Born2Live: Maximizing piglet survival via altered nutrition for hyper- prolific sows

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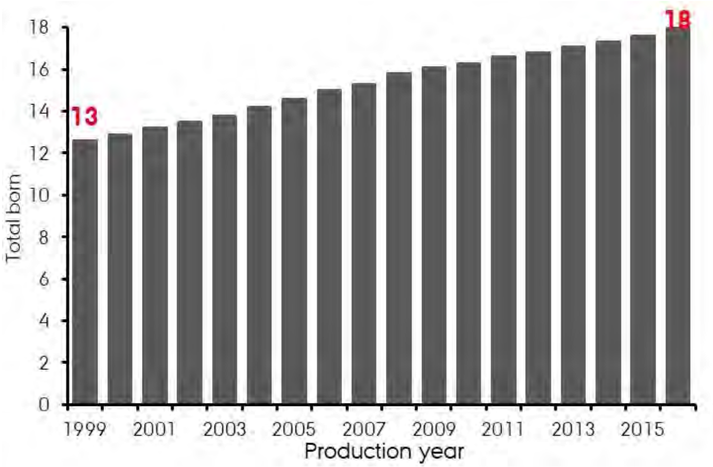
Agenda

- Farrowing process and stillborn piglets
- Colostrum: Yield- , intake- , how and when is it produced?
- Maximizing milk yield and feed efficiency

What makes prolific sows special?

Genetic selection: Litter size ↑

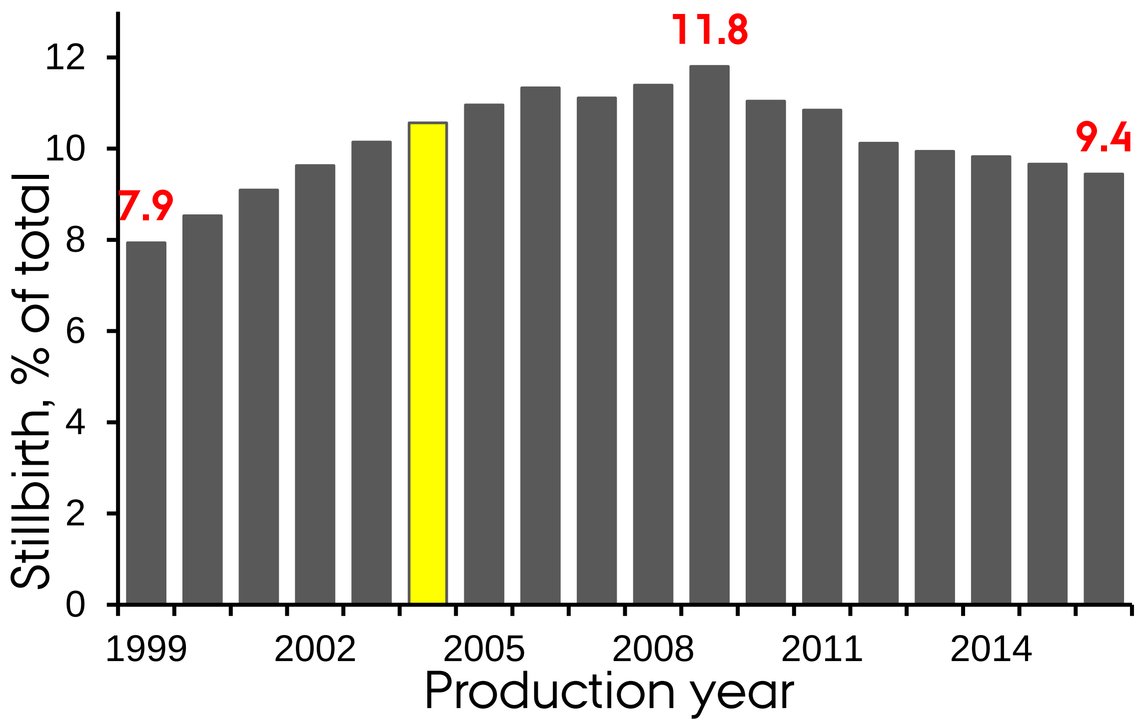


⇒ Challenges productivity / physiology

1. Farrowing length
2. Colostrum yield
3. Milk yield

Can we improve these traits by improving nutrition of prolific sows?

Trends in stillbirth rate (%) in Denmark

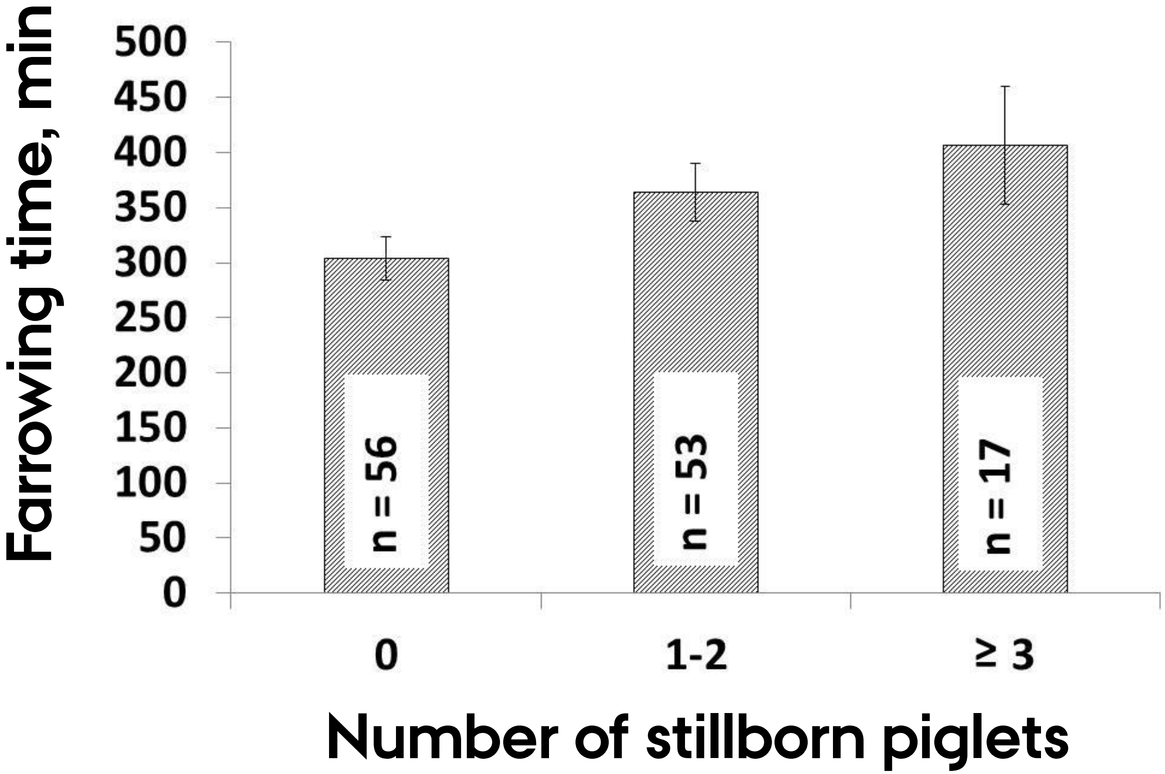


- Stillbirth rate has declined since 2009 (due to new selection index)
- Piglet mortality is still challenging the Danish pig industry

DPRC (1999-2016)

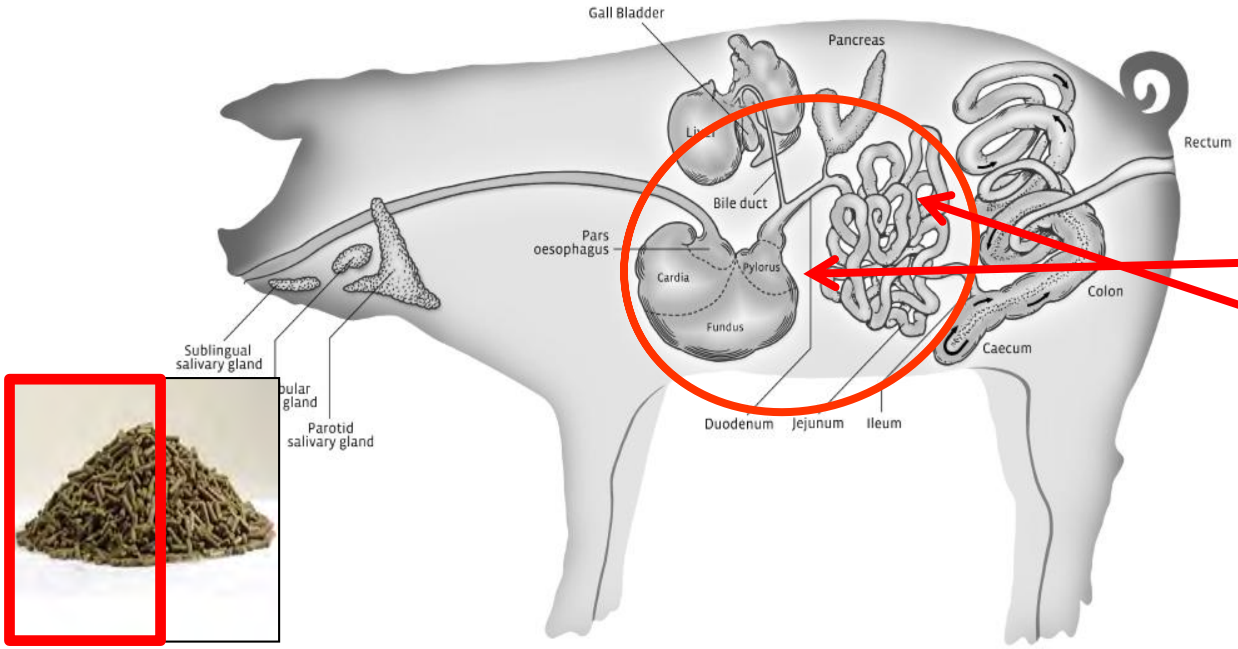
Does sow nutrition play a role for the farrowing process?

Farrowing time < ------> number of stillborn piglets



Theil (2015)

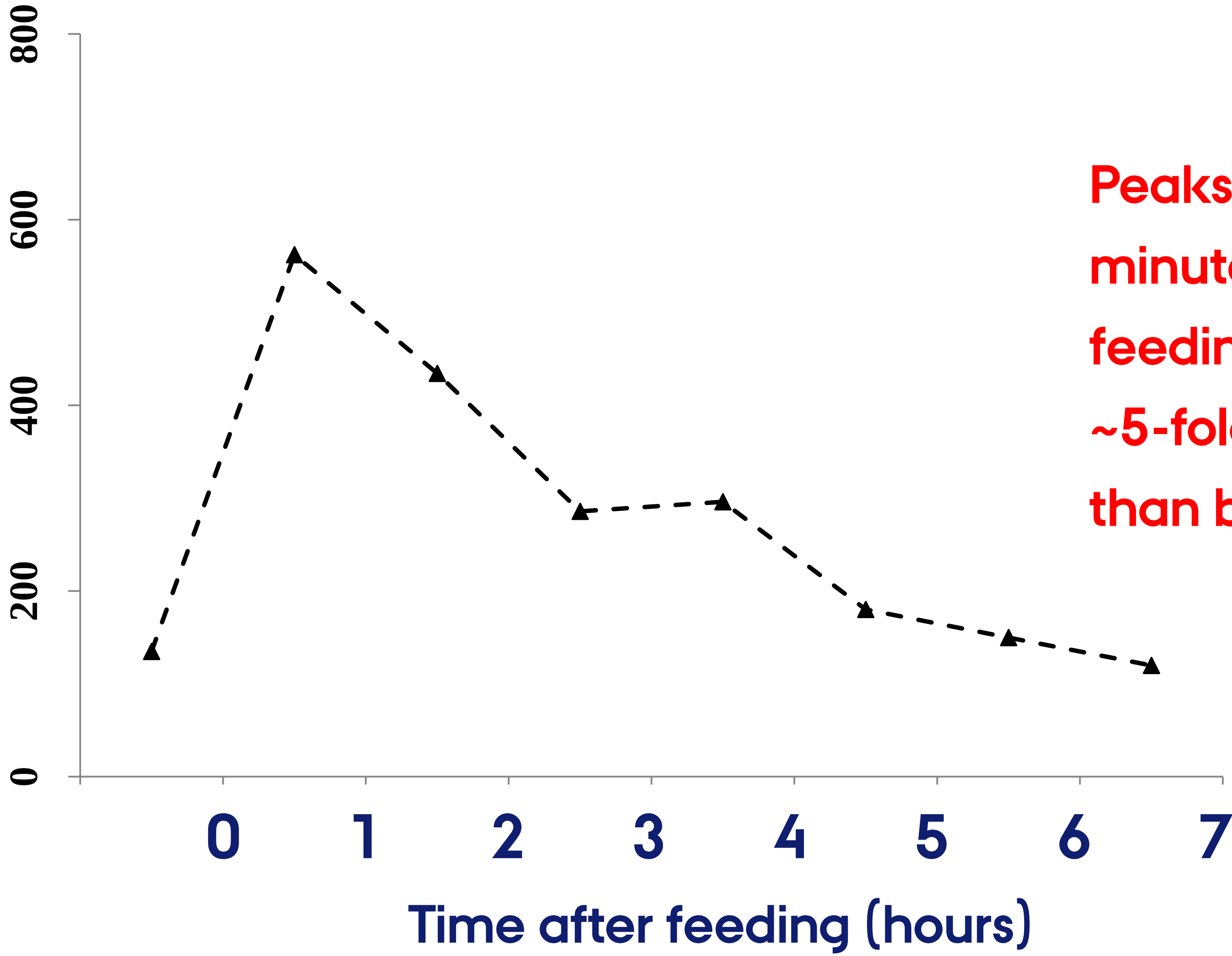
Energy uptake from the GI-tract



Starch (~50%)

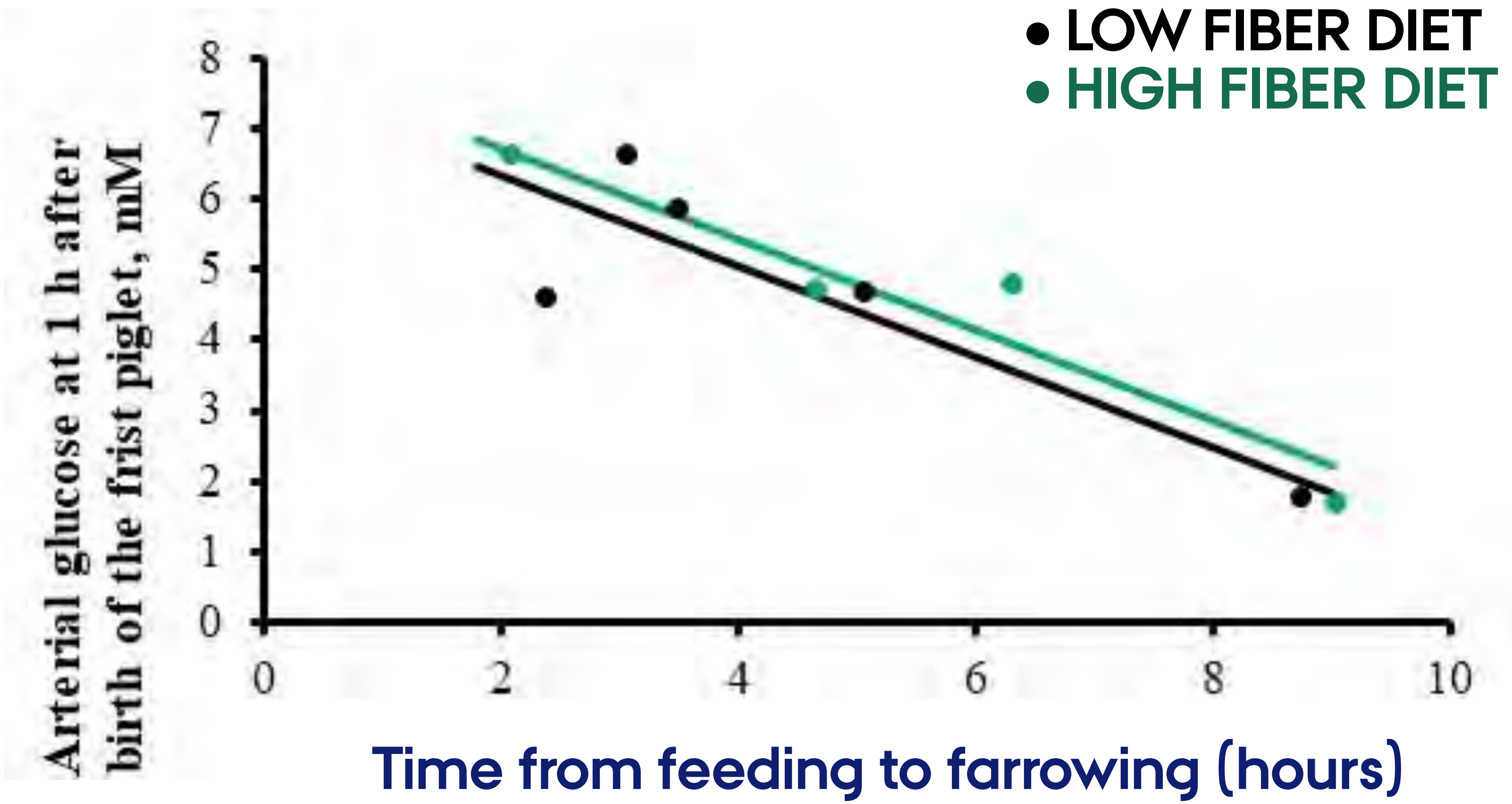
Uptake from stomach and small intestine

Energy uptake from starch (feed @ 0 h)



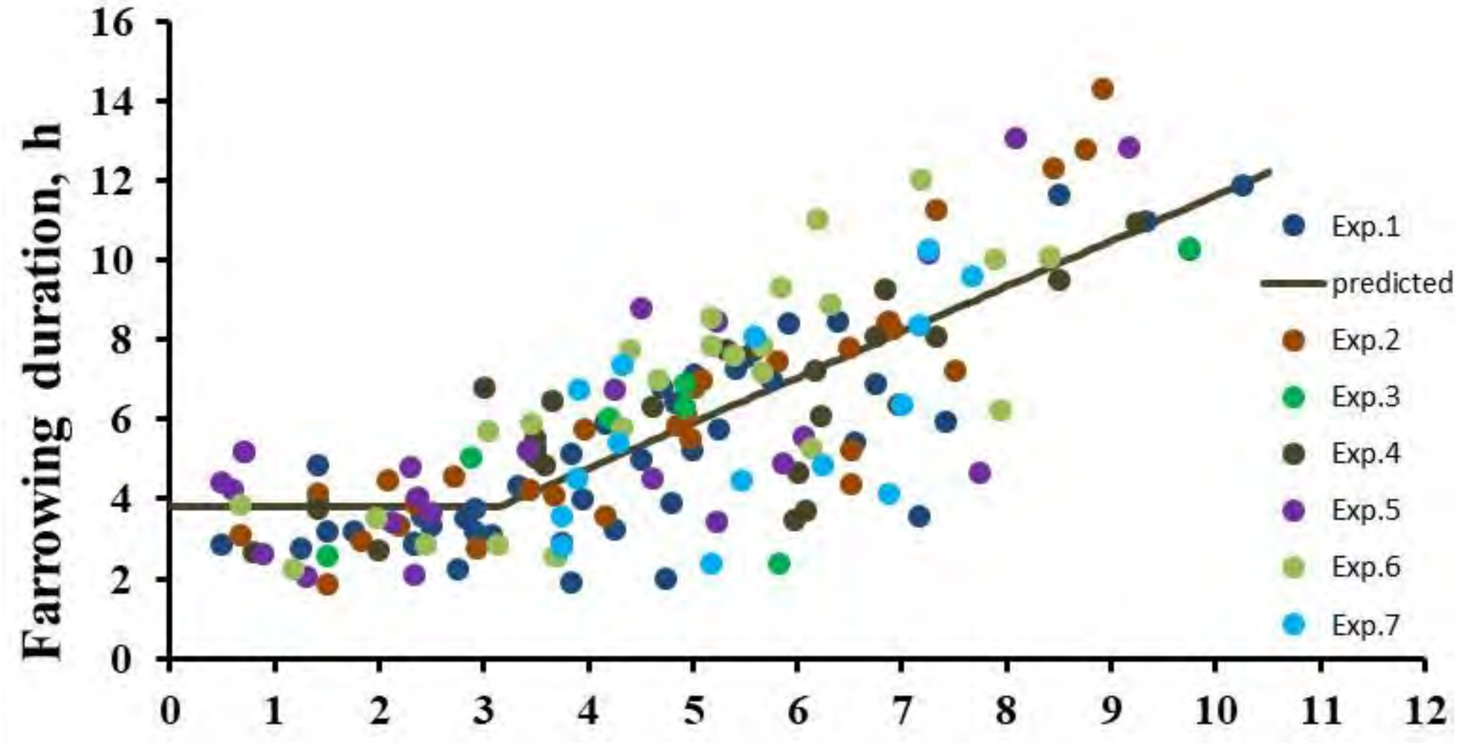
Peaks 30 minutes after feeding.
~5-fold higher than before.

PLASMA GLUCOSE AND FARROWING LENGTH



Feyera et al. (2018)

ENERGY STATUS AND FARROWING LENGTH



Time from feeding to farrowing (hours)

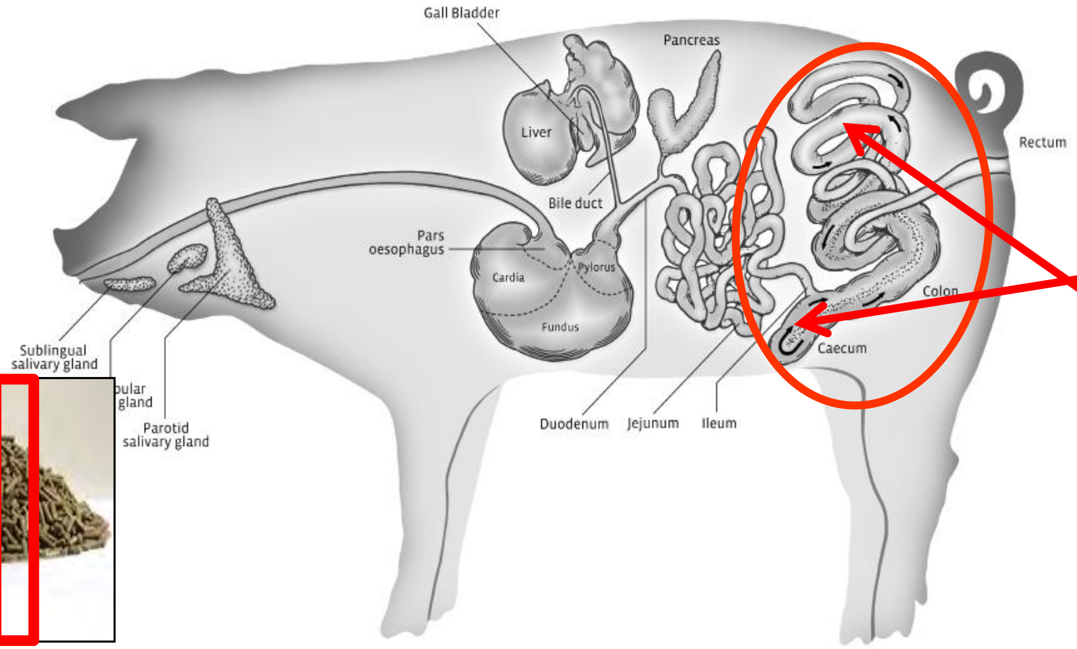
Feyera et al. (2018)

Impact of increased fibre supply d 101 of gestation until farrowing on piglet mortality

	Control	Fiber-suppl.	P-val
Groups (weeks)	32	32	
Number of sows	298	322	
Total born per litter	18.4	18.1	0.38
Dead born per litter, %	8.7	6.6	<0.001
Mortality, birth - weaning, %	14.6	13.7	0.21
Total mortality, %	22.3	19.9	0.004
Medication, % of sows	6.4	5.3	0.66

(Feyera et al., 2017)

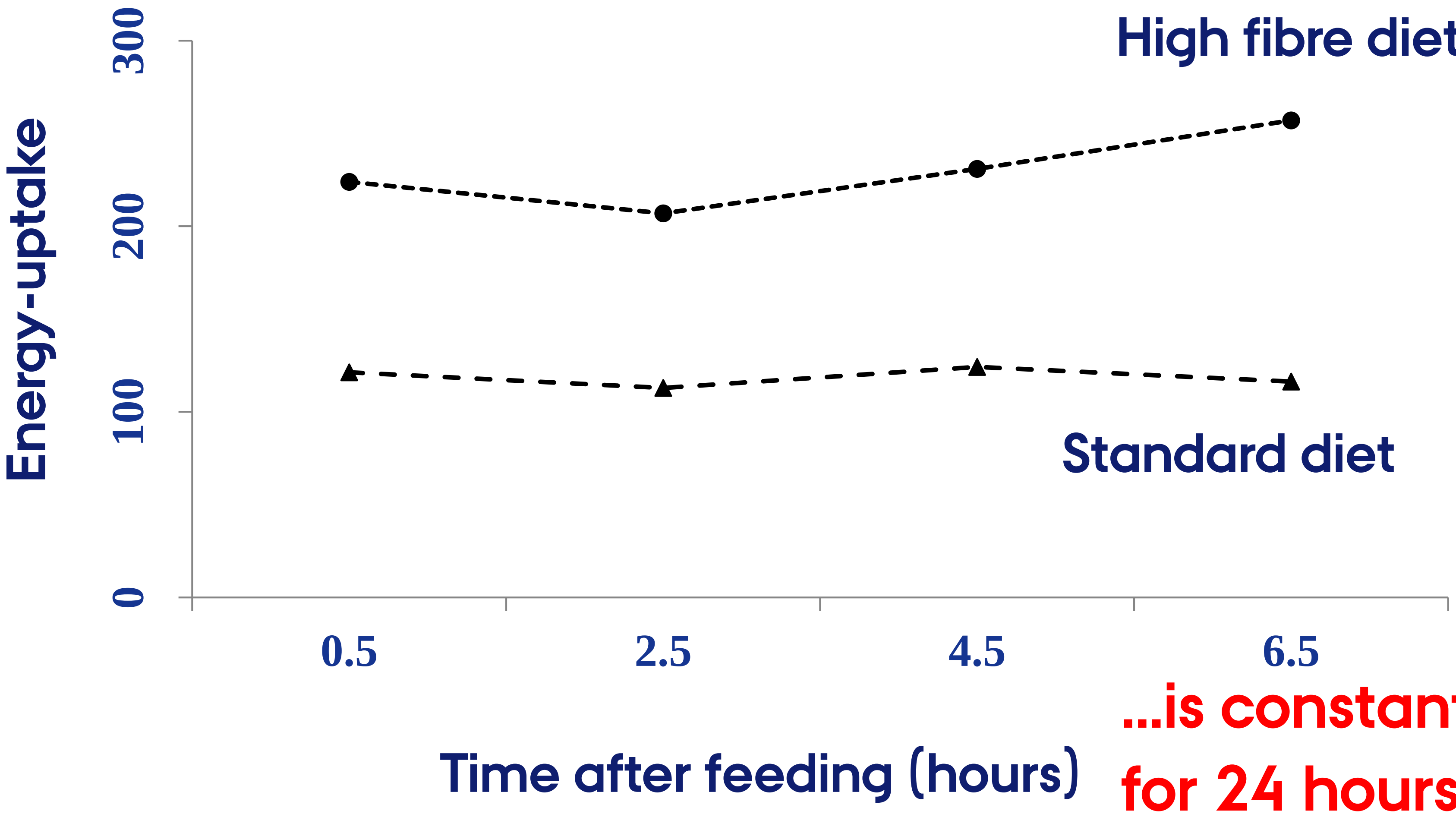
Energy uptake from the GI-tract



Fibre (8%)

Uptake from caecum and colon

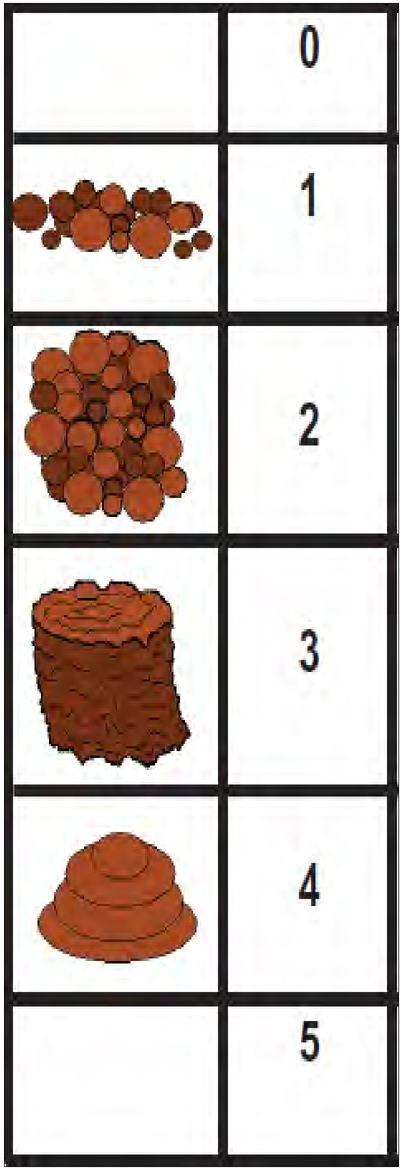
Energy uptake from fibre (feeding @ 0 hours)



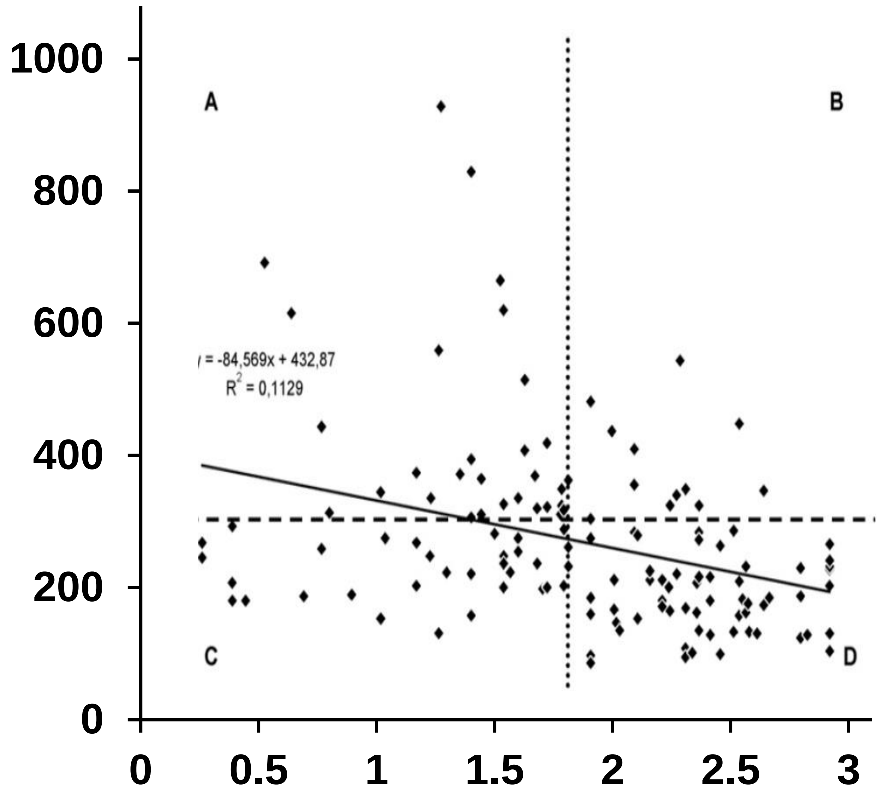
...is constant for 24 hours!

(Serena et al., 2009)

Constipation and farrowing length



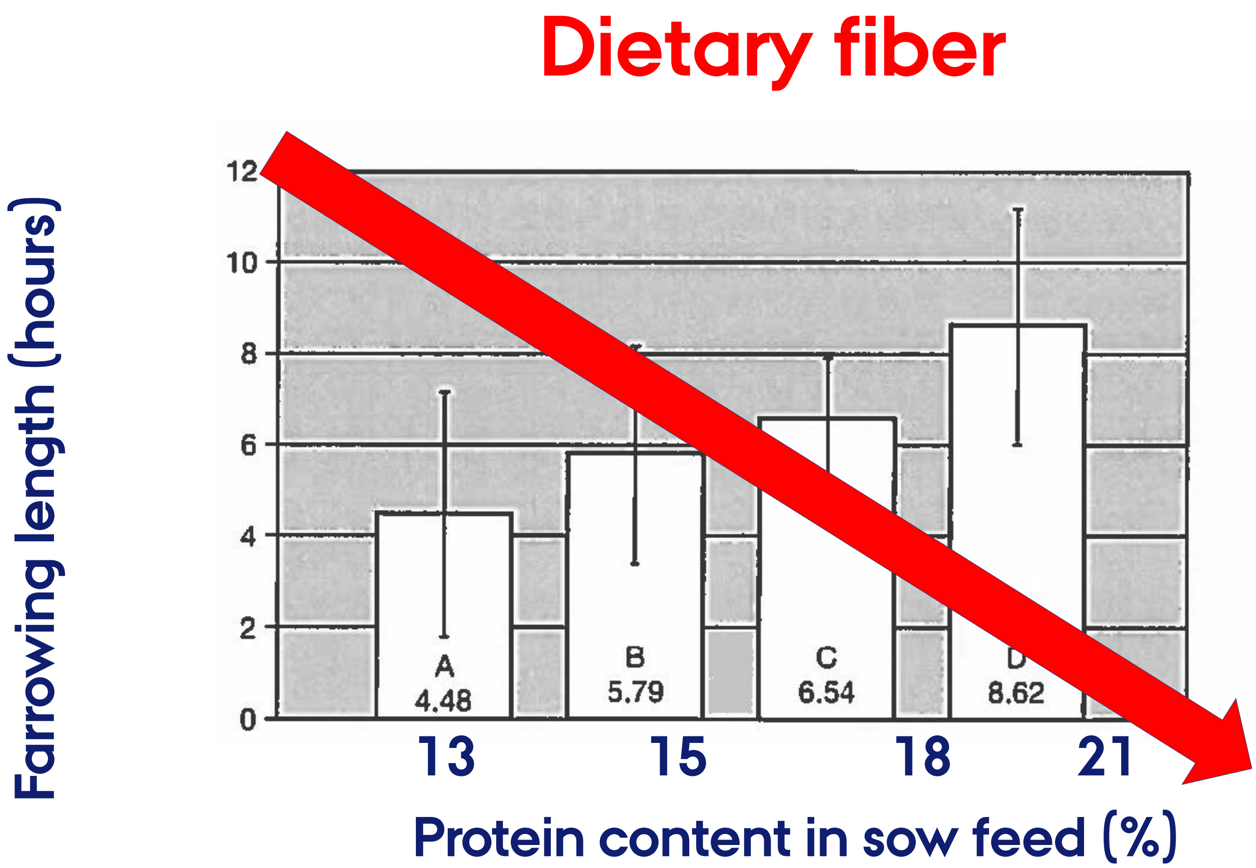
Farrowing length (minutes)



Constipation **soft feces**

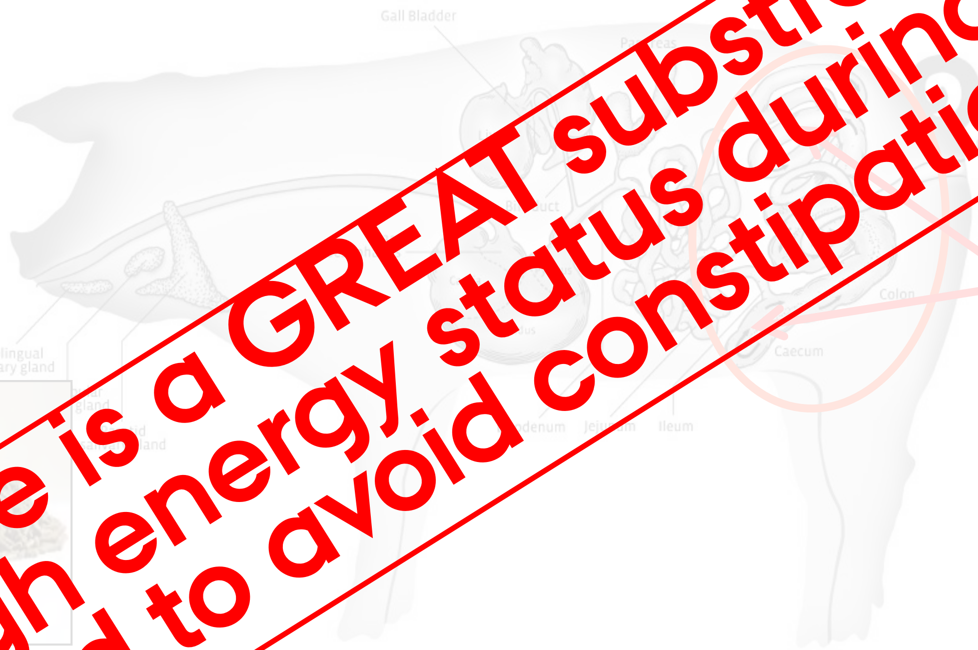
(Oliviero et al., 2010)

FARROWING LENGTH AND PROTEIN IN SOW FEED



(Tydlitat et al., 2008)

Energy uptake from the GI tract



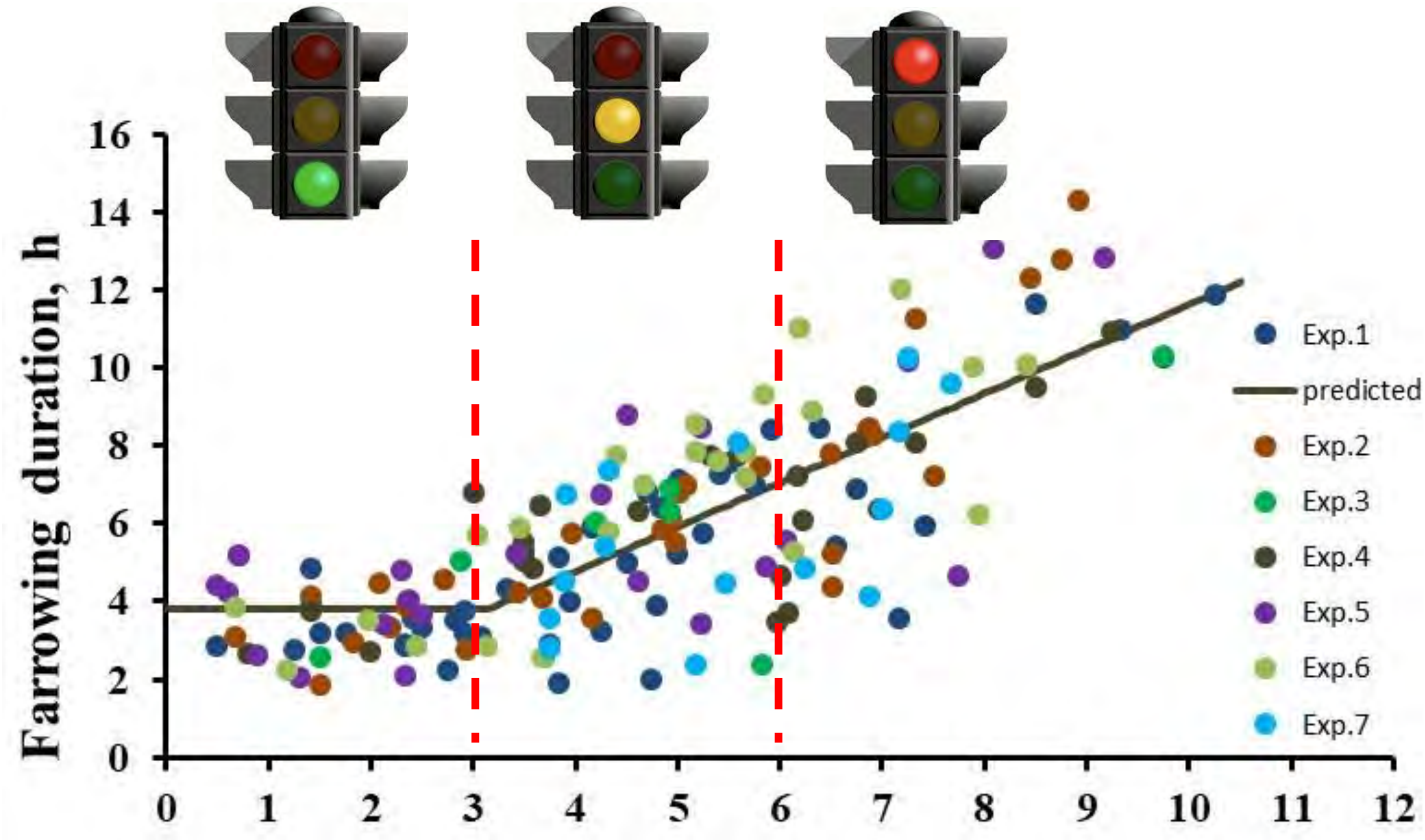
Fibre (8%)

Uptake from caecum and colon

4-24 hours after feeding

Fibre is a GREAT substrate to ensure high energy status during farrowing (and to avoid constipation)

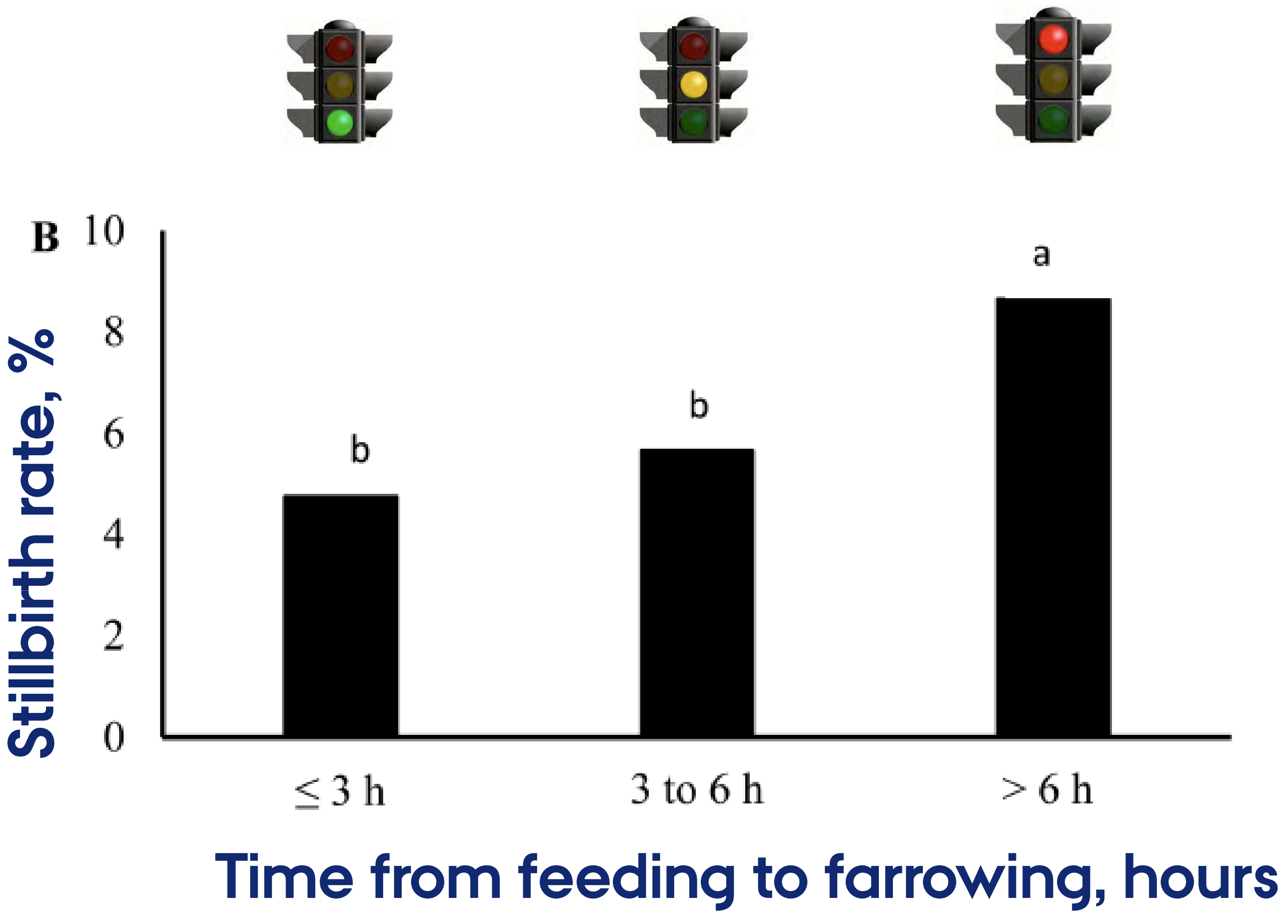
ENERGY STATUS DURING FARROWING



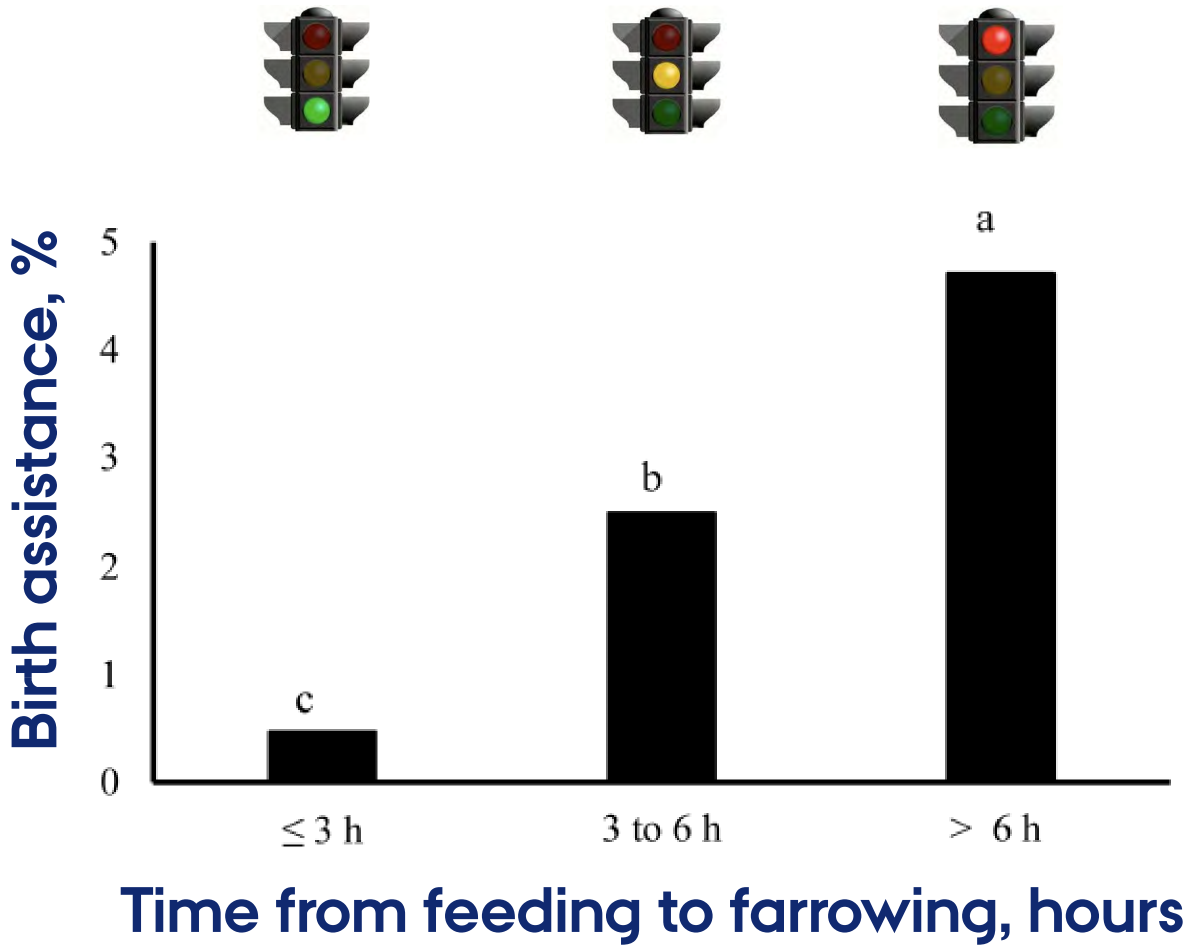
Time from feeding to farrowing (hours)

Feyera et al. (2018)

ENERGY STATUS DURING FARROWING AND STILLBIRTH RATE (%)



ENERGY STATUS AND BIRTH ASSISTANCE (% BIRTHS ASSISTED)



FARROWING IS LIKE RUNNING A MARATON

ALL PIGLETS NEED TO BE BORN…

…….before plasma glucose become critically low (2 mmol/L)

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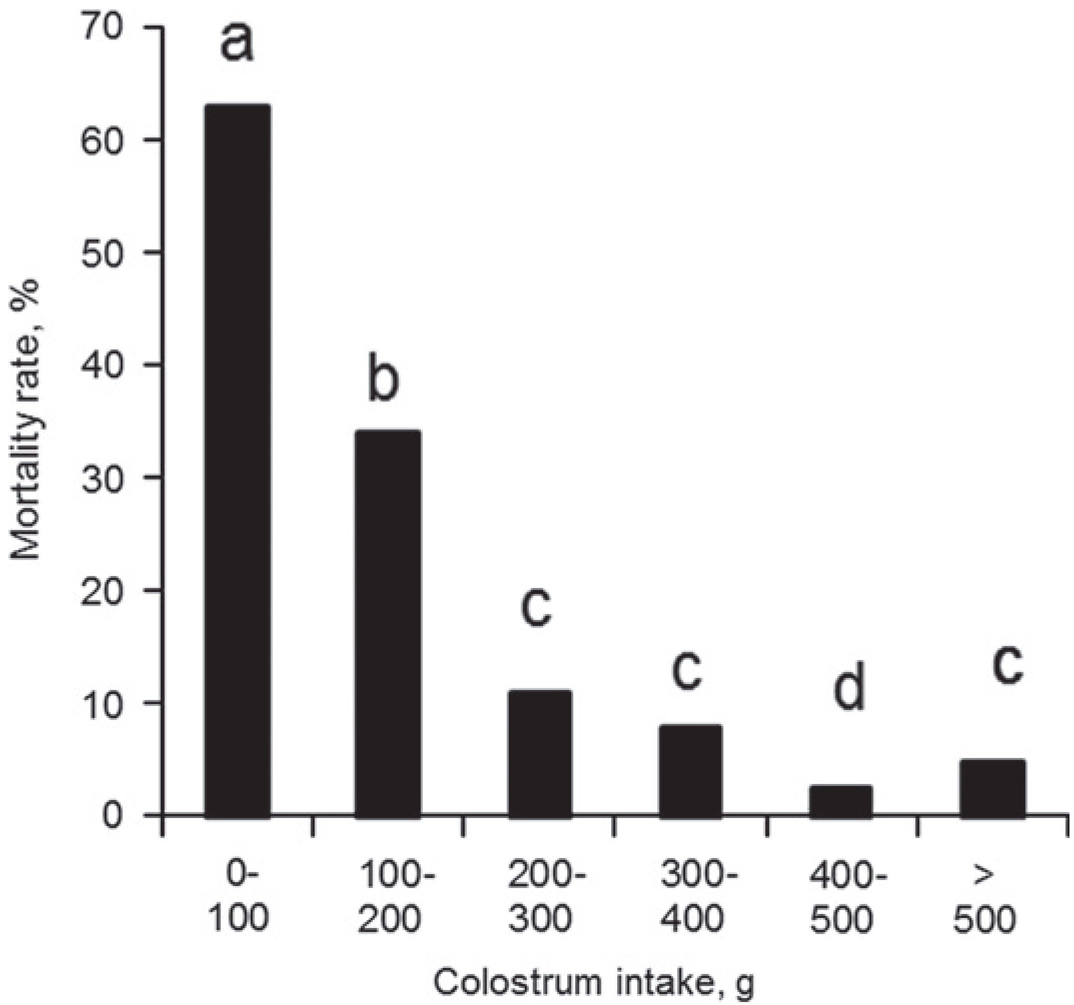
- **Colostrum: Yield- , intake- , how and when is it produced?**
- Maximizing milk yield and feed efficiency

IMPORTANCE OF COLOSTRUM

"Piglets born alive should be kept alive"

Impact of colostrum intake on piglet survival



Quesnel et al., (2012)

Colostrum and survival

What is most important during the first few critical days?

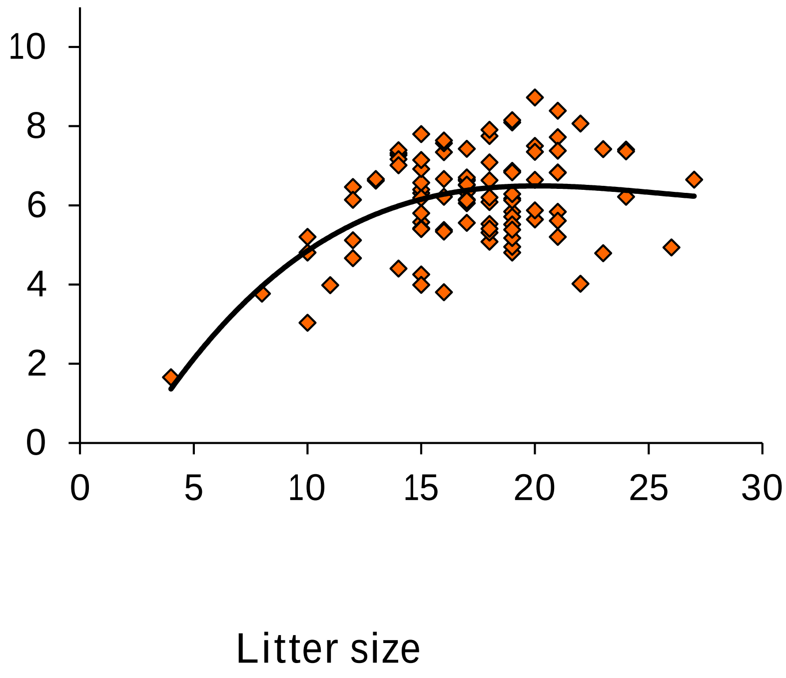
1. High colostrum intake (each piglet)

2. High colostrum yield (increases probability of sufficient intake for all littermates)

3. Colostrum quality (Composition, contents of immunoglobulins and growth factors)

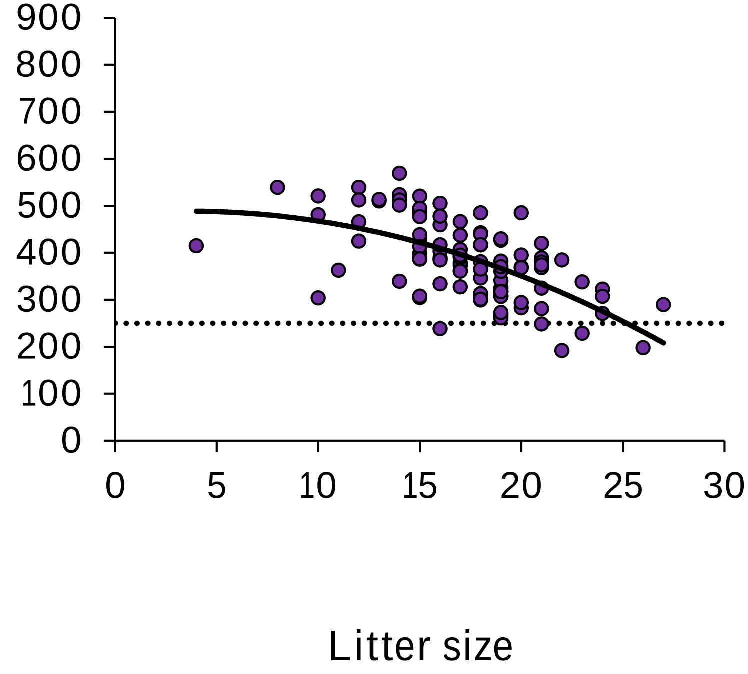
Impact of Litter size on production and intake of colostrum

Colostrum yield, kg/sow



Krogh (2017)

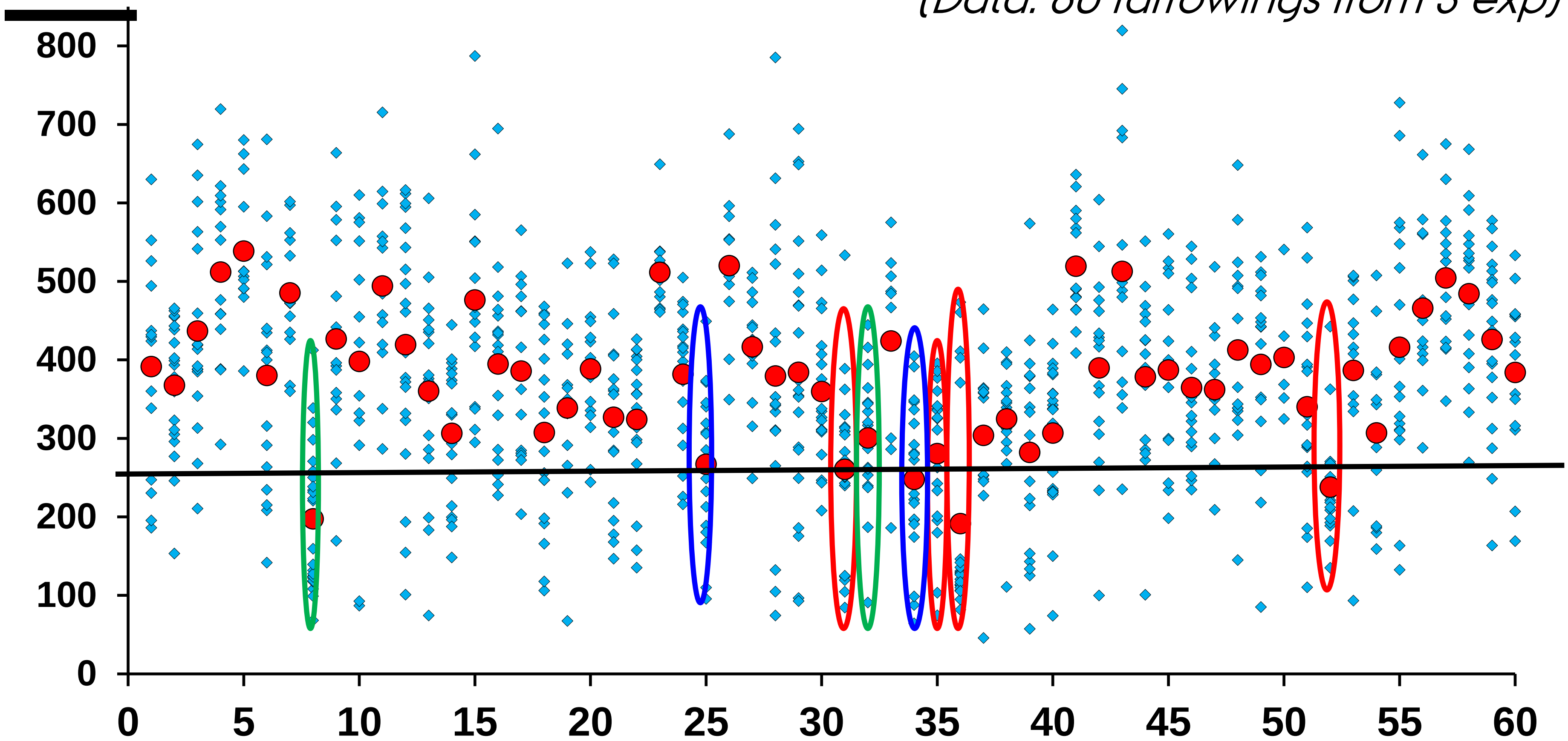
Colostrum intake, g/piglet



Krogh (2017)

Colostrum (g/piglet)

(Data: 60 farrowings from 3 exp)



Low feed intake pre partum

Large litter size (>26)

Low mean birth weight (average < 900 g)

Should fiber in the diets be higher – and when? (Theil et al., 2014)

		weight gain (g/piglet)
33% suger beet pulp	Mating- > d 108	135
21% pectin residue	Mating-> d 108	131
46% potato pulp	Mating-> d 108	71
Standard gest diet (17%)	Mating-> d 108	96

(Krogh et al., 2015)

12% suger beet pulp	d 105 -> parturition	101
17% alfalfa	d 105 -> parturition	90
Standard lact diet (15%)	d 105 -> parturition	85

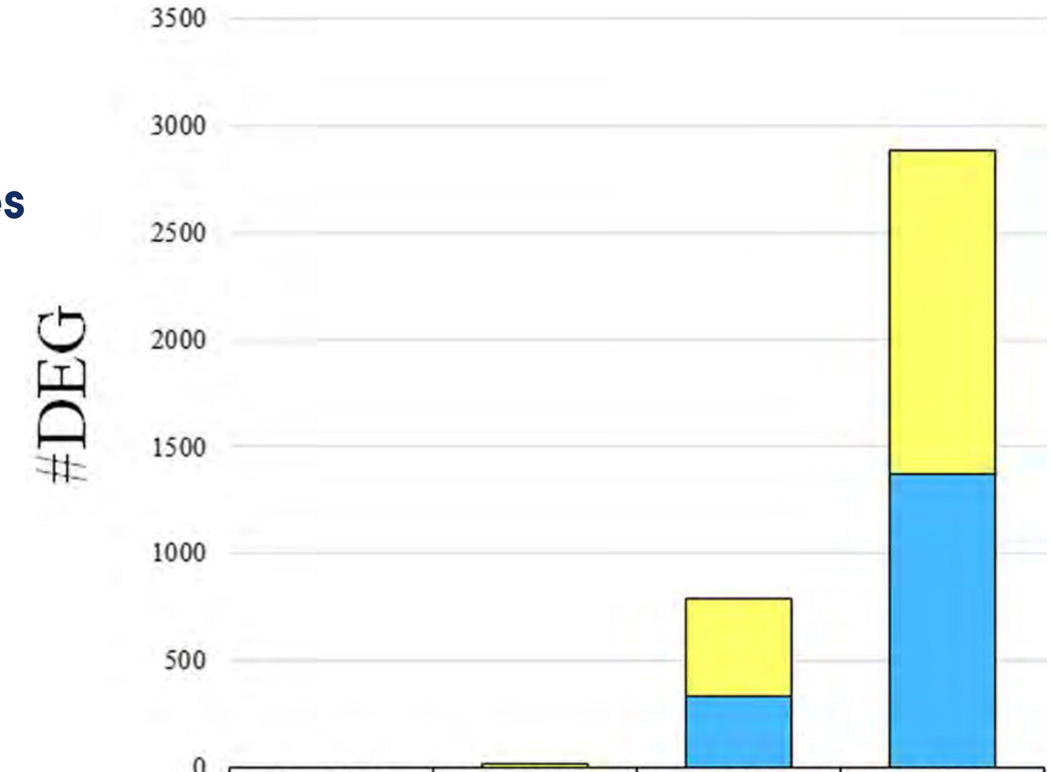
(Loisel et al., 2013)

SBP, Sunflow, soy (23%DF)	d 106 -> parturition	76
Low fiber (13% DF)	d 106 -> parturition	85

When does colostrum production occur?

#DEG = Number of

<u>D</u>ifferentially <u>E</u>xpressed <u>G</u>enes



	-10vs-14 time comparison	-6vs-14 time comparison	-2vs-14 time comparison	+1vs-14 time comparison
upregulated	0	15	451	1508
downregulated	0	2	337	1376

Mammary biopsies collected -14, -10, -6, -2, and +1 DIM

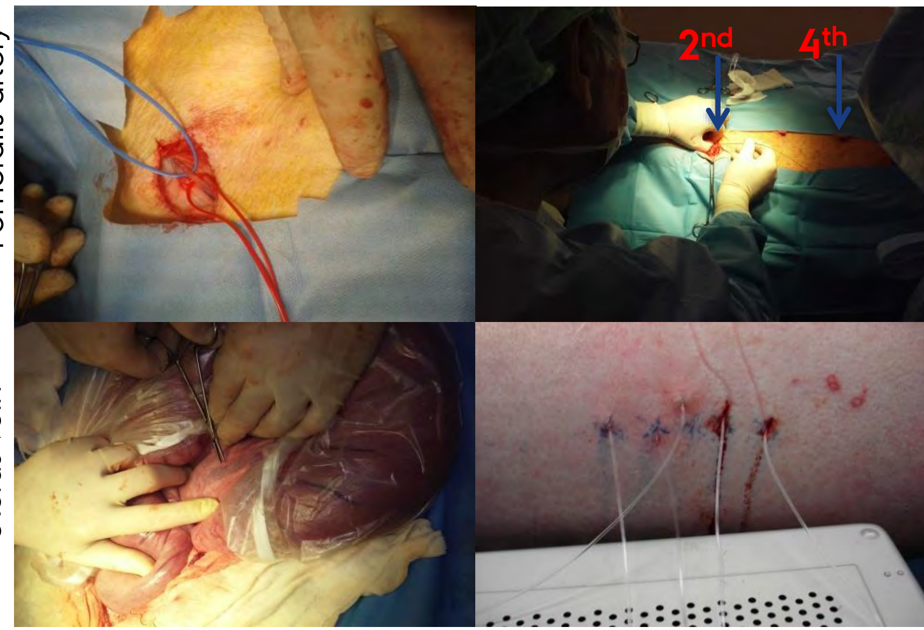
(Palombo et al., 2018)

Experiment with 10 multicatheterised sows

- Aim: to understand ontogeny of colostrogenesis

Hot water bath

General anesthesia



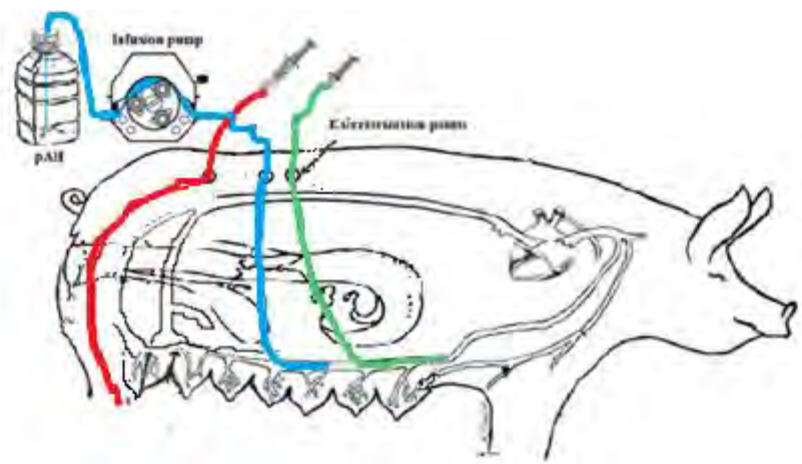
Femoralis artery

2 in M. vein

Uterus vein

Exteriorized at lumber region

Blood sampling protocol during the colostrum period

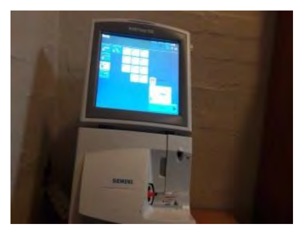


1 2 3 4 5 6 7 8 12 18 24

During farrowing, hours after birth of first piglet

Whole blood

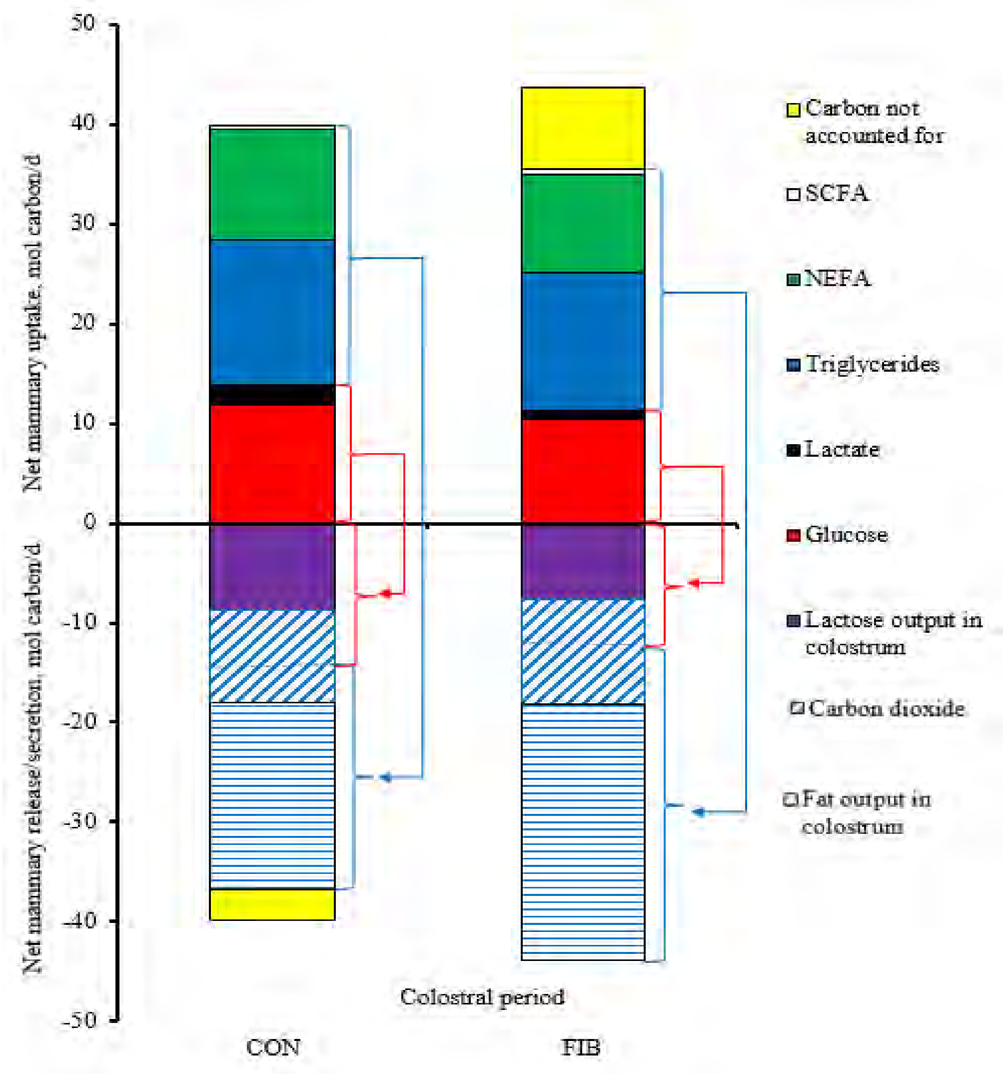
-blood gasses



Plasma

-Energy metabolites
-pAH
-IgG and IGF-I

Net mammary carbon balance during the colostrum period (0-24h)
(Carbons for protein in colostrum not included!)



Input and output of mammary carbon was similar 0-24 h

=> Fat and lactose in colostrum is mainly produced <u>after</u> onset of farrowing!

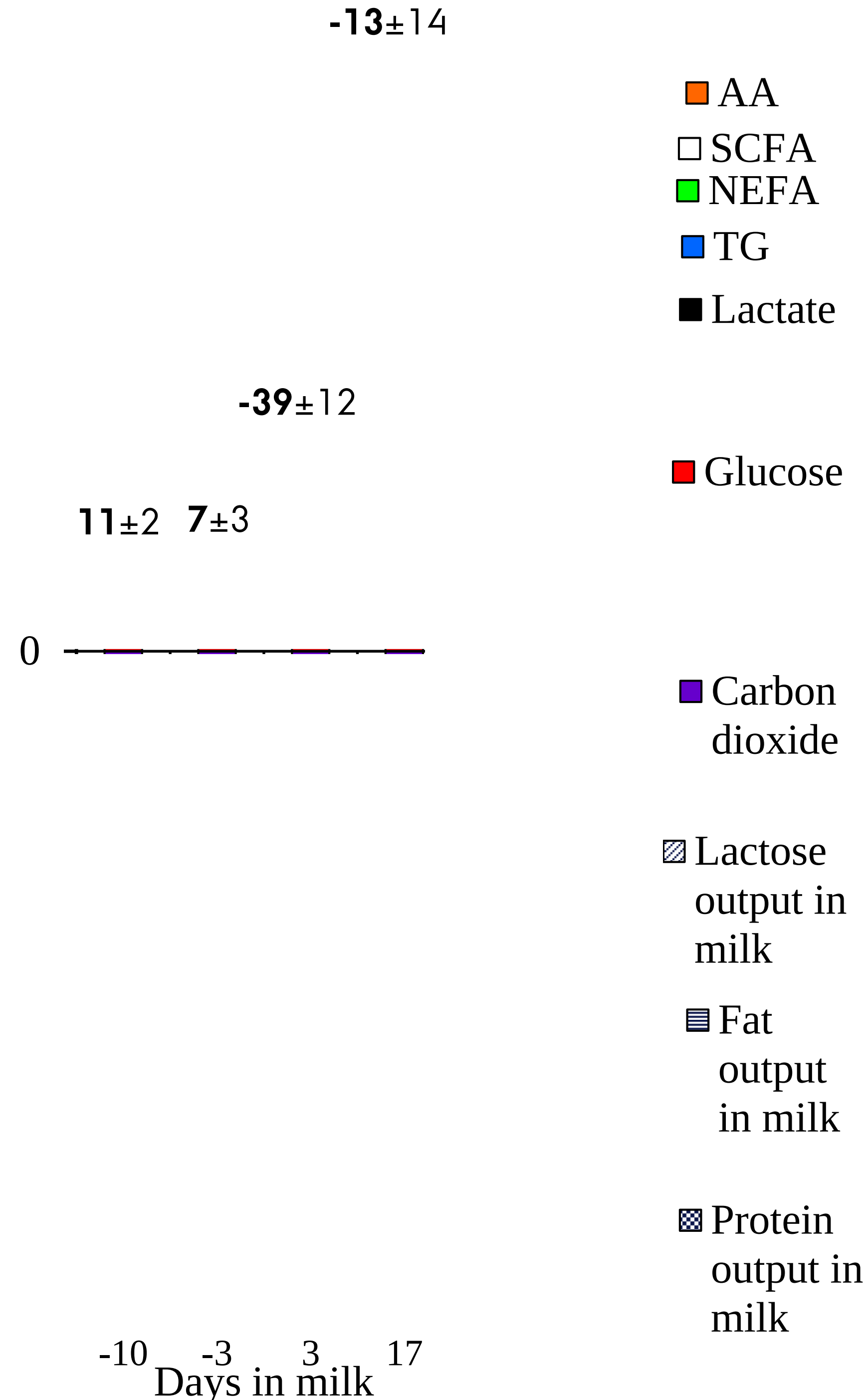
Lack of glucogenic precursors

=> Oxidation of ketogenic substrates

Feyera et al. (2019)

MAMMARY C-METABOLISM

- Impact of reproductive stage



Krogh et al. (2017)

Colostrum production – new thoughts...

Why did sows fed high fibre from mating until d 108
produce more colostrum? (Theil et al., 2014)

Why did sows fed high fibre during the last week prior to parturition
NOT produce more colostrum? (Krogh et al., 2015)

1. Are mammary glands getting adapted over time to oxidize ketogenic substrates?
2. Is a greater part of fat secreted in colostrum produced prior to parturition when sows are fed high fiber?

Fibres in the diet may increase colostrum production.
Mechanism still needs to be clarified

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Impact of sow back fat on litter weight gain

Recommended level in DK when sows approach farrowing: 16-19 mm BF

(*Kim et al., 2015*)

Is mobilization during lactation good or bad?

Mobilisation → Milk yield

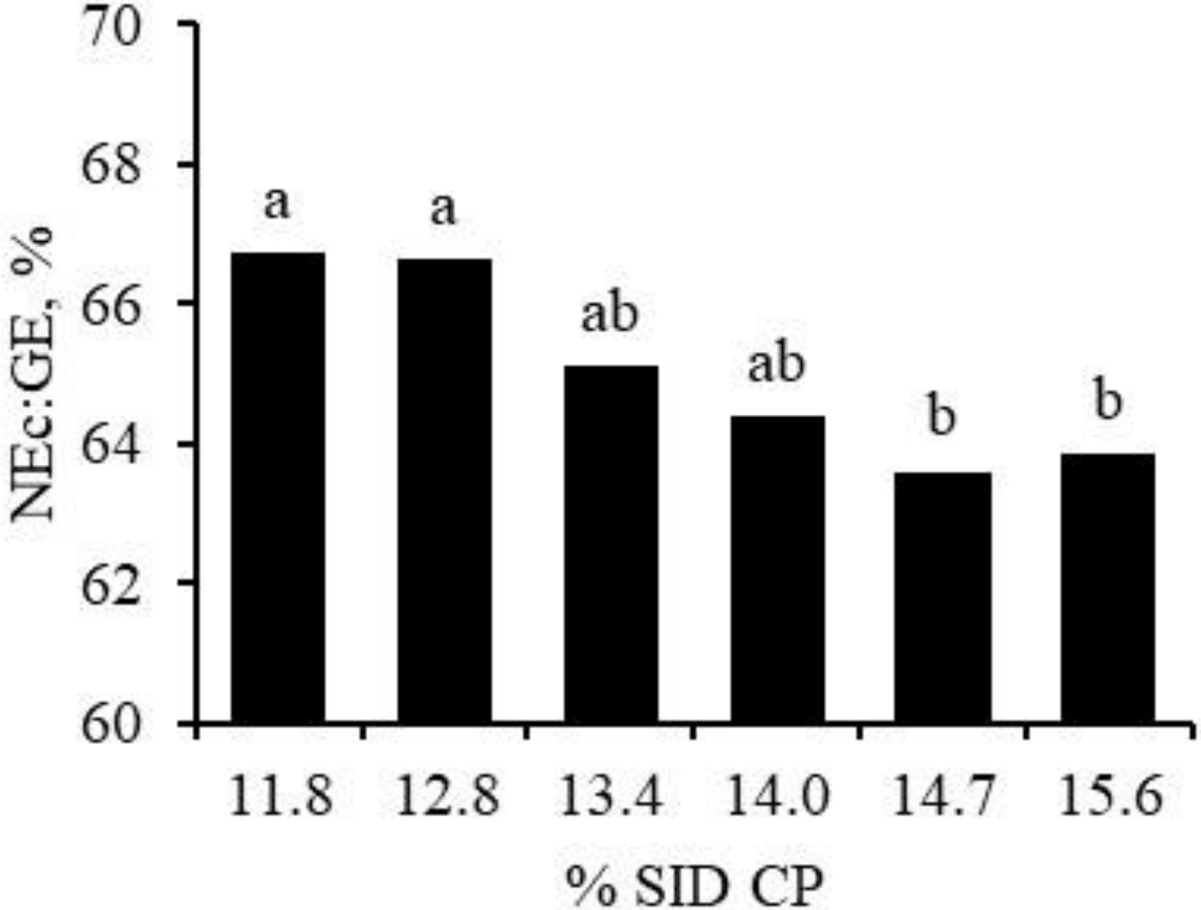
Feed → Milk yield

Efficiencies of utilizing energy for milk production

Dietary energy -> milk	k = 78% (22% lost as heat)
Mobilized energy -> milk	k = 89% (11% lost as heat)
Restoring mobilized energy	k = 73% (27% lost as heat)
Mobilisation + restoring	k = (89% x 73%)= 65% (35% heat)

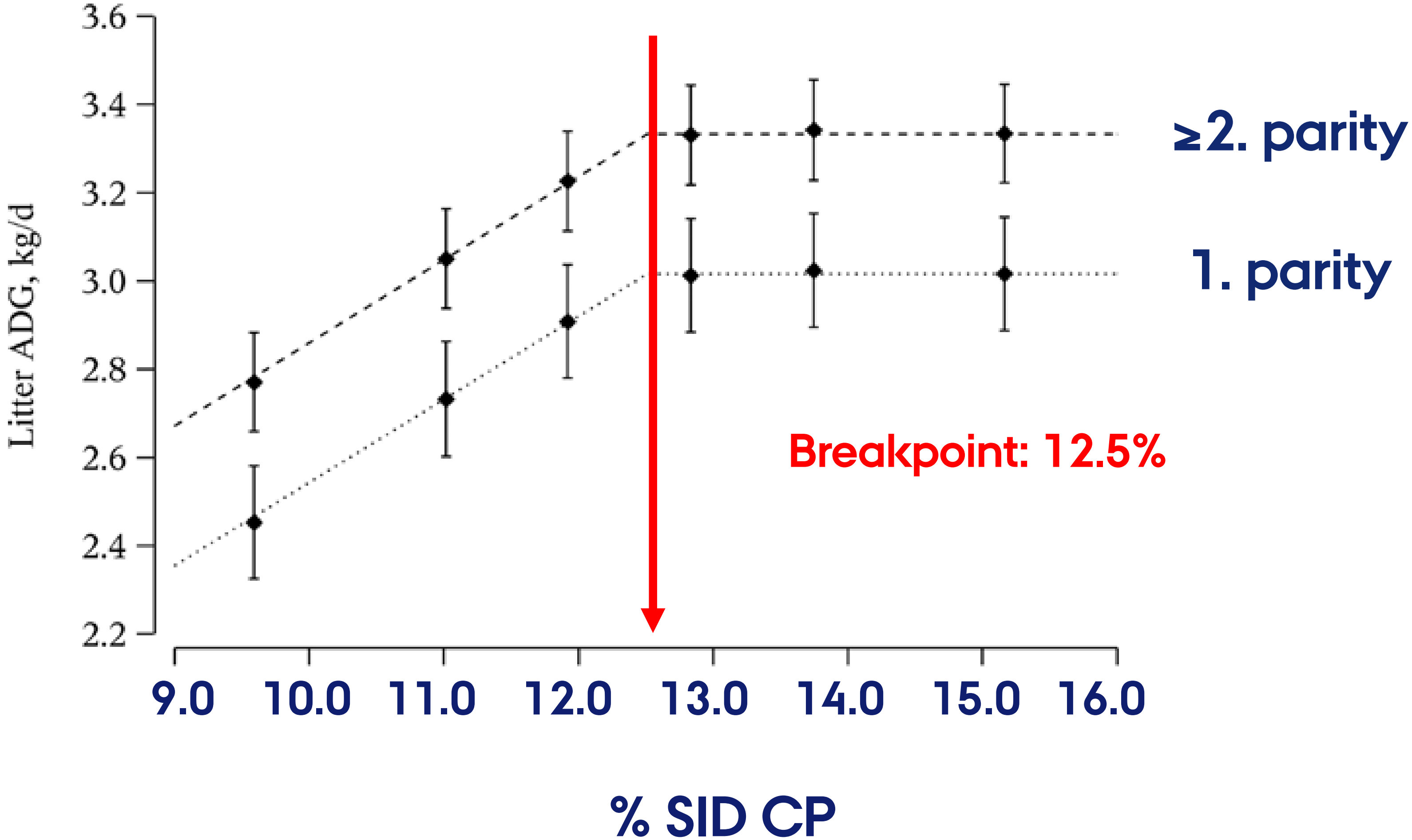
Maximizing milk produced directly from feed will increase feed efficiency - but likely not affect milk yield

UTILIZATION OF DIETARY ENERGY

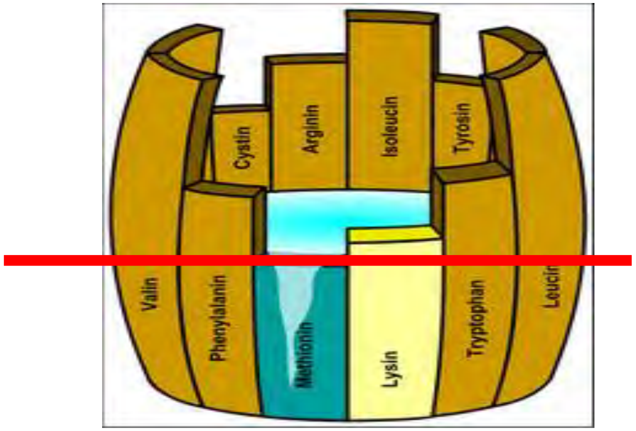


(Pedersen et al., 2019)

Impact of dietary protein (Lysine) on milk yield



(Hojgaard et al., 2019)



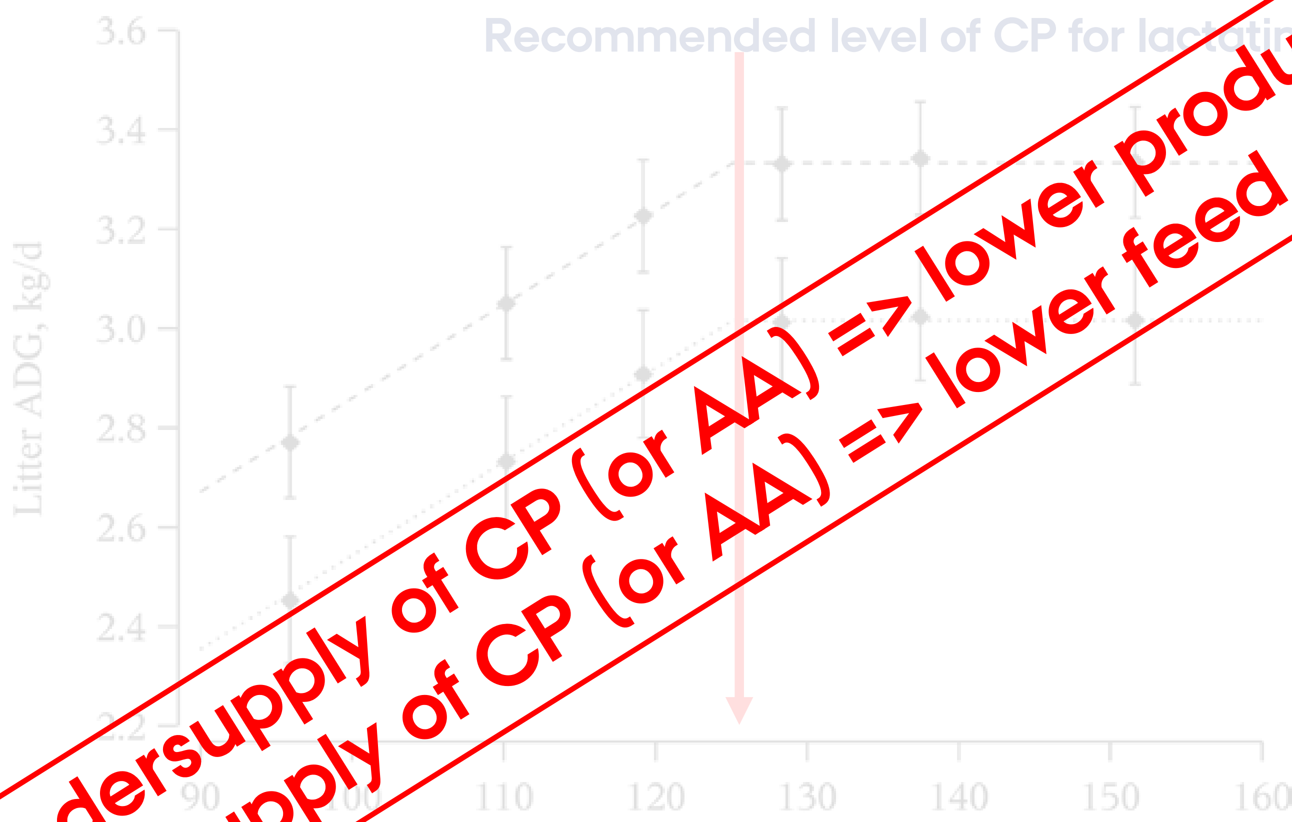
First limiting AA ALSO determines how much EXCESS dietary AA is being oxidised

First limiting AA in the feed determines how much colostrum or milk protein can be produced

Oxidation of AA (protein) is costly in two ways
⇒More energy is lost in urine
⇒More energy is lost as heat

The study by Tydlitat (2008) and Pedersen (2019) may suggest that too much dietary protein contributed to energy depletion during farrowing

UTILIZATION OF DIETARY ENERGY IN HIGH YIELDING LACTATING SOWS



Undersupply of CP (or AA) => lower productivity
Oversupply of CP (or AA) => lower feed efficiency

(Pedersen et al., 2019)
(Hojgaard et al., 2019)

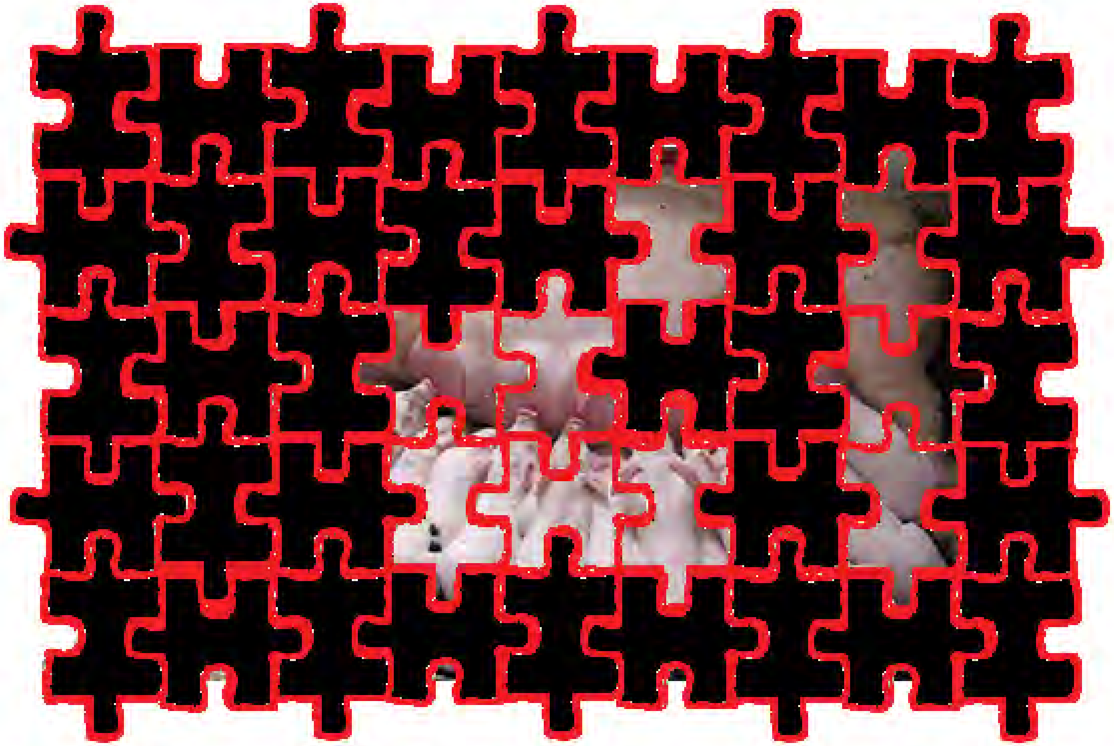
Xylanase – a way to improve feed efficiency

	Control	Xylanase	P-Val
Sow feed intake (kg/d)	6.6	6.9	**
Energy digestibility (%)	82.9	83.9	**
Weight loss (kg/week)	3.4	1.3	*
Milk Yield (kg/d)	13.3	13.0	0.66

Zhou et al. (2018)

Conclusions

- Sows lack energy during farrowing - more energy and 3 daily meals are needed
- Fiber in feed: constipation ↓ Energy status ↑ stillbirth rate ↓
- Colostrum HIGHLY important for piglet survival
- Lactose and fat in colostrum is mainly produced (>80%) after onset of parturition
- Fiber in feed before parturition may increase colostral fat
- Sugar beet pulp and pectin fibres enhance colostrum yield
- Feed efficiency / lactation performance may be increased by
    1. Controlling back fat (management/long term feeding)
    2. Maximizing milk produced directly from feed
    3. Avoiding under- and oversupply of dietary CP (and AA's)
    4. Adding xylanase to the feed



Thank you for your attention ☺