Sow influence on neonatal survival: a special focus on colostrum
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Sow influence on neonatal survival: a special focus on colostrum
Hélène QUESNEL, INRA, FRANCE
Preweaning mortality of live-born piglets varies between countries from 9% up to 14%
Piglet mortality in herds

✓ Two thirds of mortality before weaning occur during the first 3 days after birth

✓ Early death is mainly due to a low consumption of colostrum

   Even when the cause of the death is crushing (weak or starved piglets)

*Edwards, 2002; Le Dividich et al., 2005*
Sow influence on neonatal survival: a special focus on colostrum

Roles of colostrum for newborn piglets

In relation with piglet features at birth
Relation between colostrum intake and performance

Factors that affect colostrum production by the sow
Mortality (%)
Piglets

1 out of 7 piglets born alive dies before weaning

Piglet mortality in herds

Colostrum: the first secretion of the mammary gland, rich in immunoglobulins (IgG)

Colostrum:
the first secretion of the mammary gland, rich in immunoglobulins (IgG)
Ways of measuring colostrum yield

✓ Estimation of colostrum intake by each piglet using weight gain between birth and 24 h after birth

✓ Colostrum yield for 24 h = \sum \text{intakes by each piglet in the litter}

Estimation of colostrum intake:
Prediction equation established by Devillers et al., 2004

Alternative predictive model established by Theil et al. (2014)
Roles of colostrum

Exposed to a cold environment at birth
⇒ Energy needed for heat production and homeothermia

✓ Low energy stores
   No brown adipose tissue
   Low fat content

≠ other newborn mammals

aggravated by selection for reduced carcass fatness
(Herpin et al., 1993; Canario et al., 2007)
Energy stores and requirements for the first 24 h after birth

To be provided by colostrum

Thermoregulation
Energy retention
Physical activity
Maintenance

Le Dividich et al., 2005
Roles of colostrum

✓ No immunity & underdeveloped immune system
   no transfer of Ig through the placenta

No production of Ig before 7 to 10 days of age

Rooke and Bland, 2005

→ The piglet relies on colostrum for immune protection
Immunological role of colostrum

Specific to colostrum
Absorbed within 24 h after birth

Prevention of neonatal diarrhea
Provided by colostrum and milk
Mortality (%)

Piglets

French national data base GTTT

1 out of 7 piglets born alive dies before weaning

Piglet mortality in herds

Immunological role of colostrum

Colostrum intake should occur without delay after birth

Concentrations of IgG

in colostrum

in piglet blood

Klobasa et al., 1987

Devillers et al., 2005

Colostrum intake should occur without delay after birth
**Immunological role of colostrum**

- **Mammary epithelial cells**
- **Lymphocytes**
- **Eosinophiles**
- **Macrophages**
- **Neutrophils**

**Systemic protection**

**Phagocytosis of bacteria**

**Antimicrobial activity**
- Lactoferrin
- Lactoperoxydase
- Transferrine
- Lysozyme

**Cytokines**
- IL-4, IL-6, IL-10,
- IL-12, TGF-β

**Differentiation of cells that produce IgA**

- **Colostrum provides local and systemic immunity**
- **Participates in educating the immune system**
Physiological roles of colostrum

✔ Immature gastrointestinal tract

→ Colostrum provides growth factors (IGF-I, insulin, EGF, TGFβ) for the development and maturation of the gastrointestinal tract

_Xu et al., 2002_

✔ Among other bioactive components, relaxin stimulates uterine development of young females

“Lactocrine programming” of female reproductive tract

_Bartol et al., 2009_
Colostrum intake and piglet performance

Average intake: 250 - 300 g (0-700 g)

Mortality rate until weaning

BW gain for 24 h

Devillers, 2004
Colostrum intake and piglet performance

Devillers, 2004
Colostrum intake and piglet performance

Positive correlation between [IgG] in piglet plasma at 2 and 28 days of age

⇒ The higher passive immunity is soon after birth, the higher immunity is at weaning.

Rooke et al., 2003; Devillers et al., 2011

What is the influence of other immune components on piglet health and survival??
Roles of colostrum for newborn piglets

- Consumption of “250” g of colostrum for an average piglet (1.4 kg),
  - strongly reduces the risk of mortality before weaning,
  - provides passive immunity
  - allows body-weight gain.

- A litter of 13 piglets needs 3.3 kg of colostrum
- One third of litters do not get enough colostrum to fulfill their needs.

INRA experimental herd
n = 200
Colostrum intake by individual piglets

Gestation / Farrowing

Newborn piglet
- Birth weight
- Maturity
- Vitality

Sow
- Colostrum production
- Maternal behaviour

Colostrum intake
- Litter
  - Size
  - Heterogeneity
- Environment
  - Thermoregulation
  - Passive immunity
  - BW gain
- Neonatal survival

Gestation / Farrowing
Sow influence on neonatal survival: a special focus on colostrum

Roles of colostrum for newborn piglets

In relation with piglet features at birth
Relation between colostrum intake and performance

Factors that affect colostrum production by the sow
(quantity and quality)
Colostrum yield is highly variable

INRA experimental herd
150 LR x LW sows

Mean = 3.5 kg
Colostrum yield: sow vs piglets?

Devillers et al., 2007; Quesnel, 2011

≠ milk yield
The sow likely produces less colostrum than could be consumed by the litter.
Colostrum yield and sow parity

Colostrum yield according to sow parity:
- P1 < P2 & P3 > older sows  
  Devillers et al., 2007
- P1, P2 & P3 > older sows  
  Decaluwé et al., 2013
- P1 & P2 > older sows  
  Quesnel et al., 2015

⇒ Older sows (> P3) produce less colostrum than young sows.

≠ milk yield
Colostrum yield and sow endocrine status

Lactogenesis regulated by hormones involved in the process of parturition, and prolactin

Progesterone  Prolactin  Oestradiol-17β  Cortisol

Necessary for colostrum production
Colostrum yield and sow endocrine status

In primiparous sows

✓ Colostrum yield is influenced by the relative concentration of prolactin and progesterone before parturition, with progesterone having a negative influence and prolactin a stimulatory influence.

Loisel et al., 2015

✓ Impaired lactogenesis (~1 kg of colostrum produced) could be due to a delay in hormonal changes before farrowing.

Foisnet et al., 2010
## Colostrum yield and sow endocrine status

| Level of colostrum yield | Low | Medium | High | $P$ |
|--------------------------|-----|--------|------|-----|
| n                        | 26  | 29     | 17   |     |
| Colostrum yield, kg      | 2.4 | 3.5    | 4.5  |     |
| Born alive               | 14.4| 13.7   | 15.1 | ns  |
| Stillborn                | $1.8^a$| $0.9^b$| $0.9^b$| *   |

**Kinetics of birth of the piglets**

*Impact on vitality? Hormonal background?*

Quesnel, 2011
## Colostrum yield and sow metabolic status

**Significant correlations**

| Markers on d-1 | Colostrum yield | Litter BW gain during lactation |
|---------------|-----------------|--------------------------------|
|               | r = 0.50**      | d1-7  | d1-14   | d1-21   |
| Urea          |                 | r = 0.45* | r = 0.54** | r = 0.39* |
| Creatinine    | r = 0.43*      | r = -0.13 | r = -0.15 | r = -0.12 |
| BHBA          | r = -0.12      | r = -0.51** | r = -0.50** | r = -0.52** |
| Gamma-GT      | r = -0.11      | r = -0.28 | r = -0.42* | r = -0.38* |

**But many discrepancies between studies** ➔ *needs to be further investigated.*
Colostrum yield and maternal stress

Repeated nose-sling (last third of pregnancy)

- piglet preweaning mortality from 6 to 14%
- the % of diseased piglets from 12 to 28%

No effect on IgG concentrations in colostrum

- IgG concentrations in piglet plasma 3 days after birth

*Did cortisol accelerate gut closure?*

*Tuchscherer et al., 2002*

Heat stress (32 vs 22°C, d 100-term)

- IgG concentrations in colostrum
- IgG concentrations in piglet plasma

~90 vs 72 °F

*Machado-Neto et al., 1987*
Colostrum yield and maternal feeding

Few data
(colostrum yield cannot be measured easily)

Recent studies on the level and the source of dietary fat and fiber, and specific amino acids, provided during late pregnancy.
Colostrum yield and maternal feeding

✓ Fatty acid composition

5 diets (various proportions of MCFA and LCFA)
From d 108 of pregnancy

| Colostrum yield, g/piglet/24 h | Low 460 | Medium 490 | High 550 |
|--------------------------------|--------|------------|---------|
| 3% animal fat                  | X      |            |         |
| 8% fish oil                    |        | X          |         |
| 8% coconut oil                 |        |            | X       |
| 8% sunflower oil               |        | X          |         |
| 4% octanoic acid + 4% fish oil (MCFA) |       |            | X       |

Theil & Lauridsen, EAAP 2012
## Colostrum yield and maternal feeding

### Dietary fiber

High-fibre vs. Low-fibre diet (7.9 vs. 3.3% crude fiber)

Fiber from 4 sources ➔ soluble and insoluble fiber

From d 106 of pregnancy until parturition

| Diets                                | Low Fibre | High Fibre | Effect |
|---------------------------------------|-----------|------------|--------|
| No. primiparous sows                  | 14        | 15         |        |
| Colostrum yield, kg                   | 3.9       | 3.8        | NS     |
| Colostrum intake, g                   |           |            |        |
| - all piglets                         | 308       | 282        | NS     |
| - piglets < 900 g                     | 137       | 216        | 0.02   |
| Mortality during lactation, %         | 14.7      | 6.2        | 0.01   |

Loisel et al., 2013
Colostrum yield and maternal feeding

Cumulative time of birth, min

Loisel et al., 2013
Colostrum quality and maternal feeding

✓ Specific amino acids
  Glutamine + glutamate
  From d 108 of pregnancy until weaning

| Diets                     | Control | Gln +Glu | Effect |
|---------------------------|---------|----------|--------|
| Glu+Gln cc, mmol/mL       |         |          |        |
| in colostrum              | 0.42    | 0.58     | ns     |
| in milk at 21 days        | 1.03    | 2.10     | **     |
| Fat content, %            |         |          |        |
| in colostrum              | 4.6     | 7.4      | **     |
| in milk at d 21 days      | 5.0     | 6.6      | *      |

No effect on piglet growth and rate of survival

*Santos de Aquino et al., 2014*
## Colostrum quality and maternal feeding

**Ig content**

| Treatment                                    | Duration | [Ig] | [IgG] | Performance                  |
|----------------------------------------------|----------|------|-------|------------------------------|
| Conj. Linoleic Acid                          | 8 d      | ↑ IgG| ↑     | ns                           |
| Fish oil                                     | 35 d     | ↑ IgG| ↑     | ↑ ADG                        |
| Fermented liquid feed                       | 14 d     | ↑ IgG| IgA   | ?                            |
| Mannan oligosaccharides                      | 21 d     | ↑ IgG| IgA   | ?                            |
| Immunostimulants                            | 35 d     | ↑ IgG| ?     | ↑ diarrhoea                  |
| Fructo oligosaccharides                     | 28 d     | ↑ IgA| ns    | ↑ gut immunity               |

Presumably through immunomodulating effects of active components
Conclusions and Perspectives

Increasing colostrum intake by piglets is important:
- to reduce neonatal mortality
- to improve the immune protection of piglets (important in the context of reducing the use of antibiotics)

Increasing colostrum production by sows?
Colostrum yield and quality can be influenced by maternal feeding during the end of pregnancy.
Conclusions and Perspectives

Increasing colostrum yield by sows
Further knowledge needed on the impact of:
✓ metabolic background during the peripartum period
✓ mammary gland development during pregnancy.

Increasing immune quality of colostrum
Knowledge needed on the impact of immune components on piglet health and survival
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