Improved piglet survivability by altered maternal nutrient supply for transition sows

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Agenda

1. Introduction
2. Glycogen depots in neonatal piglets
3. Colostrum – quantity and quality
4. Time for onset of lactation
5. Milk yield in early lactation
6. Conclusions

1. Introduction

Litter size has increased from 12 (1992) to 16 (2012)

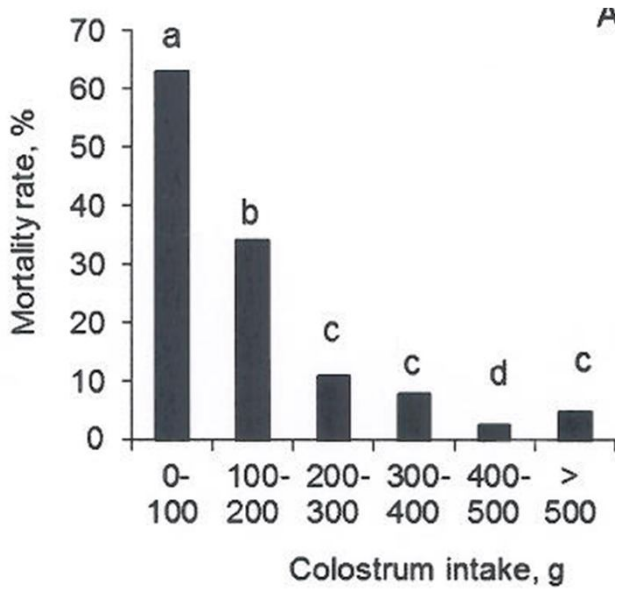
The total mortality has increased to 24%

Nutrition of the sow in late gestation is important:

The sow has to prioritize between foetal growth, udder growth and colostrum synthesis

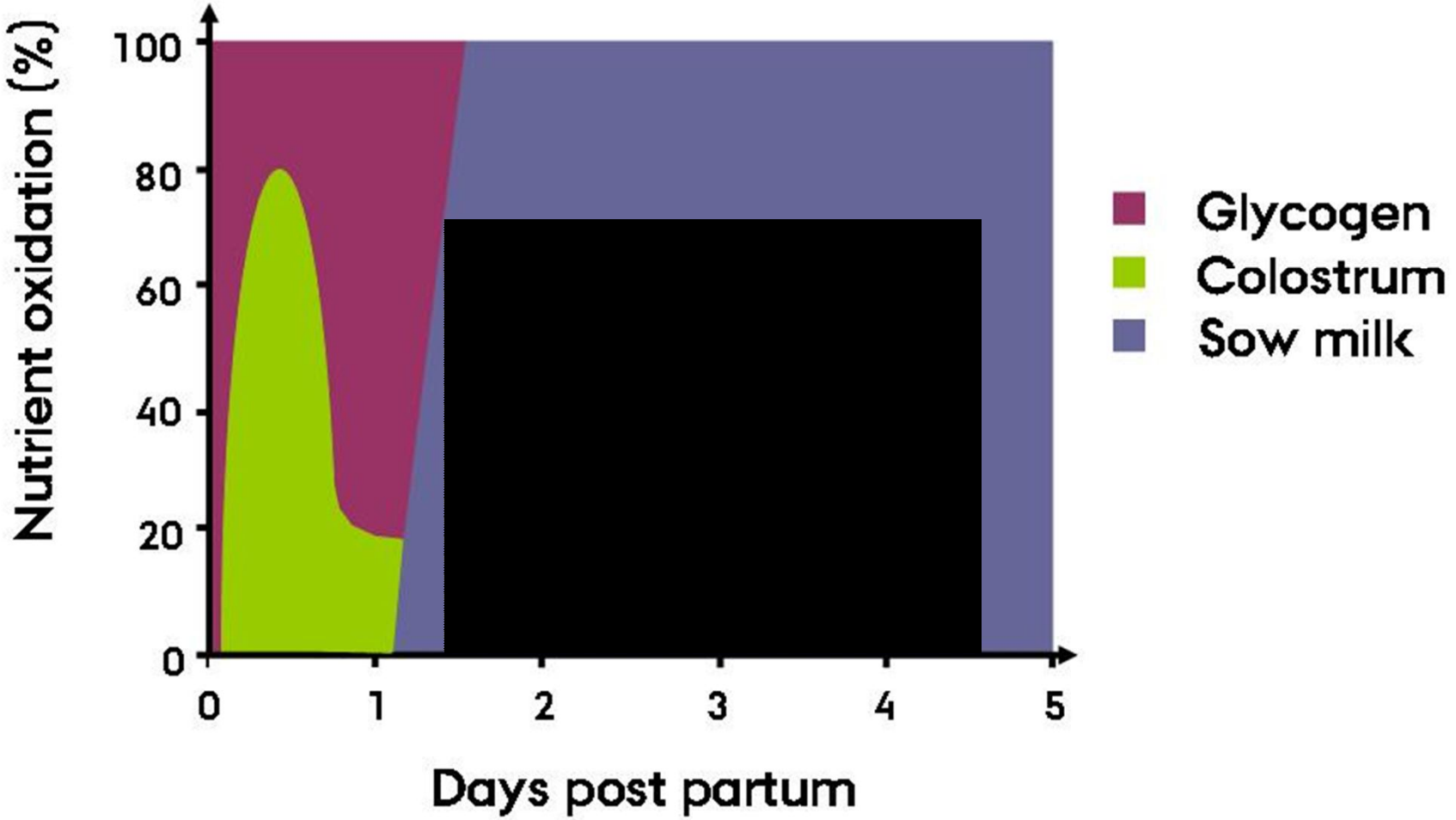
Why is glycogen and colostrum important for survival?

- Glycogen is only energy source until colostrum is ingested
- Colostrum supplies antibodies - colostrum quality (long term survival)
- Most piglet die day 1-2 after birth due to depletion of energy (Pedersen et al., 2012) - colostrum quantity (short term survival)



(Quesnel et al., 2012)

Energy supply of neonatal piglets



(Theil et al., 2012)[5]

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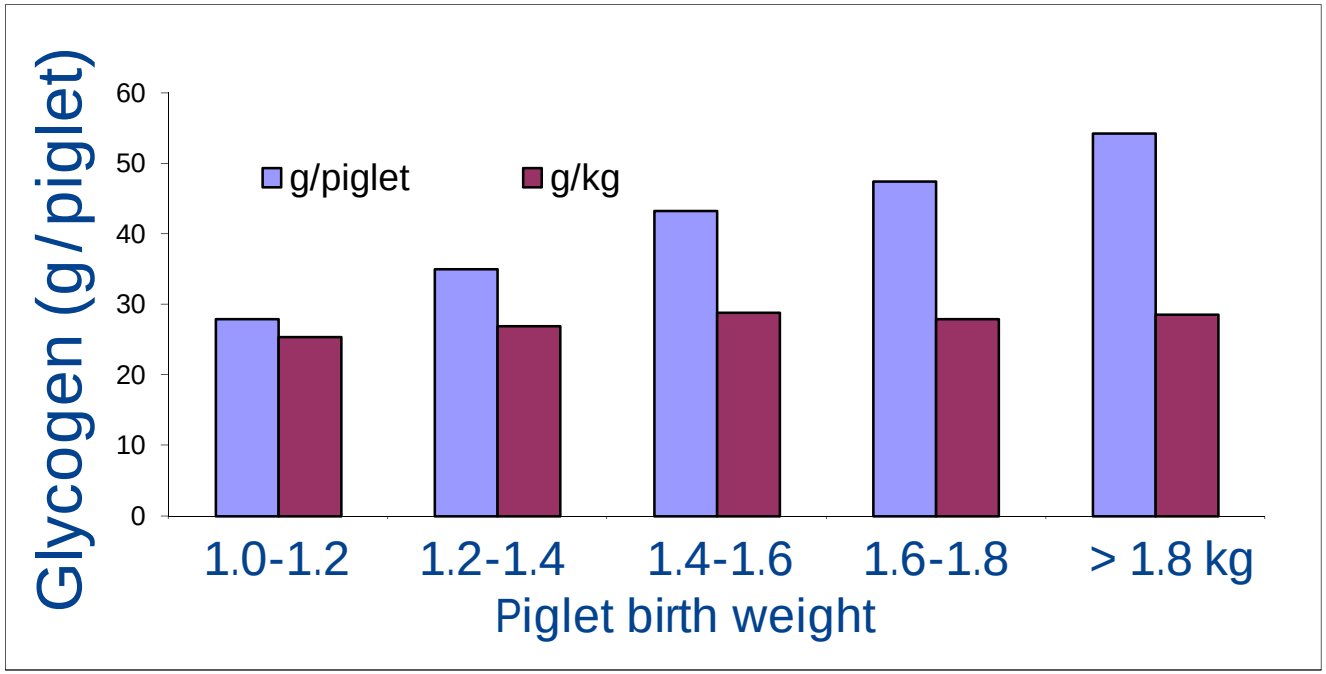
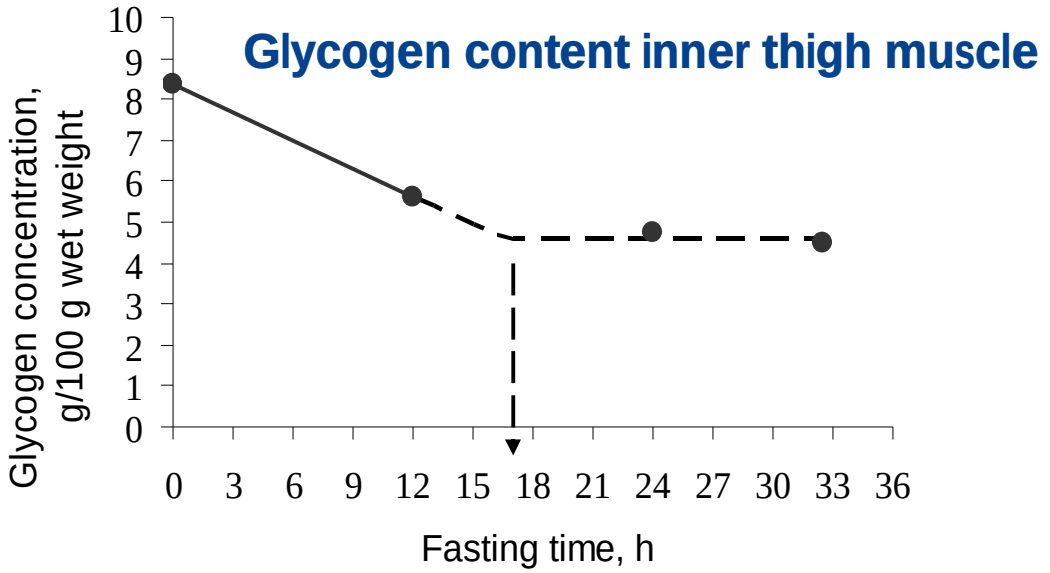
2. Glycogen depots – relation with birth weight



(Theil et al., 2011)[7]

2. Glycogen depots in piglets with NO colostrum intake

- Fastest mobilisation of glycogen from the liver
- Largest depot in muscles
- Depot depleted in semimembranosus muscle (=> no more locomotory activity after 17 h)



(Theil et al., 2011)

Attempts to increase glycogen depots by dietary means:

1. Low fibre (high starch) vs. high fibre (low starch) during gestation – NO EFFECT
2. Addition of 8% fat from different fat sources (last week of gestation) – NO EFFECT
3. Use of coconut oil (4.5%) in 0, 1, 3, or 5 weeks prior to farrowing – NO EFFECT

(Theil et al., 2011; Sørensen, 2011)

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Nutritional aspects related to colostrum production

- **Diet changed from gestation to lactation diet approx 1 week prior to parturition (and energy supply is often lowered d -3) – concomitantly with synthesis of colostrum synthesis**
- **Fat affects yield and composition of sow milk – no knowledge on colostrum production**
- **Fat is more than energy - some fatty acids are bioactive. Bioactivity depends on chain length, saturation, Ω-3, Ω-6, Ω-9 fatty acids, stereo isomeric structure (e.g. cis/trans conf., + position of double bindings)**

- **Dietary effects on colostrum yield studied in 3 exp.**

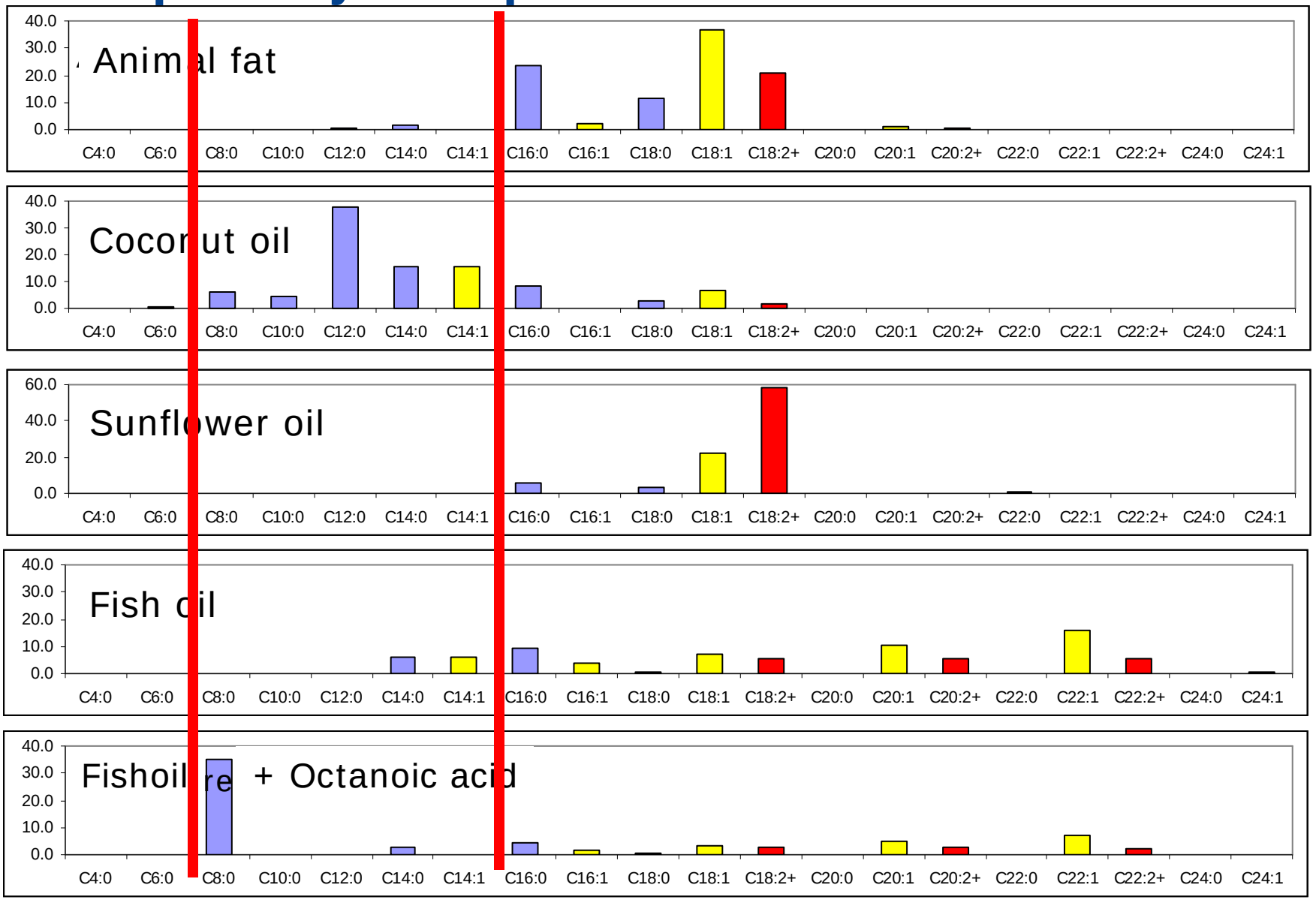
Dietary treatment fed to sows during the last week of gestation

- **Exp. 1: Sows fed different fat sources (n = 40 sows)**
- **Exp. 2: Sows fed +/- 2.5 g/d of hydroxy methyl butyrate (HMB; n = 16 sows)**
- **Exp. 3: Sows fed +/- 1.3 % conjugated linoleic acid (CLA; n = 23 sows)**

Exp. 1: Transition diets (rich in MCFA and/or LCFA):

- Control diet containing animal fat (3%)
- Coconut oil (8%)
- Sunflower oil (8%)
- Fish oil (8%)
- Octanoic acid (4%) and fish oil (4%)

1. Exp: Fatty acid profiles in fat / oils in transition



1. Exp: Fat source and colostrum production

5 transition diets fed to 40 sows d 108 to farrowing

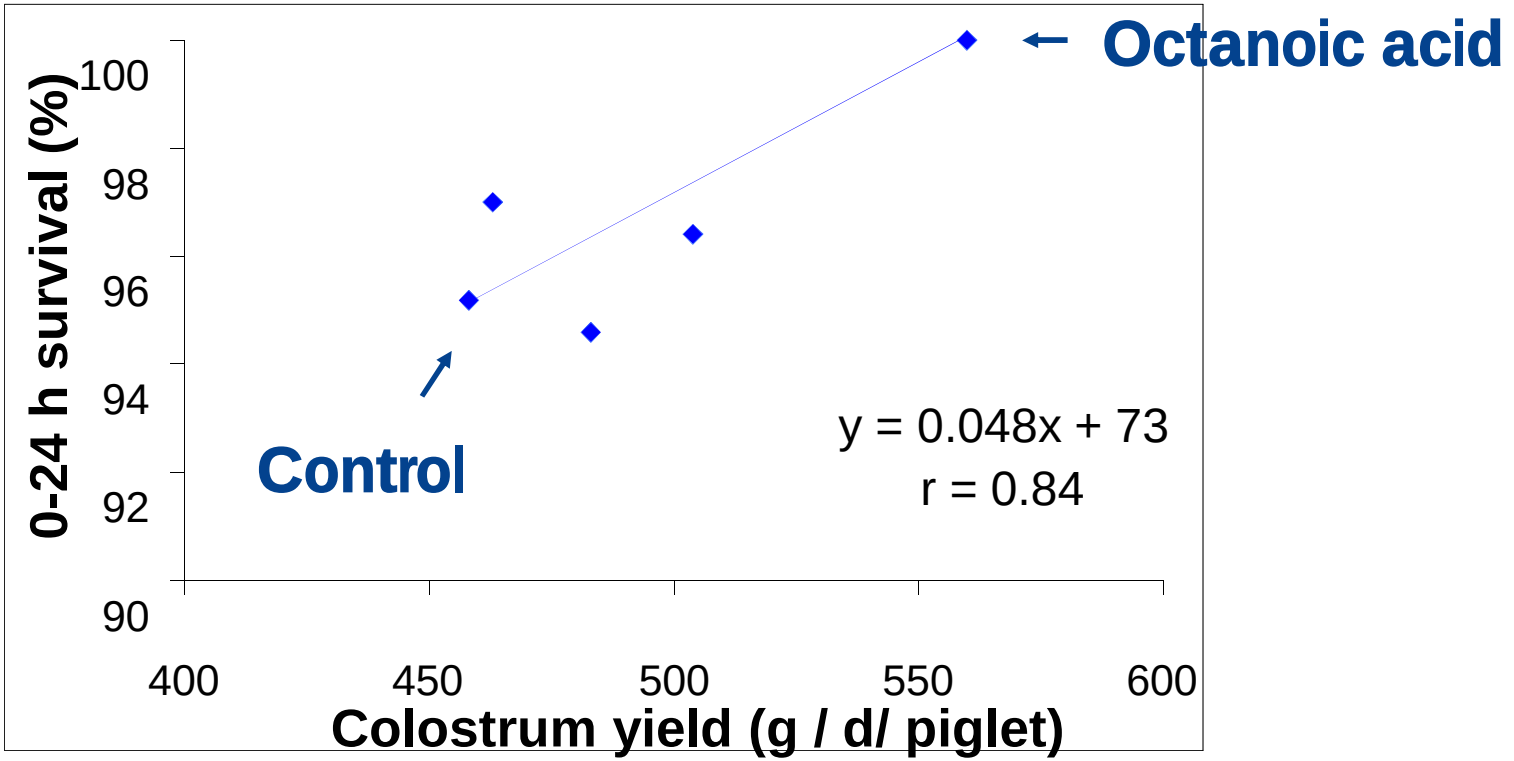
Low colostrum production - 460 g/piglet/d
- Standard lactation diet– commercially available (3% anim fat)
- 8% fish oil

Intermediate colostrum production - 490 g/piglet/d
- 8% coconut oil
- 8% sunflower oil

High colostrum production - 550 g/piglet/d
- 4% octanoic acid + 4% fish oil

Did higher colostrum yield increase short term survival? Yes!

More colostrum => energy => higher survival in colostrum period.



2. Exp: Effect of dietary HMB (2.5 g/d) d 108 to farrowing on piglet characteristica in the colostral period

	Control	HMB	P-value
Gain 0-24 t	76 [b]	132 [a]	0.05
Colostrum yield (g/piglet)	434 [b]	512 [a]	0.05
Mortality 0 to 24 h, %	4.8 [a]	0.0 [b]	< 0.05
Birth weight (g)	1440	1540	0.28

Conclusion: HMB improves colostrum yield

(Flummer & Theil, 2012)

3. Exp: Effect of dietary CLA (c9, t11+ c10, t12) d108 and onwards on piglet LW gain in the colostral period (1.3 % CLA)

	Control	CLA	P-value
Gain 0-24 t	97 [a]	58 [b]	0.07
Colostrum yield, g/piglet	463 [a]	409 [b]	0.07
Dead/moved in wk 1, %	7.8 [b]	17.6 [a]	0.04
Birth weight	1387	1391	0.96

Conclusion: CLA inhibits colostrum yield

(Krogh et al., 2012)

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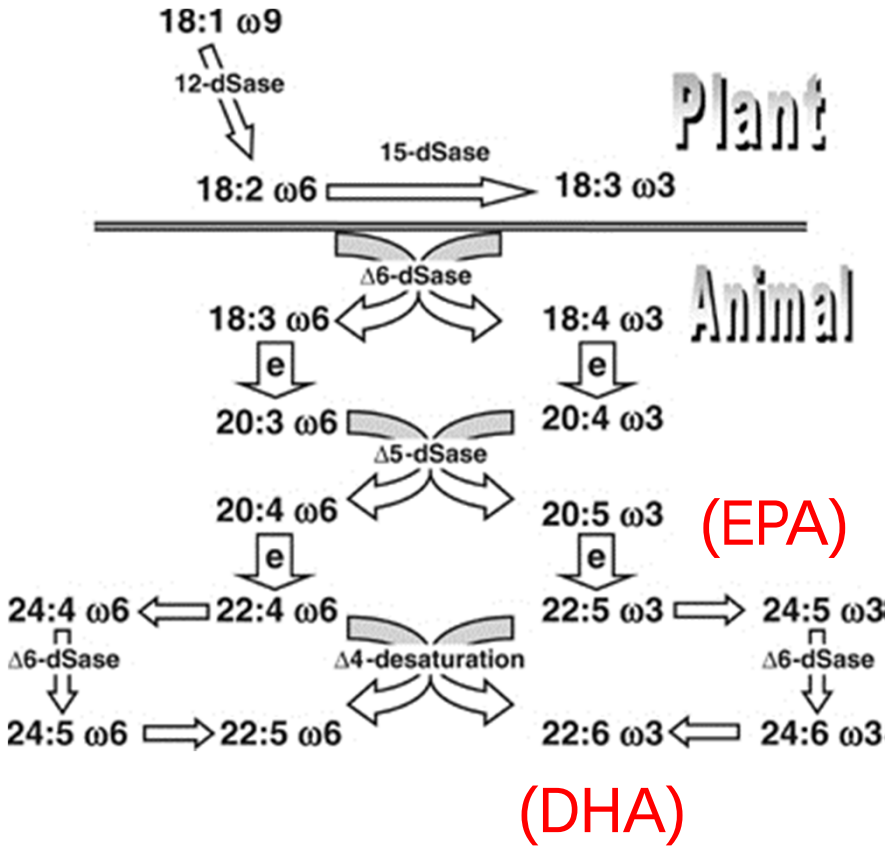
Biosynthesis of long chained PUFA



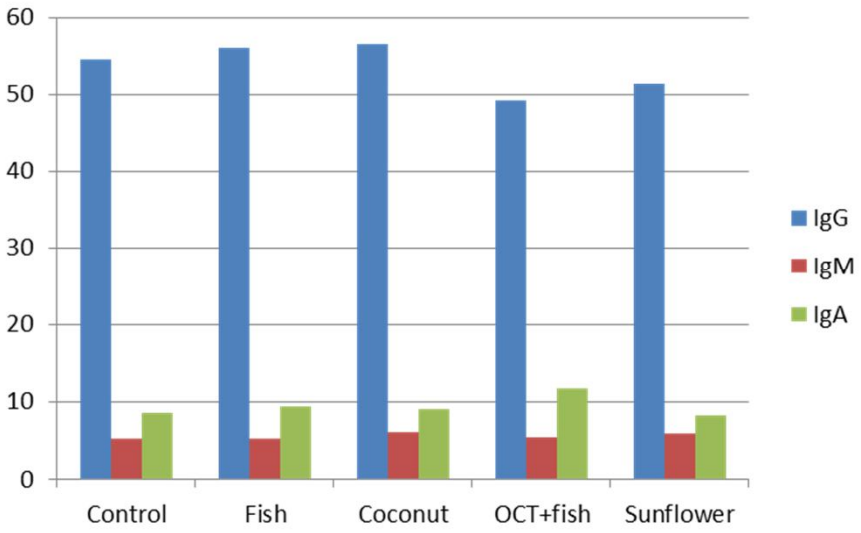
- EPA, DPA and DHA important for Ig synthesis
- Synthesis low in mammals/pigs

- Hypothesis: Supplementation of sows during transition/lactation with LC-PUFA would influence fatty acid composition and immunoglobulin concentration.

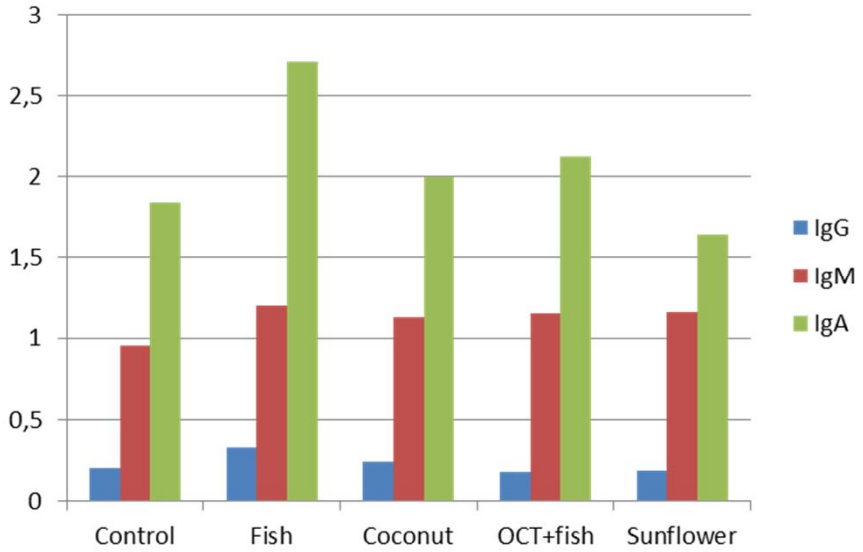
Concentration of immunoglobulins (mg/L):

Effect of fat: IgG: P=0.009, IgM: P=0.013, IgA: P=0.002

Colostrum

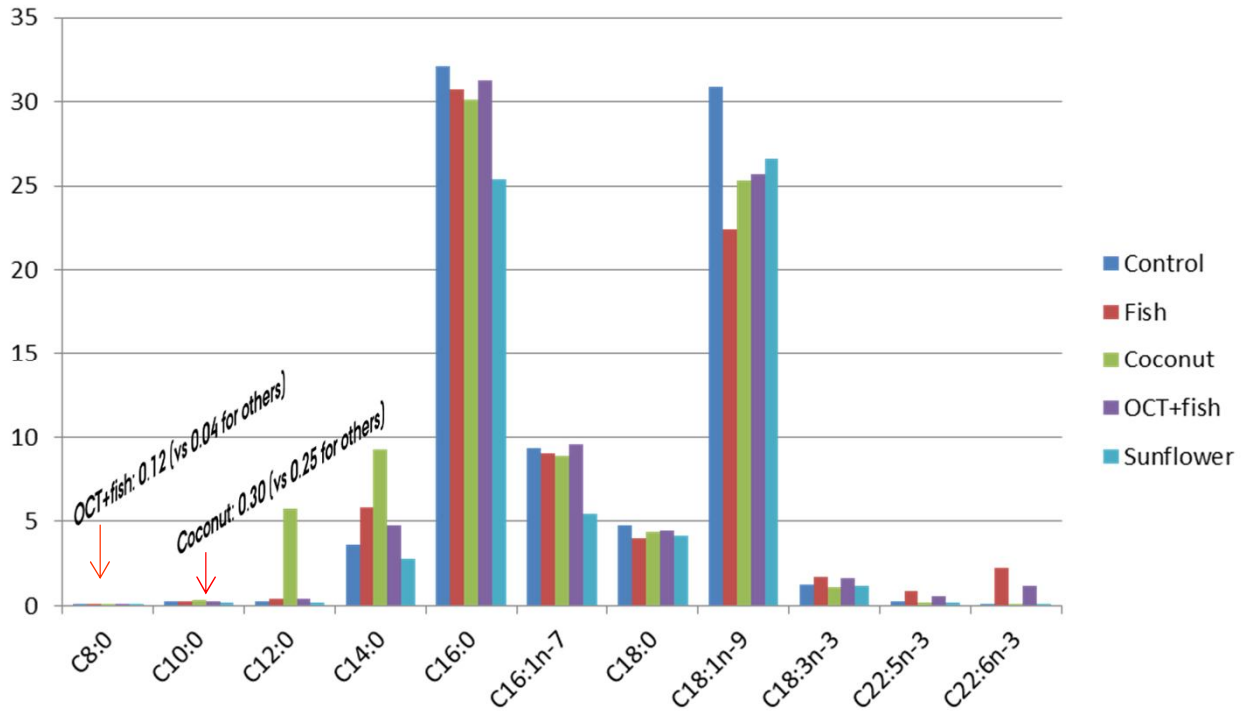


Milk



Lauridsen and Theil, 2012, in preparation

Proportion of selected fatty acids (%) in mammary secreta (colostrum and milk)



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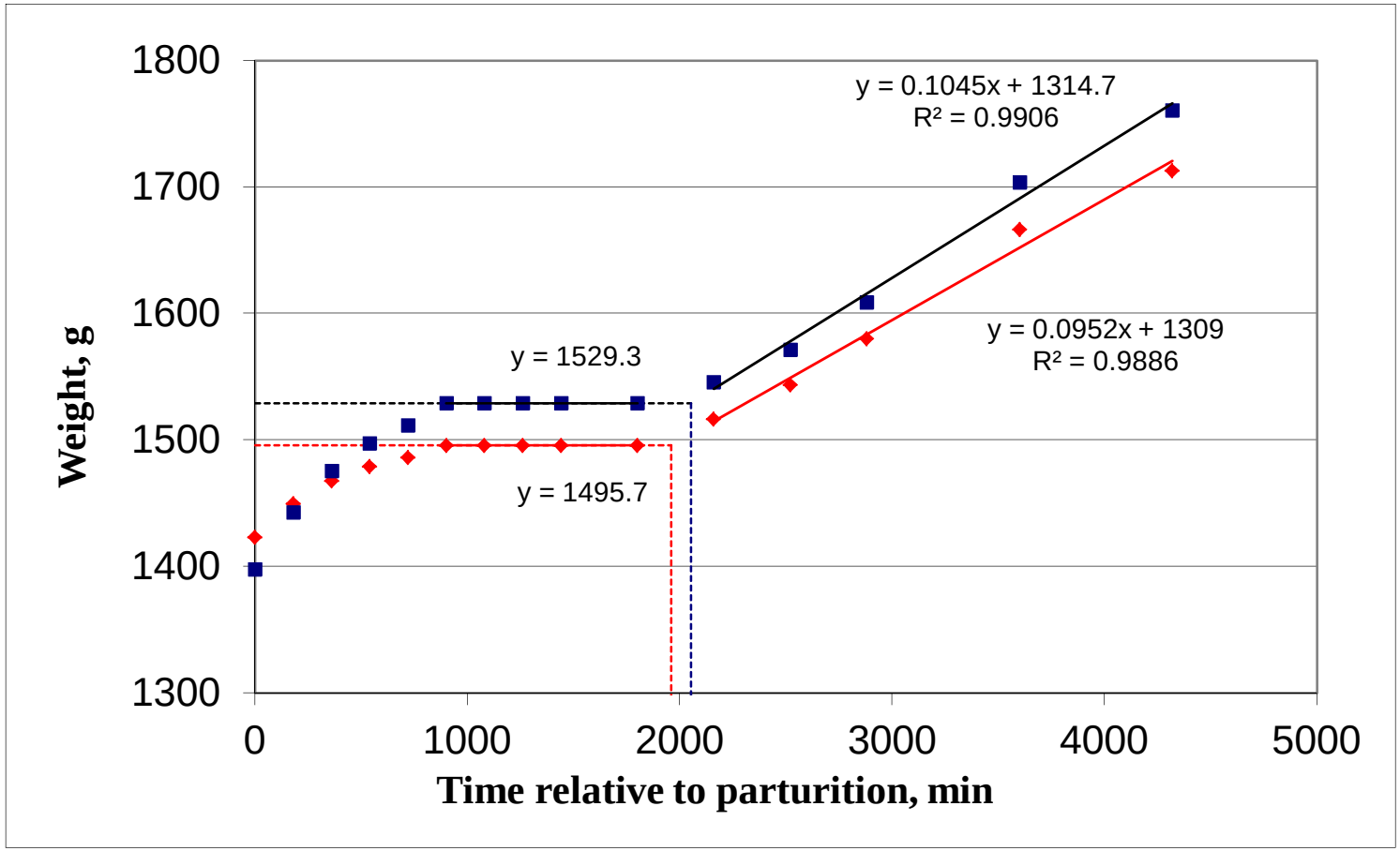
Onset of lactation determined by broken-line analysis



CLA: 33 h **Control: 34 h (P > 0.05)**

(Krogh et al., 2012)

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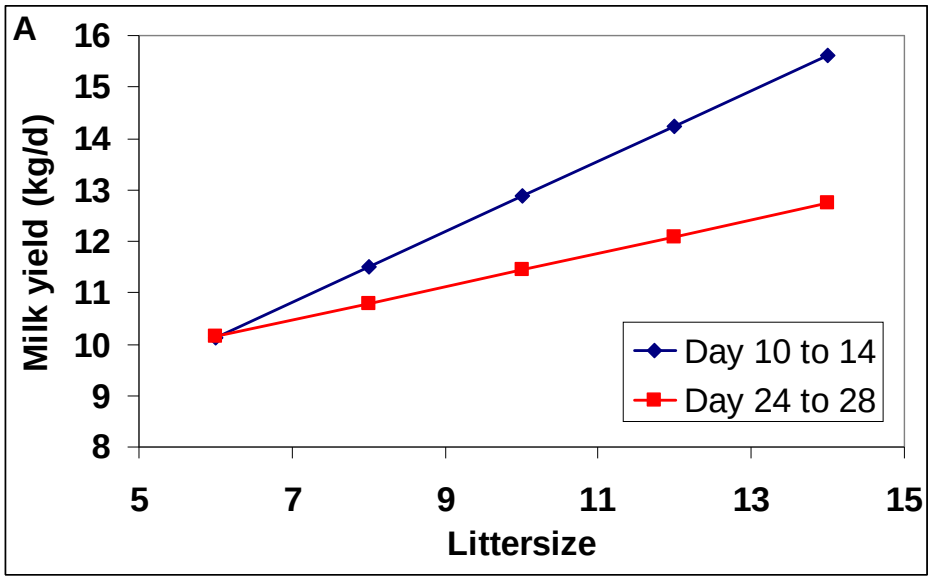
Breeding success: 1 winner, 15 loosers

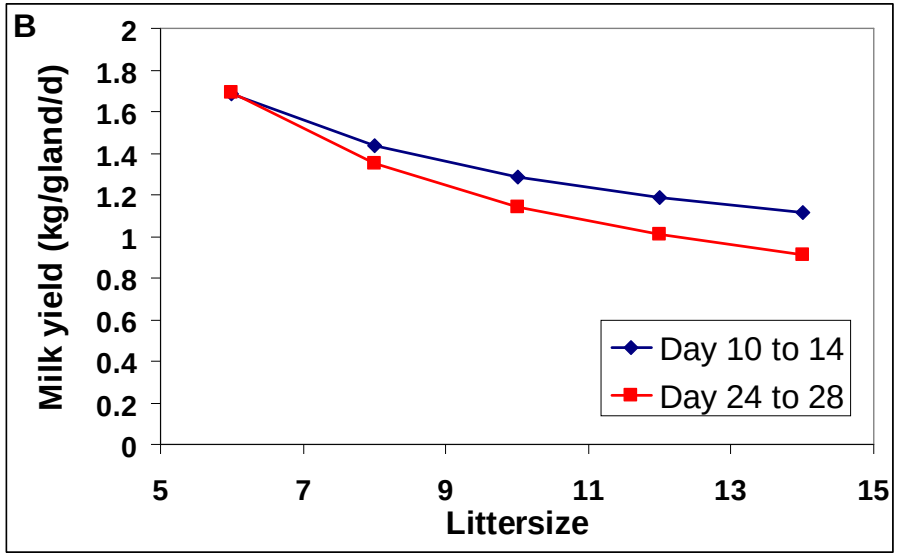
Sow milk yield increases with litter size



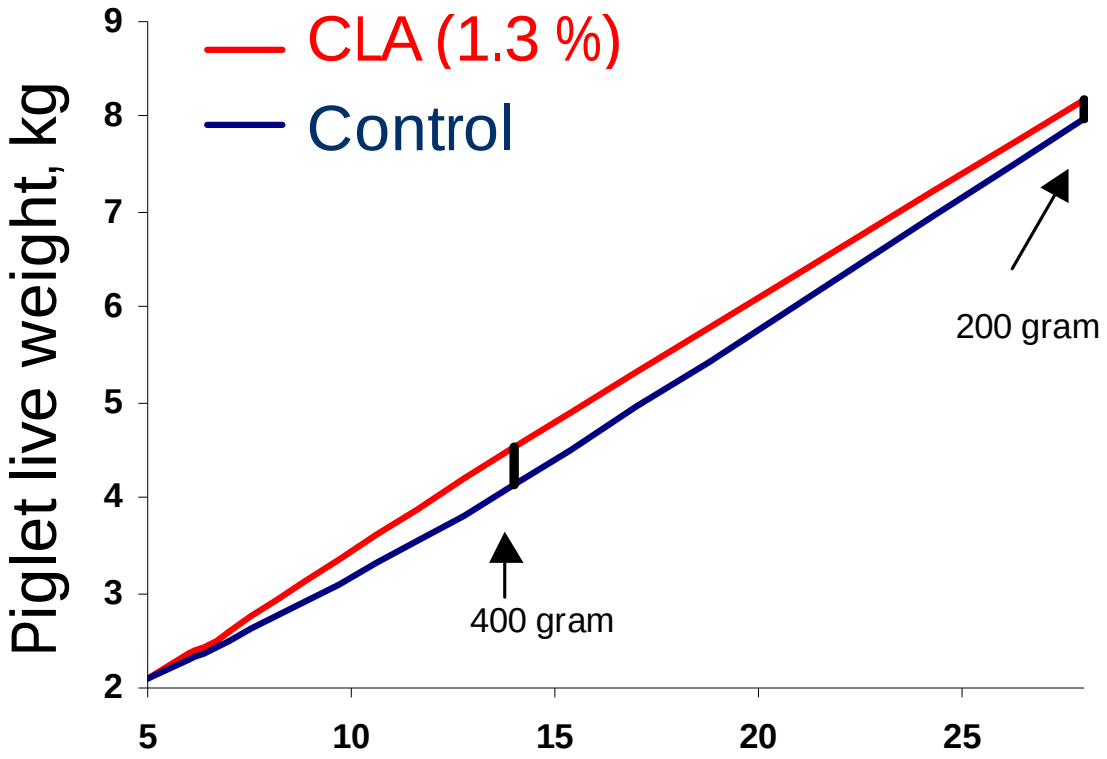
(Auldist et al., 1998)

More milk in early lactation is needed to ensure survival!!

But milk intake (g/d/piglet) decreases!!



Dietary fat (some) may improve lactation performance



(Krogh & Theil, 2011)

Conclusions: Glycogen depots, colostrum- and milk yield

Glycogen depots are not affected by sow feeding (~17 survival)

COLOSTRUM QUANTITY IS IMPORTANT for neonatal survival.
Yield may be stimulated by the diet the last week of gestation.

Questionable whether lactation may be onset earlier by altering the sow diet

Milk yield may be increased by dietary CLA from d 4 to 14

Huge variation in colostrum and milk yield among individuals -
More knowledge on the intermediary metabolism and nutrient partitioning will enable us to improve the performance of sows during transition and lactation

Conclusions: Transfer of fatty acids and Ig's

- Fatty acid composition of sow plasma, colostrum/milk and especially piglet plasma were all influenced by dietary fat treatment.

- Concentrations of IgM and IgA in sow plasma (but not IgG) were influenced by dietary fat sources.
- Concentrations of IgG, IgM and IgA, in colostrum and milk were influenced by dietary fat sources.
- BUT – IgG, IgM and IgA concentrations in piglet plasma were not significantly influenced by dietary fat sources.

- Important to stress that colostrum and milk are two very different secreta!

Read more: http://vsp.lf.dk/Viden/Laerebog_fysiologi/Chapter%2017.aspx