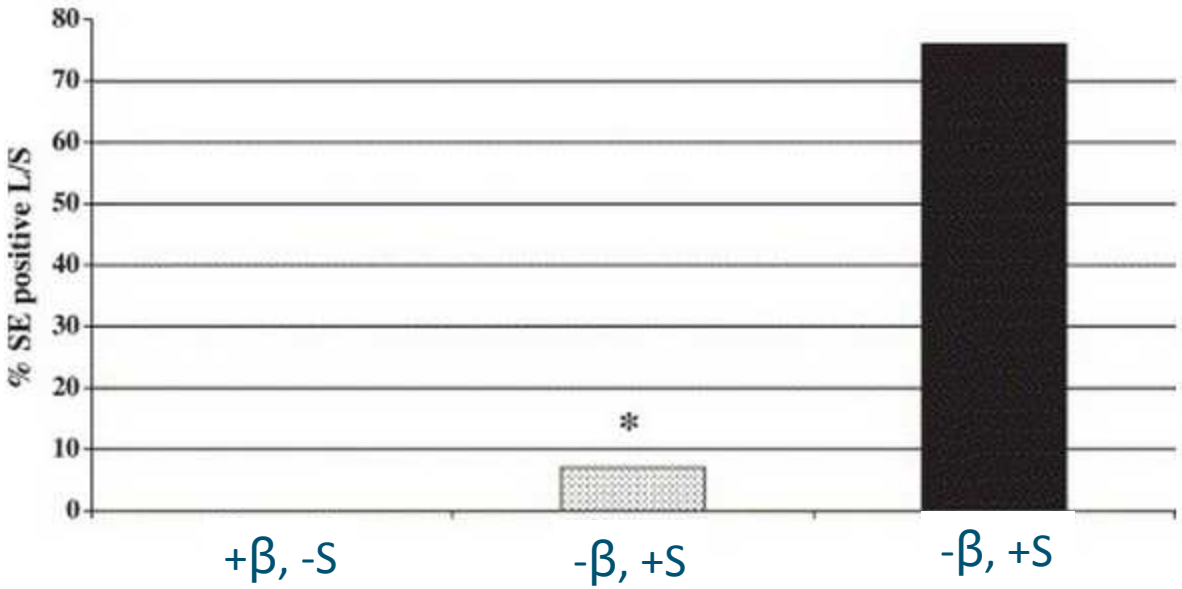
Nutrient - β-glucan [Design]

β-glucan feed no SE	β-glucan feed SE	Control feed SE

- 30 ♂ one-day old White Leghorn chicks per group
- Feed intervention 2 days
- Purified β-glucan

- Challenge at 3 days post-hatch
  - *S. enterica* serovar Enteritidis

Nutrient - β-glucan [Results]



Effects of feeding β-glucan on chicken heterophil phagocytosis

Treatments	Percent heterophils+SE	Mean #SE/heterophil	Phagocytic index (PI)
Control feed	38.54±0.05	4.38±1.08	175.54±44.92
β-glucan feed	78.84±0.03[a]	8.20±0.76[a]	644.10±57.07[a]

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Lowry et al., 2005

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Nutrient - β-glucan

Putative mechanism

- Surface receptors on innate immune cells are responsible for binding to β-glucans
- Allowing the immune cells to recognize them as "non-self"

Prebiotic - polydextrose (PDX) [Design]

PDX	PDX	PDX	PDX	Control
1.7	4.3	8.5	17.0	0 g/L

- 1-day-old piglets
- 18 days intervention
- Housed in individual pens

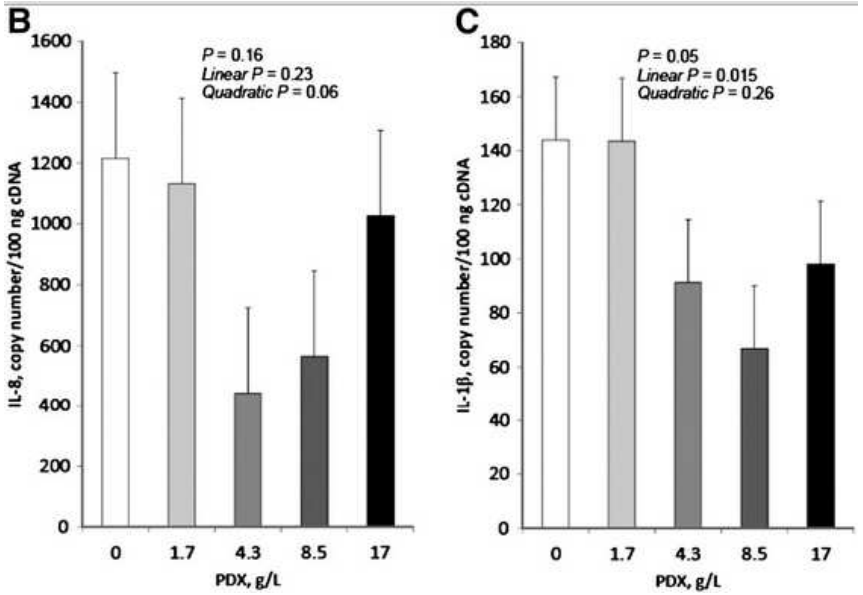
Prebiotic - polydextrose [Results]

	PDX, *g/L*							Orthogonal *P*	
	0	1.7	4.3	8.5	17	SEM	*P*	Linear	Quadratic
	µmol/g of wet digesta								
Lactic	0.63^{b}	1.12^{b}	0.60^{b}	3.52^{a}	3.83^{a}	0.81	0.02	<0.01	0.26
	log$_{10}$ CFU/g wet digesta								
Lactobacilli	10	4.3	16	13	34	50	10	0.12	0.01	0.53
Bifidobacteria	72	37	48	28	47	33	20	0.78	0.93	0.69

↑ Short Chain Fatty Acids

↓ pH digesta

↓ IL-1β, and IL-8



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Herfel et al., 2011

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Prebiotic - polydextrose

Putative mechanism

- Oligosaccharides act as receptor analogs, as prebiotics, and support innate immunity

Spray-dried animal plasma [Design]

SDAP 10%	autoclaved SDAP 10%	Control, fish-meal 10%

- Duroc × Landrace × Large White
- Day 3 start experiment (n=12)
- Markers measured (day 21)
  - Growth performance
  - Morphology
  - Antioxidant capacity
  - Cytokines serum and intestinal mucosa

Spray-dried animal plasma [Results]

Results

Item	Control	SDAP	auSDAP	Pooled SEM	*P*-value
ADG, g	209.43^{a}	260.33^{b}	246.98^{ab}	10.72	0.012
ADFI, g	240.79^{a}	293.63^{b}	284.1^{b}	8.79	0.002

Item	Control	SDAP	auSDAP	Pooled SEM	*P*-value
Duodenum					
Villus height, µm	327.35^{a}	443.78^{b}	397.98^{b}	19.17	0.002
Crypt depth, µm	116.46	126.71	122.63	5.00	0.369
Villus:crypt	2.81^{a}	3.53^{b}	3.27^{ab}	0.17	0.026

Item	Control	SDAP	auSDAP	Pooled SEM	*P*-value
IL-1β, pg/mg of prot	247.68^{a}	203.98^{b}	234.27^{a}	4.38	<0.001
TNF-α, pg/mg of prot	63.22^{a}	56.74^{b}	53.99^{b}	1.54	0.002
IL-2, pg/mg of prot	226.90^{a}	224.05^{a}	198.33^{b}	5.81	0.006
sIL-2R, pg/mg of prot	41.58^{a}	25.45^{b}	25.19^{b}	3.21	0.003

Spray-dried animal plasma

Putative mechanism

- reduced activation of helper T cells (via IL2)

Conclusion literature study

- Although complex interplay between host-microbiota-environment (feed), it is possible to modulate the (immune competence of the) host by a multitude of nutritional factors
- This literature study gives new possible routes to intervene via feed (additives) on the immune development
- Putative working mechanisms proposed

Thanks for your attention

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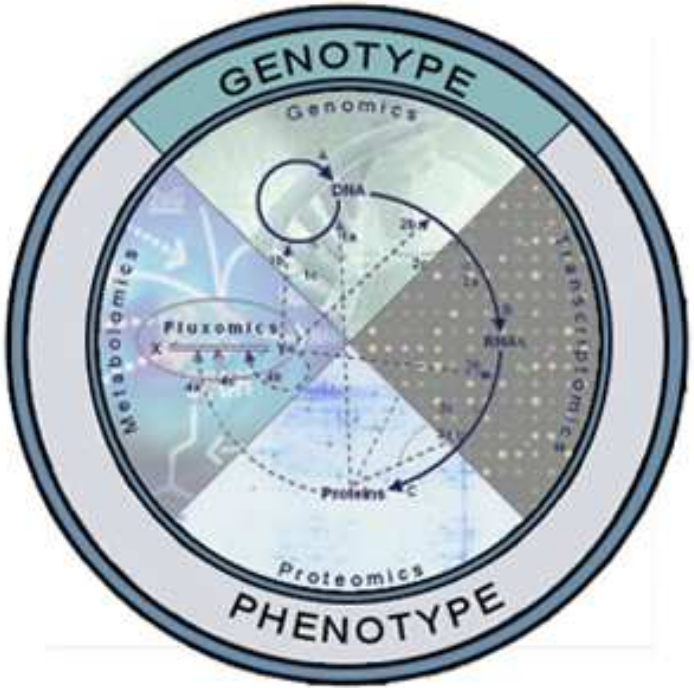

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