Bovine colostrum as a natural growth factor for newly-weaned piglets

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Plan

- Introduction
  - Pig weaning
  - Bovine colostrum
- Bovine colostrum in the weaning diet
  - Growth performance and feed intake
  - Digestive and immune system
- Conclusions

Introduction

Introduction

- Weaning = Critical period

Stress

Psychological	Nutritional	Environmental
- Separation	- Solid food	- Mixing
- Manipulation	- Composition	- New environment
- Transport		

Introduction

- Effects of weaning
  - Underfeeding
  - BW ↘
  - Intestinal modifications
    - » Morphological
    - » Immunological
    - » Digestion and absorption
    - » Intestinal flora
  - Metabolic modifications
  - Endocrinal modifications

Economical Impact

Introduction

- Use of feed additives
  - Ban on antibiotics
  - Colostrum as alternative

Introduction

- Bovine Colostrum
  - 1st milk after calving
  - Composition
    - Essential nutrients
    - Bioactive compounds
      - » Growth factors (IGF-I and –II, GH, EGF, TGF)
      - » Immune factors (Ig, cytokines)
      - » Antimicrobial factors (lactoferrin, lactoperoxidase, lysozymes)

Bovine colostrum and milk composition

Composition (/l)	Colostrum	Milk
Dry Matter	153-245 g	122 g
Crude Proteins	41-140 g	34 g
Crude Fat	39-44 g	37 g
Lactose	27-46 g	46 g
Ash	5-20 g	7 g
IgA (Immune factors)	3.0-6.5 g	0.2 g
IgG1 (Immune factors)	50-90 g	0.3-0.4 g
IgG2 (Immune factors)	1.5-2 g	0.05 g
IgM (Immune factors)	3.8-6 g	0.05 g
IGF-I (Growth factors)	100-2000 µg	< 25 µg
IGF-II (Growth factors)	200-600 µg	< 10 µg
EGF (Growth factors)	4-8 mg	2 µg
TGF-β (Growth factors)	100-300 µg	1-2 µg
Lactoferrin (Anti-microbial factors)	1.5-5 g	0.1-0.3 g
Lactoperoxidase (Anti-microbial factors)	30 mg	20 mg
Lysozyme (Anti-microbial factors)	0.14-0.7 mg	0.07-0.6 mg

Elfstrand *et al.*, 2002 ; Gopal *et al.*, 2000 ; Korhonen, 1977

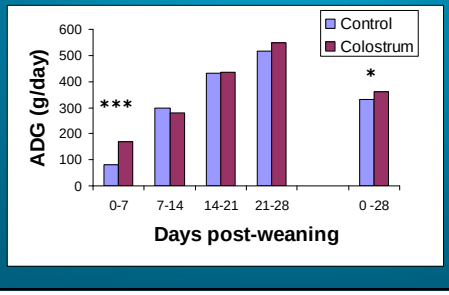
Introduction

- Bovine Colostrum
  - Availability
    - Colostrum Bank
    - 80 000 litres collected/year

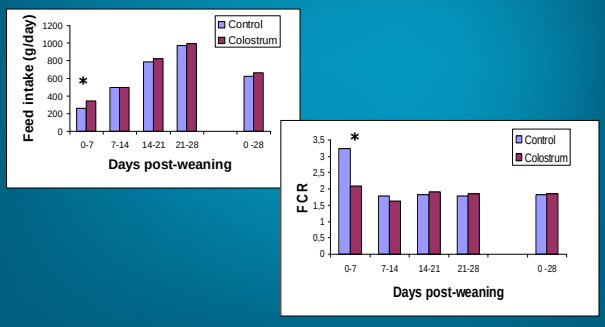
Bovine colostrum in weaning diet

Bovine colostrum in weaning diet

– Growth performance and feed intake
  - 20 g of BC serum/kg of diet (Boudry et al., 2008)



Bovine colostrum in weaning diet



Bovine colostrum in weaning diet

- Growth performance and feed intake
  - ↗ ADG and ADFI Week 1 PW
  - ↘ FCR Week 1 PW
  - First studies in 1999: 5 to 10 % of BC
  - Last studies: 1 % of BC
  - Pathogen pressure

Bovine colostrum in weaning diet

- Gastro-intestinal tract
  - Morphology (King et al., 2007 and 2008)
    - ↗ villi length
    - ↘ crypt depth
  - ↗ duodenal protein synthesis (Le Huërou-Luron et al., 2003)

➔ Maintain the intestinal barrier integrity

Bovine colostrum in weaning diet

- Gastro-intestinal tract
  - Microflora (Huguet et al., 2006)
    - ↗ Lactobacilli/Coliform
    - ↘ Stomach pH (Gram -)

➔ ↘ diarrhoea risk

Bovine colostrum in weaning diet

- Immune system
  - Systemic response (Boudry et al., 2007 and 2008)
    - ↗ total IgA
  - Local response (Boudry et al., 2007)
    - ↗ anti-colostral IgA
    - Cytokine expression : Th1 and Th2 immune response
    - Mainly in the iPP (Primary immune organ) : Th2 immune response
    - ↗ of Tc and Th in the lamina propria (King et al., 2008)

Bovine colostrum in weaning diet

- Hormonal response
  - Boudry et al. (in preparation)
    - ↗ in IGF-I on day 7 : Feed intake ???
    - No effect on T3 and T4 on day 7 : decrease after weaning but returned faster to initial level

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Conclusion

Conclusion

- Bovine colostrum supplementation
  - Increase growth performance and feed intake
  - Maintain intestinal barrier integrity PW
  - Induce an humoral immune response
- In pig production
  - Bovine colostrum = 60 €/kg
  - 1% during 7 days = 500 g/piglet
    = 0.70 €/piglet

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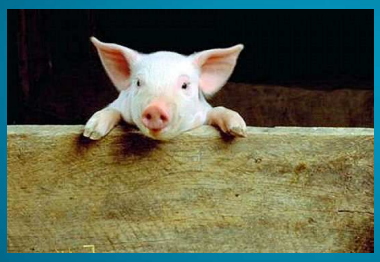

Table 2

Effects of BC *vs.* control treatment	
↗ADG Week 1 and 2 PW ≈ ADFI and FCR ↘ Days to slaughter	↗ADG and ADFI Week 1 PW ↘ FCR Week 1 PW
≈ ADG and FCR ↗ADFI Week 1 PW	↗ADG and ADFI Week 1 PW ↘ FCR Week 1 PW
≈ ADG, ADFI and FCR	≈ ADG, ADFI and FCR
↗ADG Week 1 and 2 PW ↗ADFI Week 1 PW ↘ FCR Week 1 PW	↗ BW on d 7 PW ↗ADG and ADFI Week 1 PW ↘ FCR Week 1 PW No effect of the dose of BC
↗ADG d5-d7 PW ≈ ADFI and FCR	↗ADG on d4-d7 PW with the defatted BC ↗ADFI on d4-d7 and on d11-14 PW with the defatted BC ≈ FCR
↗ BW on d 7 PW ↗ADG and ADFI Week 1 PW ↘ FCR Week 1 PW	

Table 3

Effects of BC *vs.* control treatment
↗duodenal VH ↗duodenal protein synthesis ≈ SI mucosa weight and protein content ≈ SI lactase and aminopeptidase N activities
↘ gastric pH on d7 and d14 ↗ duodenal *lactobacilli:coliform* ≈ duodenal mucosal structure, crypt cell proliferation, migration index, digestive enzyme activities
≈ duodenal mucosa/muscularis ratio ↗duodenal villi perimeter ≈ duodenal crypt size and crypt cell proliferation
↗ proximal and mid jejunal VH ↘ proximal and mid jejunal and distal ileal CD ↗VH:CD in distal ileum ↗ epithelial cell height in mid jejunum
↗ jejunal and ileal VH ↘ jejunal and ileal CD ↗ VH:CD in jejunum and ileum ≈ epithelial cell height

Table 4

Effects of BC *vs.* control treatment
↗ MC in the ileal PP on d21 ↘ B cells in the ileal PP on d 21 ↗ SI of ileal PP MC ↗ serum total IgA on d 21 ↗ local anti-colostral IgM, IgG and IgA ↗ cytokine Th1 and Th2 in the GALT
↘ serum Tc cells on d 7 PW ↗ serum total IgA on d 7 PW
↗ mid jejunal Tc and Th cells