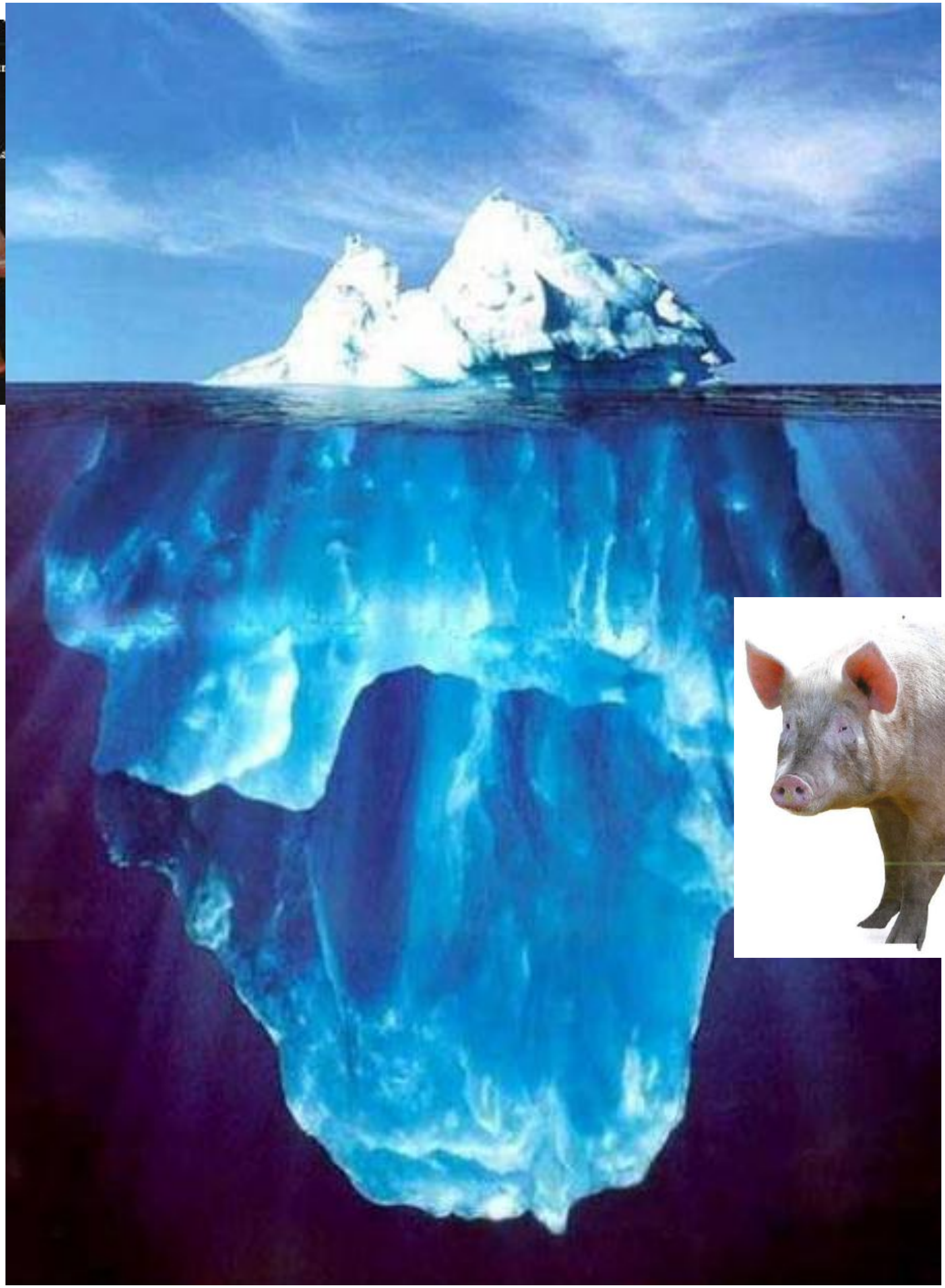
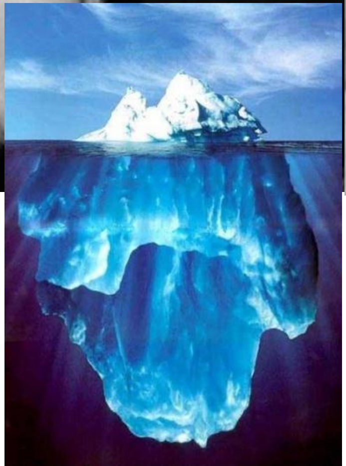
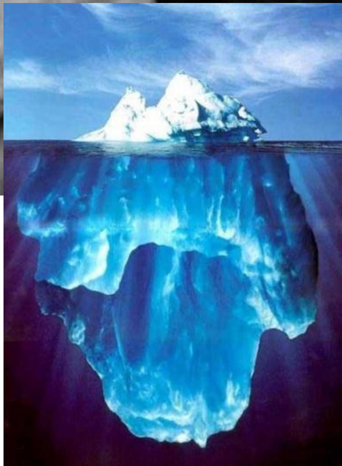

« once upon a time, homeorhesis … »
Mantova
Tuesday, the 11th of June, 2013


Normal ? Abnormal ? Where is the limit ?



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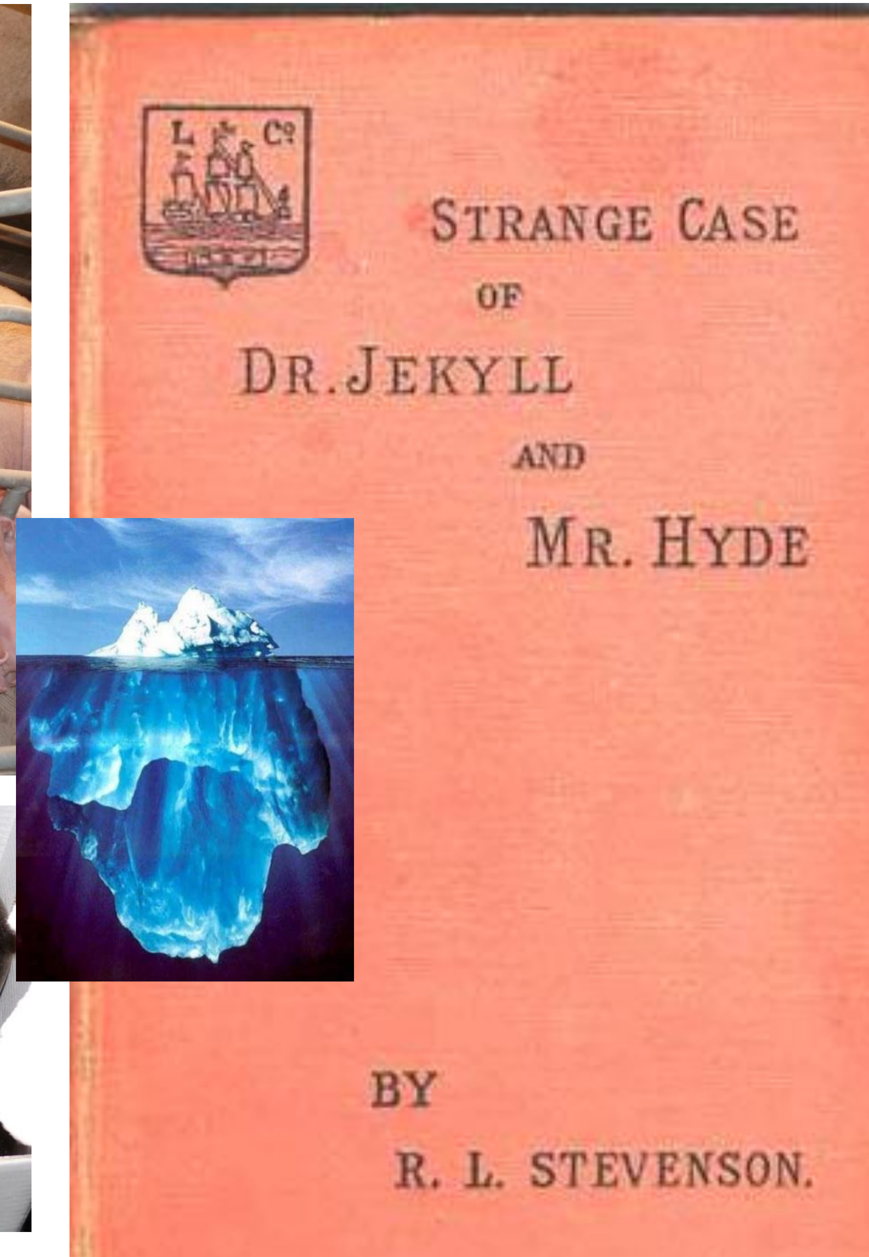


Normal ? Abnormal ? Where is the limit ?


Normal ? Abnormal ? Where is the limit ?

Post-partum Dysgalactia Syndrome for practitioners

Agnès Waret-Szkuta, Guy-Pierre Martineau
Poultry & Swine clinics. National Veterinary School. Toulouse. FRANCE - 23, chemin des Capelles 31076 Toulouse Cedex 3
a.waret@envt.fr

Introduction

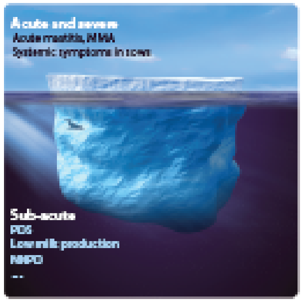
Postpartum dysgalactia syndrome (PDS) is a common problem for practitioners in field faced with more subtile symptoms than by the past with Mastitis, metritis and agalactia syndrome (MMA) that may represent only the small emerging part of the iceberg.

Symptoms can be very diverse as :
- in sows : anorexia, hyperthermia, low milk production…
- in piglets : new neonatal porcine diarrhea (NNPD), stillbirth, crushing, poor weaning weight…

They are encountered in very diverse herds handled by multifaceted producers with different management procedures.

Some risk factors for PDS have been elucidated mainly related to nutrition, housing, and management practices. A central role of endotoxins and cytokines in the development of the problem has also been suggested. However, the pathophysiology of PDS remains unclear and lacks of a practical approach.

Our objective was to propose a plausible model for PDS on which to draw a systematic method to investigate clinical cases in field.



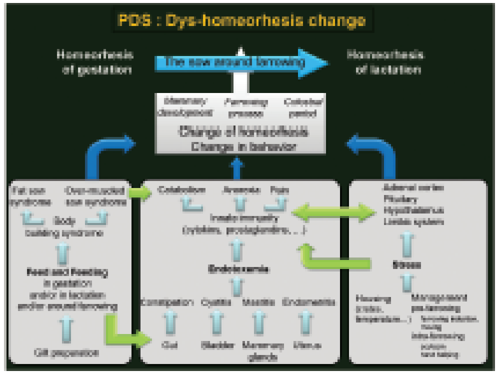
At the heart of PDS : an unsuccessful change in homeorhesis when shifting from gestation to lactation

Homeorhesis encompasses dynamic systems that return to a trajectory, referring to orchestrated changes in metabolism of body tissues to support a physiological state (such as gestation or lactation).
At farrowing there is a shift in priorities during which a "slight" asynchronism may lead to a major problem (PDS), similar to the butterfly effect.

Proposed holistic approach to tackle PDS in field

Three groups of related components should be successively investigated reflecting our understanding of the physiopathology of PDS :
- feed and feeding among which body building syndromes
- endotoxemia following constipation, cystitis, mastitis or endometritis
- and stress related factors

All three are closely linked as represented on the figure by the green arrows.



Conclusion

This should enable reconstructing the path of events specific to the herd concerned with this multifactorial disease. Indeed this is not always straightforward as modifications often occur before farrowing but remain asymptomatic before revealing animals such as piglets are present.

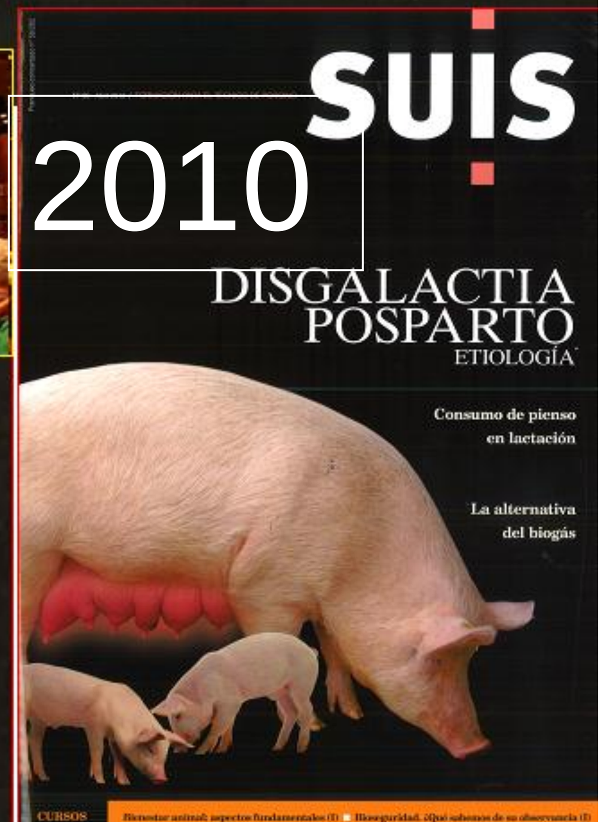
References
1 - [illegible] Partitioning of nutrients during pregnancy and lactation : a review of mechanisms involving homeostasis and homeorhesis. J Dairy Sci. 1980;63: 1514-1529.
2 - [illegible]
3 - [illegible]

Poster layout : [illegible]

Lactación y etiología del síndrome de disgalactia posparto en la cerda

Mª Victoria Falceto,
Alcides Rivera Stevenson,
Mónica Calavia y
Ana Belén Gómez

2010



Mª Victoria Falceto,
Alcides Rivera Stevenson,
Mónica Calavia y
Ana Belén Gómez

Diagnóstico y tratamiento del síndrome disgalactia posparto en la cerda

Juan Luis Úbeda[1],
María Victoria Falceto[2],
Mónica Calavia[1]
y Ana Belén Gómez[1]

Imágenes cedidas por los autores

2012

Postpartum dysgalactia in sows: pathophysiology and risk factors

D. Maes; G. Papadopoulos; A. Cools; G. P. J. Janssens
Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

Introduction

Adequate colostrum and milk production by the sow is essential for the survivability and growth of the piglets. Postpartum dysgalactia syndrome (PDS) in sows is characterized by inadequate and insufficient colostrum and milk production during the first days after farrowing. PDS occurs worldwide and incurs major financial losses to affected pig herds. Due to the multifactorial nature of the syndrome, the identification of the different risk factors and their relative impact is not straightforward (15). Logically, also the implementation of preventive and therapeutic measures is a challenge for pig veterinarians. The term MMA, most frequently used in (old) literature, is considered nowadays as a subtype of PDS, as in many instances, there is no true agalactia and the role of clinical mastitis is of debatable significance.

Table 1 Risk factors related to nutrition, housing and management for porcine dysgalactia syndrome

Potential risk factor	Reference
Nutrition	
Constipation	Hermansson et al. (7); Martineau et al. (14)
Feeding sows ad libitum shortly after farrowing compared to feeding sows restrictedly	Papadopoulos et al. (22)
Feeding sows ad libitum one day before parturition compared to one day after parturition	Neil et al. (18)
Sows too fat at parturition	Göransson (6)
Low vitamin E level (16 or 33 IU/kg vs. 66 IU/kg dietary level)	Mahan (12)
Ergot intoxication	Kopinski et al. (11)
Housing	
Crates with a width of 60 cm compared to crates of 67 cm width	Cariolet (3)
No slatted floor in farrowing pens	Hultén et al. (9)
Overheating of mammary glands	Muirhead and Alexander (16)
High ambient temperatures and heat stress	Quiniou and Noblet (23), Messias de Braganca et al. (15)
Management	
Farrowing induction	Papadopoulos et al. (22)
No supervision of farrowing compared to frequent supervision (> 50% of farrowings)	Papadopoulos et al. (22)
No washing of sows and no use of disinfectants in the farrowing rooms	Hultén et al. (9)
Abrupt change from pasture gestation to restraint in crates a few days before farrowing	Bäckstrom et al. (1)
Moving pregnant sows to the farrowing unit 4 days before expected farrowing (OR = 6.2) compared to moving the sows 7 days or earlier before farrowing	Papadopoulos et al. (22)

Peer reviewed — Literature review

Coliform mastitis in sows: A review

Imke Gerjets, Msc agr; Nicole Kemper, Dr med vet

Summary
Coliform mastitis (CM) represents an economically very important disease complex in sows that also affects the health, welfare, and performance of the piglets. Most research has concentrated on the husbandry-influenced occurrence of CM. The pathogenesis of CM suggests a prominent role for *Escherichia coli* and its endotoxins, although other *Enterobacteriaceae* species have been isolated from affected animals. Most studies on CM were conducted between 1970 and 1990. It is time for a closer look at this disease, particularly with respect to the economic damage it causes and the lack of recent literature. Treatment and use of body temperature as a single indicator for diagnosis of CM must be regarded critically. A combination of appropriate criteria should be applied to achieve a proper diagnosis and to minimize use of antibiotics. Additional approaches, for instance, incorporating knowledge concerning virulence factors of *E coli*, are promising tools for future prevention.

Keywords: swine, mastitis, dysg
sow, endotoxins

JSHAP 2009

Brief communication — Peer reviewe

Bacterial flora on the mammary gland skin of sows and in their colostrum

Nicole Kemper, Prof, Dr med vet; Regine Preissler, DVM

Summary
Mammary-gland skin swabs and milk samples were analysed bacteriologically. All skin samples were positive, with 5.2 isolates on average, Staphylococcaceae being the dominant organisms. In 20.8% of milk samples, no bacteria were detected. Two isolates on average, mainly Staphylococcaceae and Streptococcaceae, were isolated from the positive milk samples.

Keywords: swine, bacteria, colostrum, mammary gland, skin

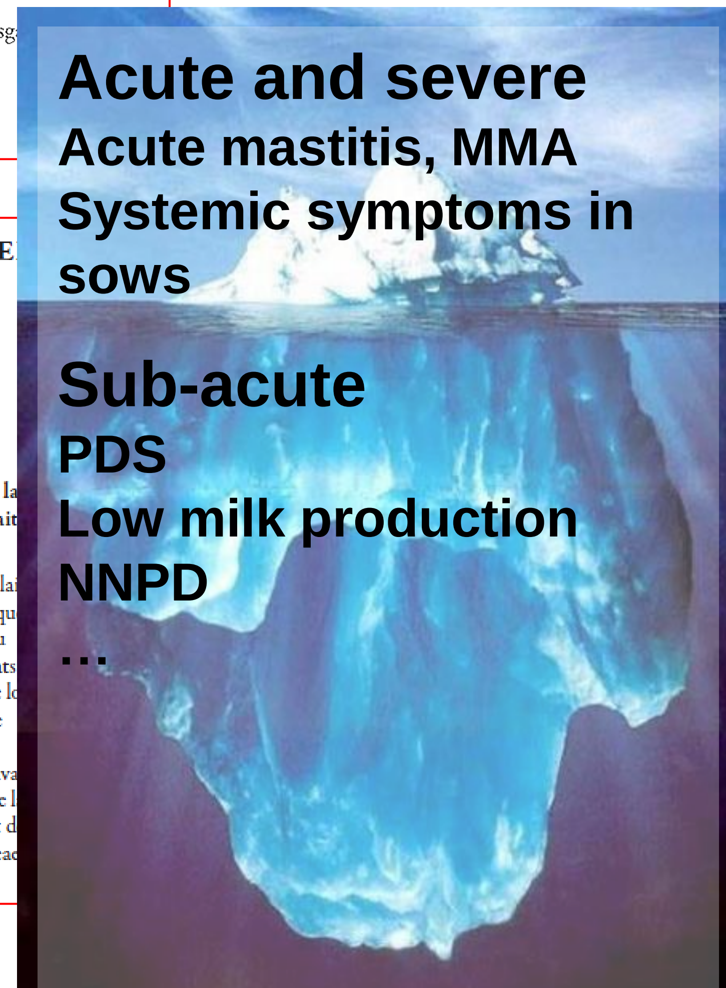
Resumen - La flora bacteriana en la piel de la glándula mamaria de las hembras y en su calostro

Se analizaron bacteriológicamente hisopos de la piel de la glándula mamaria y muestras de leche. Todas las muestras de piel resultaron positivas, con 5.2 aislados en promedio, siendo los Staphylococcaceae los organismos dominantes. En 20.8% de las muestras de leche, no se detectaron bacterias. De las muestras de leche positivas, se aislaron dos aislados en promedio, principalmente Staphylococcaceae y los Streptococcaceae.

Résumé - Flore bactérienne cutanée de la glande mammaire de truies et de leur lait

Des écouvillons de la peau de la glande mammaire ainsi que des échantillons de lai ont été soumis à une analyse bactériologiqu Tous les échantillons provenant de la peau étaient positifs, avec en moyenne 5.2 isolats bactériens, les Staphylococcaceae étant de l les micro-organismes dominants. Aucune bactérie ne fut détectée dans 20.8% des échantillons de lait. En moyenne, on trouva deux isolats bactériens par échantillon de l positif, et ceux-ci étaient principalement d Staphylococcaceae et des Streptococcacea

JSHAP 2011



PEER REVIEWED

COMMENTARY

Postpartum dysgalactia syndrome: A simple change in homeorhesis?

Guy-Pierre Martineau, DVM, ECPHM Diplomate; Yannig Le Treut, DVM; David Guillou, BSc, M
Agnès Waret-Szkuta, DVM, MSc, PhD

Summary

Mastitis, metritis, and agalactia syndrome (MMA) is a clear entity often reported as postpartum dysgalactia syndrome (PDS). However, MMA may represent only a small emerging part of an iceberg represented by PDS. Until now, investigators have compiled a list of risk factors for PDS related to nutrition, housing, and management practices and suggested that endotoxins and cytokines may play a central role in development of PDS. However, the pathophysiology of PDS has never been defined. The goal of this paper is to fill this gap, basing our proposal on the most recent published scientific literature and on the concept of homeorhesis developed by Bauman and Currie in the 1980s. Homeorhesis, a term that encompasses dynamic systems that return to a trajectory, refers to orchestrated changes in metabolism of body tissues to prioritize a physiological state (such as gestation or lactation) and brings a new perspective to this multifactorial disease that we will try to

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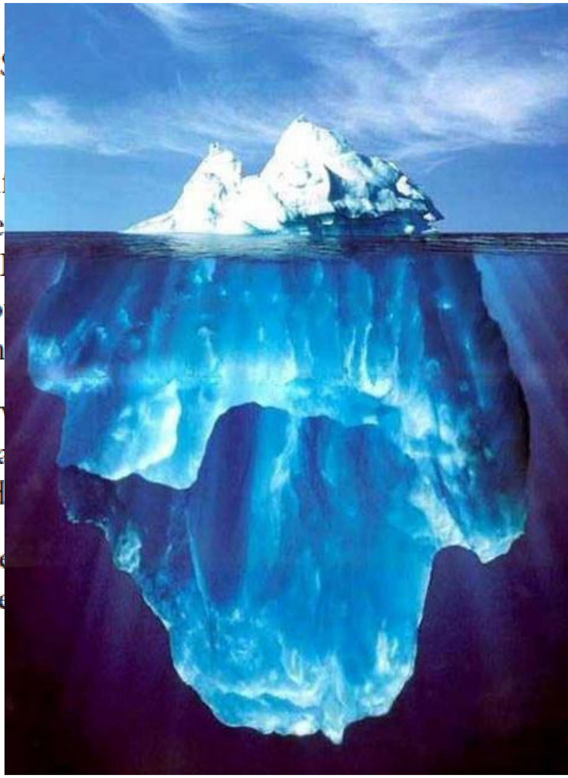

A story in 5 acts

- New emerging enzootic neonatal diarrhea: etiological investigations
- New emerging enzootic neonatal diarrhea: immunological investigations
- New emerging enzootic neonatal diarrhea: zootechnical investigations
- Easy and Difficult farrowing: on-farm investigations
- Over-Muscled Sow Syndrome: preliminary investigations

Proposal of a common pathophysiological process using the word homeorhesis

Act 1

1st European Symposium
on
Porcine Health Management

New emerging enzootic neonalal diarrhea (END) in high performing and well-managed swine herds

August 27th – 28th 2009
Faculty of LIFE Science,
University of Copenhagen,
Denmark

Organized by the European College of
Porcine Health Management www.ecphm.org

Act 1

1st Euro

Porcine H

New emerging diarrhea (END) and well-man

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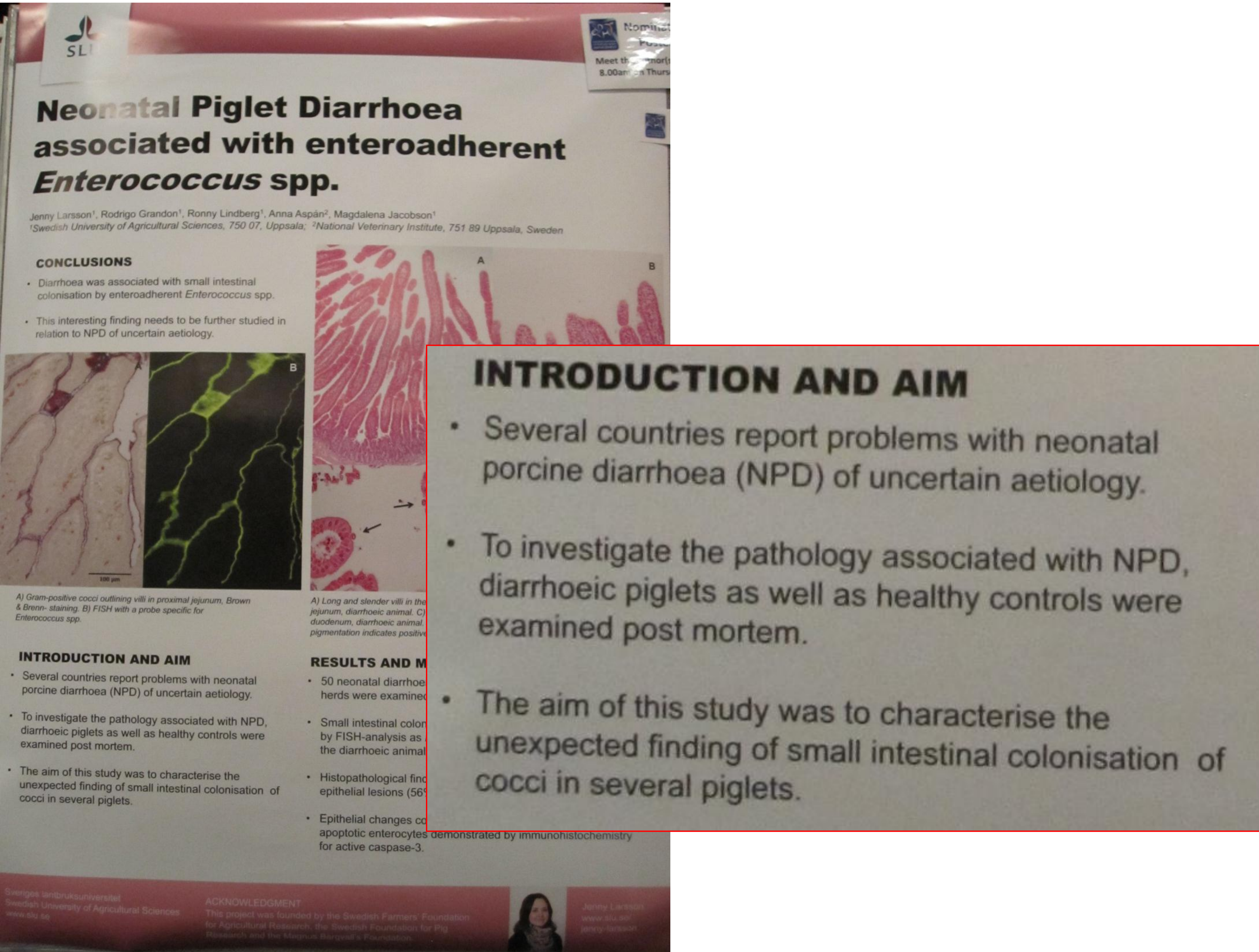
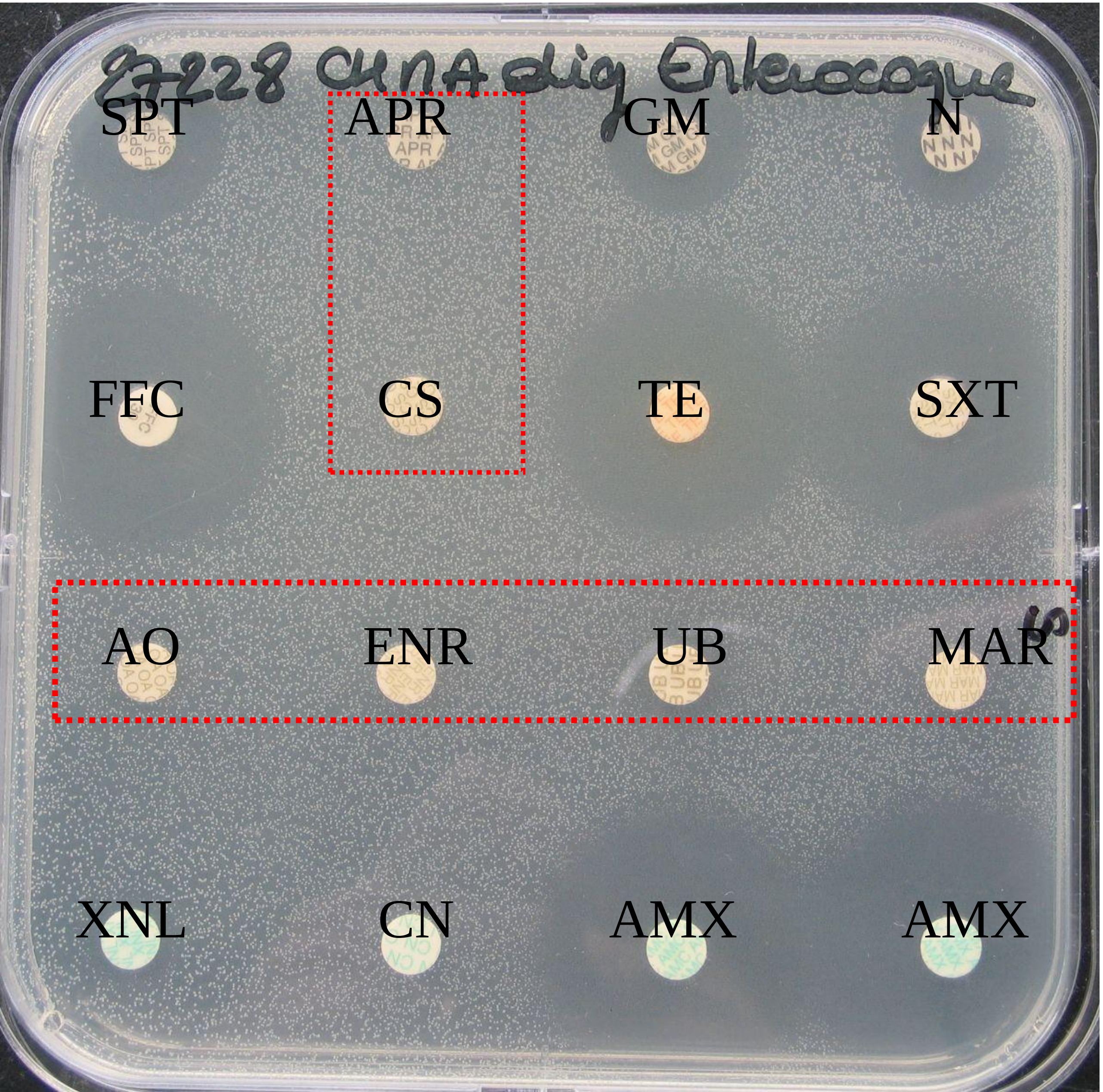


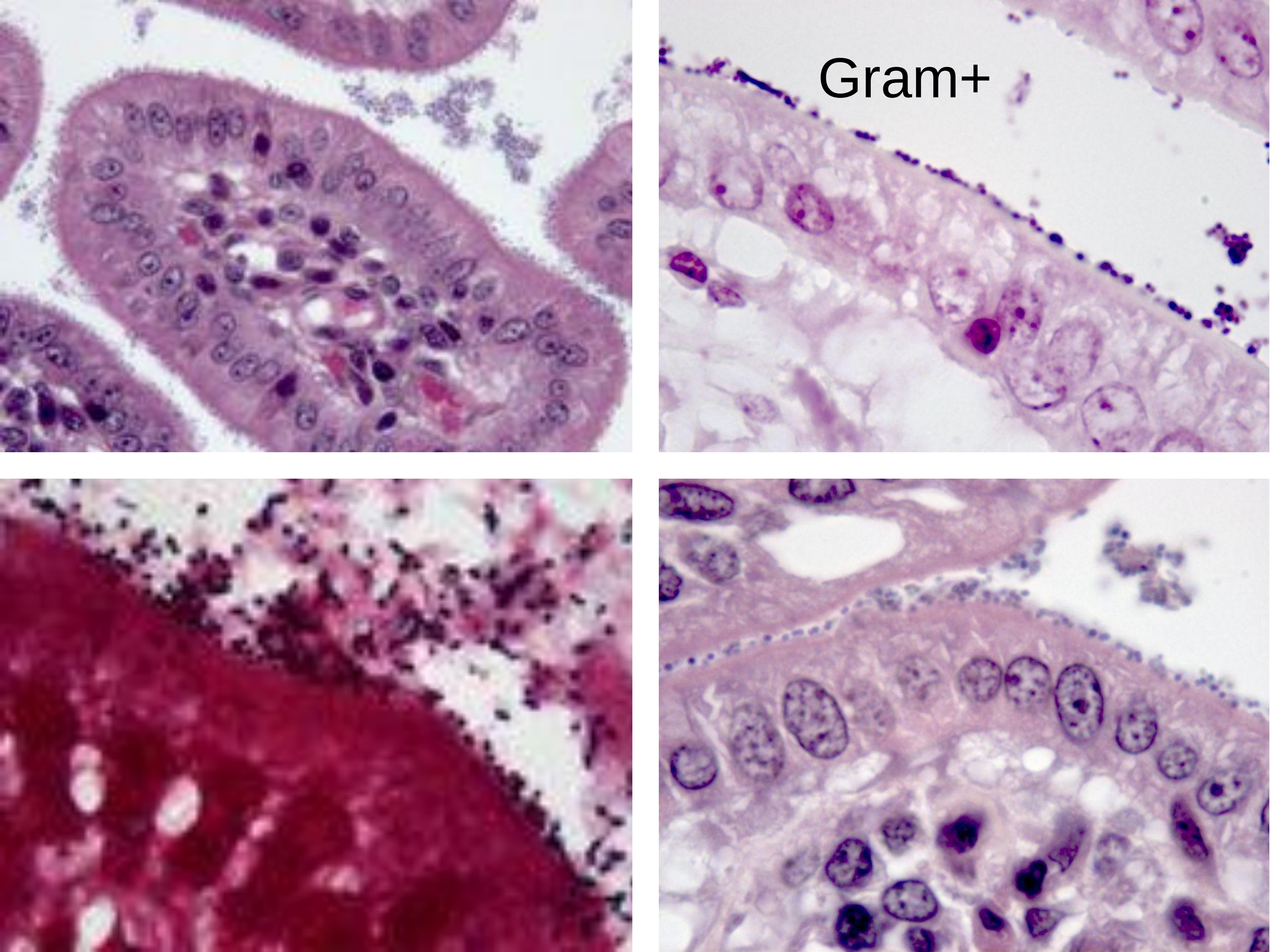
Neonatal Piglet Diarrhoea associated with enteroadherent Enterococcus spp.
Jenny Larsson[1], Rodrigo Grandon[1], Ronny Lindberg[1], Anna Aspán[2], Magdalena Jacobson[1]
[1]Swedish University of Agricultural Sciences, 750 07, Uppsala; [2]National Veterinary Institute, 751 89 Uppsala, Sweden
CONCLUSIONS
Diarrhoea was associated with small intestinal colonisation by enteroadherent Enterococcus spp.
This interesting finding needs to be further studied in relation to NPD of uncertain aetiology.
A
B
A) Gram-positive cocci outlining villi in proximal jejunum, Brown & Brenn- staining. B) FISH with a probe specific for Enterococcus spp.
INTRODUCTION AND AIM
Several countries report problems with neonatal porcine diarrhoea (NPD) of uncertain aetiology.
To investigate the pathology associated with NPD, diarrhoeic piglets as well as healthy controls were examined post mortem.
The aim of this study was to characterise the unexpected finding of small intestinal colonisation of cocci in several piglets.
RESULTS AND M
50 neonatal diarrhoe
herds were examine
Small intestinal colon
by FISH-analysis as
the diarrhoeic anima
Histopathological fin
epithelial lesions (56
Epithelial changes c
apoptotic enterocytes demonstrated by immunohistochemistry for active caspase-3.

Enterococcus durans



Antibiogram using antibiotics spectrum against *E. coli*

AMX	= Amoxi
AMC	= Amoxi/clavulanique ac.
CN	= Cefalexine
XNL	= Ceftiofur
MAR	= Marbofloxacine
UB	= Flumequine
ENR	= Enrofloxacine
OA	= Acide oxolinique
SXT	= TMP-sulfa
TE	= Tetracycline
CS	= Colistine
FFC	= Florfenicol
N	= Neomicyne
GM	= Gentamicine
APR	= Apramycine
SPT	= Spectinomycine


Gram+

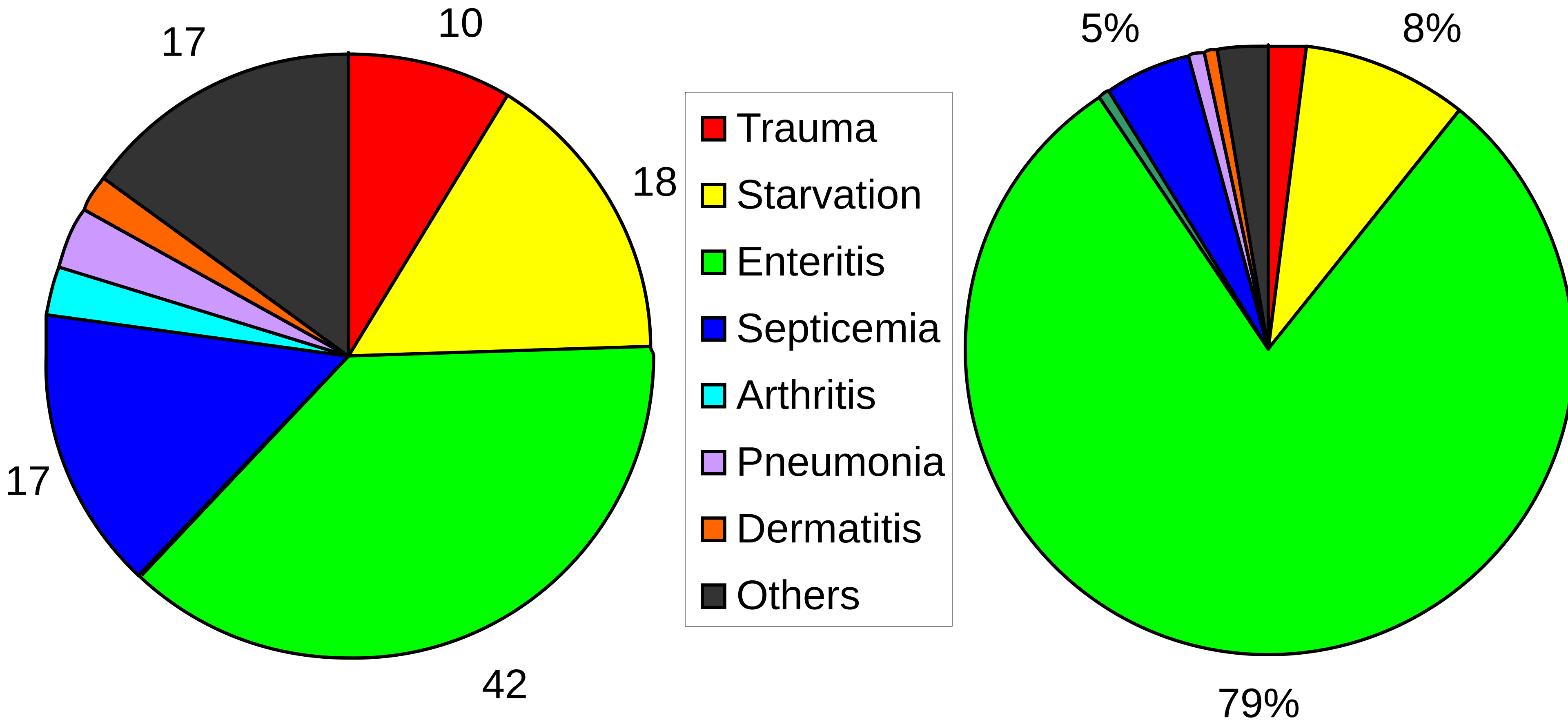
New neonathal diarrhoea syndrome, Denmark

Birgitta Svensmark
Laboratory for Swine Diseases,
Danish Pig Production,
Danish Agriculture and Food Council

Diagnoses, pigs 0 - 5 days

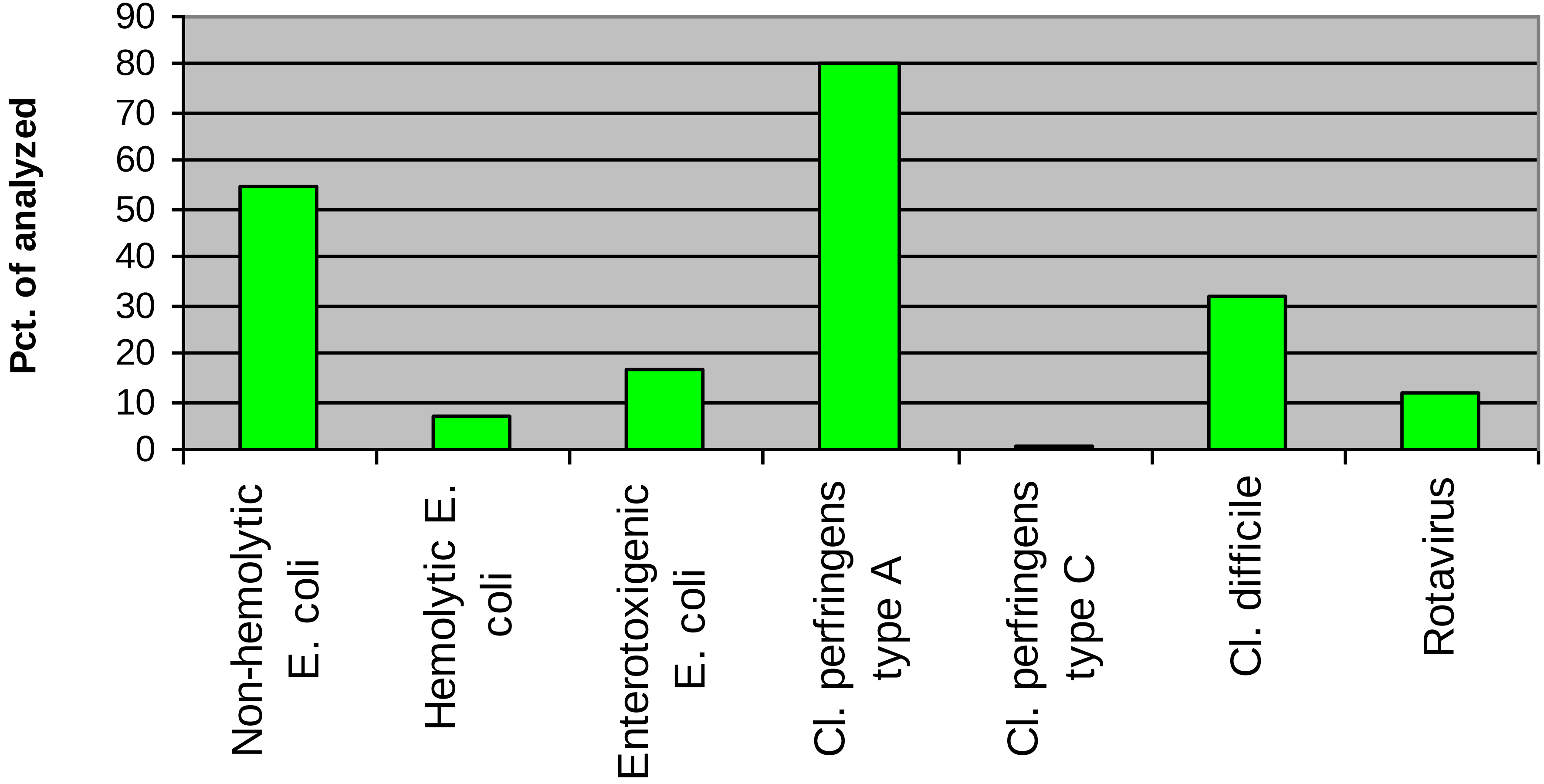
1998, 114 submissions **2008, 147 submissions**

Laboratory for Swine Diseases



Dansk Svineproduktion

Positive analyzes in pigs 1- 5 days
2008 - 09, 220 submissions
Laboratory for Swine Diseases



Dansk Svineproduktion

EO-002

| Emerging Diseases-DIARRHOEA |

New neonatal porcine diarrhoea in Denmark – a clinical description

H Kongsted[1,3], Ø Angen[2], B Kokotovic[2], SE Jorsal[2], JP Nielsen[3]

EO-005

| Emerging Diseases-DIARRHOEA |

New neonatal porcine diarrhoea. I. clinical outcome in an affected herd

Per Wallgren[1], Malik Merza [2]

IPVS 2012 KOREA

EO-006

| Emerging Diseases-DIARRHOEA |

New neonatal porcine diarrhoea. II. aspects on etiology

Per Wallgren [1], Sigbrit Mattsson [1], Malik Merza [2]
[1]National Veterinary Institute, SVA, 751 89 Uppsala, [2] Svanova, box 1545, 751 45 Uppsala, Sweden
Per.Wallgren@sva.se

Brief Communication Communication brève

How do swine practitioners and veterinary pathologists arrive at a diagnosis of *Clostridium perfringens* type A enteritis in neonatal piglets?

Gloria Chan, Abdolvahab Farzan, John F. Prescott, Robert Friendship

Abstract — A questionnaire was administered to 22 veterinary practitioners and 17 veterinary pathologists to investigate the methods used for diagnosis of *Clostridium perfringens* type A enteritis in neonatal pigs. Practitioners generally diagnosed *C. perfringens* type A associated enteritis by age of onset of diarrhea (between 1 to 7 days of age). Most practitioners (95%) were moderately to very confident in their diagnosis. Pathologists generally diagnosed *C. perfringens* type A associated enteritis by combinations of isolation of the organism, genotyping or detecting the toxins of the organism, and ruling out other pathogens through histopathology. Almost half (41%) of the pathologists were not confident of their diagnosis. This study reports that the current diagnostic method for *C. perfringens* type A enteritis is not specific, and although many pathologists expressed reservations about making a diagnosis of *C. perfringens* type A enteritis, most practitioners were confident in their diagnosis, even though reported clinical signs of clostridial diarrhea are similar to those of a number of other enteric diseases.

CVJ 2013 May

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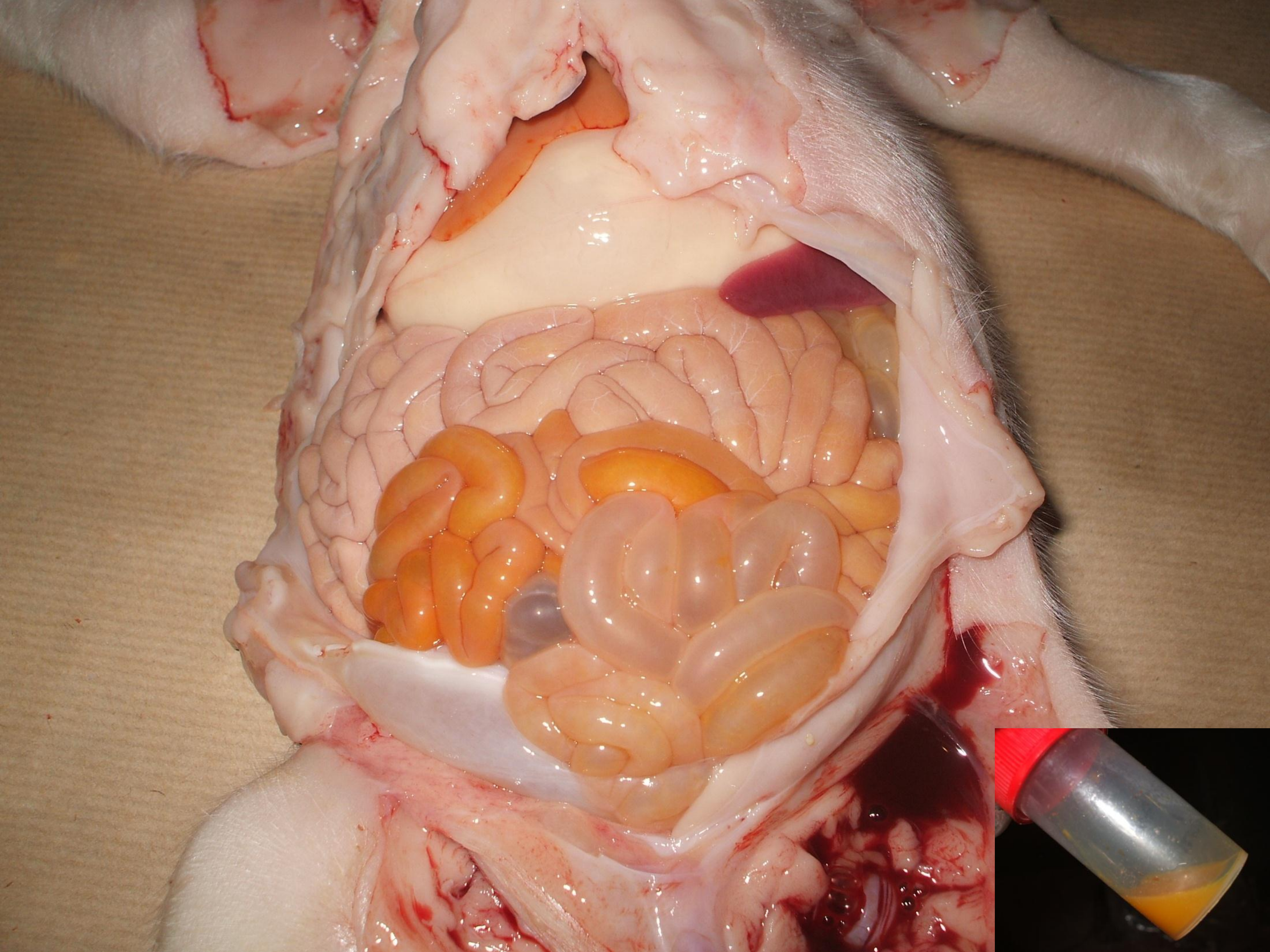
- Emerging enzootic neonatal diarrhea
  - Affected herds: 15 to 20% in Brittany (JNS, 2008)
    - Enzootic
      - Poor control with antibiotics
        - Frustration for the producers and the vets
      - Poor response to vaccinations
        - Frustration for the producers and the vets
    - Between batches variability
  - Affected piglets
    - Diarrhea: more or less …
    - Vomiting: more or less …

Act 1: On-Farm observational investigation

- 10 affected herds (Brittany)
  - Enzootically affected since > 12 months
  - One week/herd (from farrowing till one week of age)
- Clinical description
- Post-mortem investigations
  - 2 piglets/litter
  - 2 affected litters
  - less than 12 hours of diarrhea
  - histo and microbiological investigations

END: clinical description

Where ?	Very good herds
Who/what ? How many ?	Enzootic « non-*E. coli* » neonatal diarrhea, many etiologies. Variability within/between batch(es), between herds
When?	3-4 days of age but great variability within/between batch(es), between herds
Since when ?	A long time !
How ? Management?	Many diagnostical procedures Many different labs Many differents prophylactic measures …

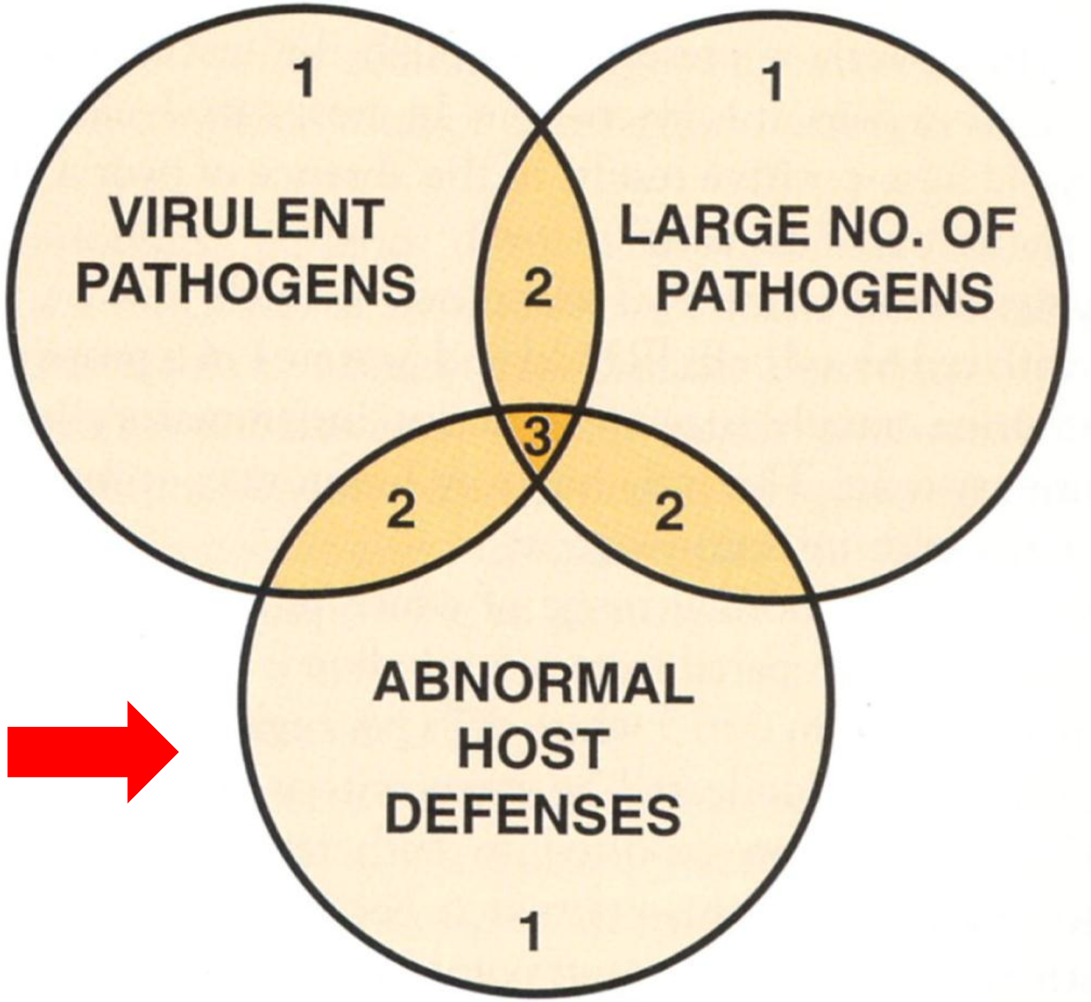


Act 1: major results

- Clinical investigations
  - Great variability between litters, within litter
  - Great frustration for producers
- Microbiological investigations
  - In an affected herd, **never** the same micro-organisms and the same histopathological lesions in all the 4 piglets even if less 12 hours before onset of diarrhea and necropsy
    - *C. perfringens* type A
    - *C. difficile*
    - *Enterococcus durans*
  - Never the same age (between 2 to 5 days)
  - Never the same prevalence, the same incidence pattern …

  => More questions than answers
    - Many hypothesis on colostrum consumption or colostrum production or colostrum quality …

Act 2: On-farm immunological investigations



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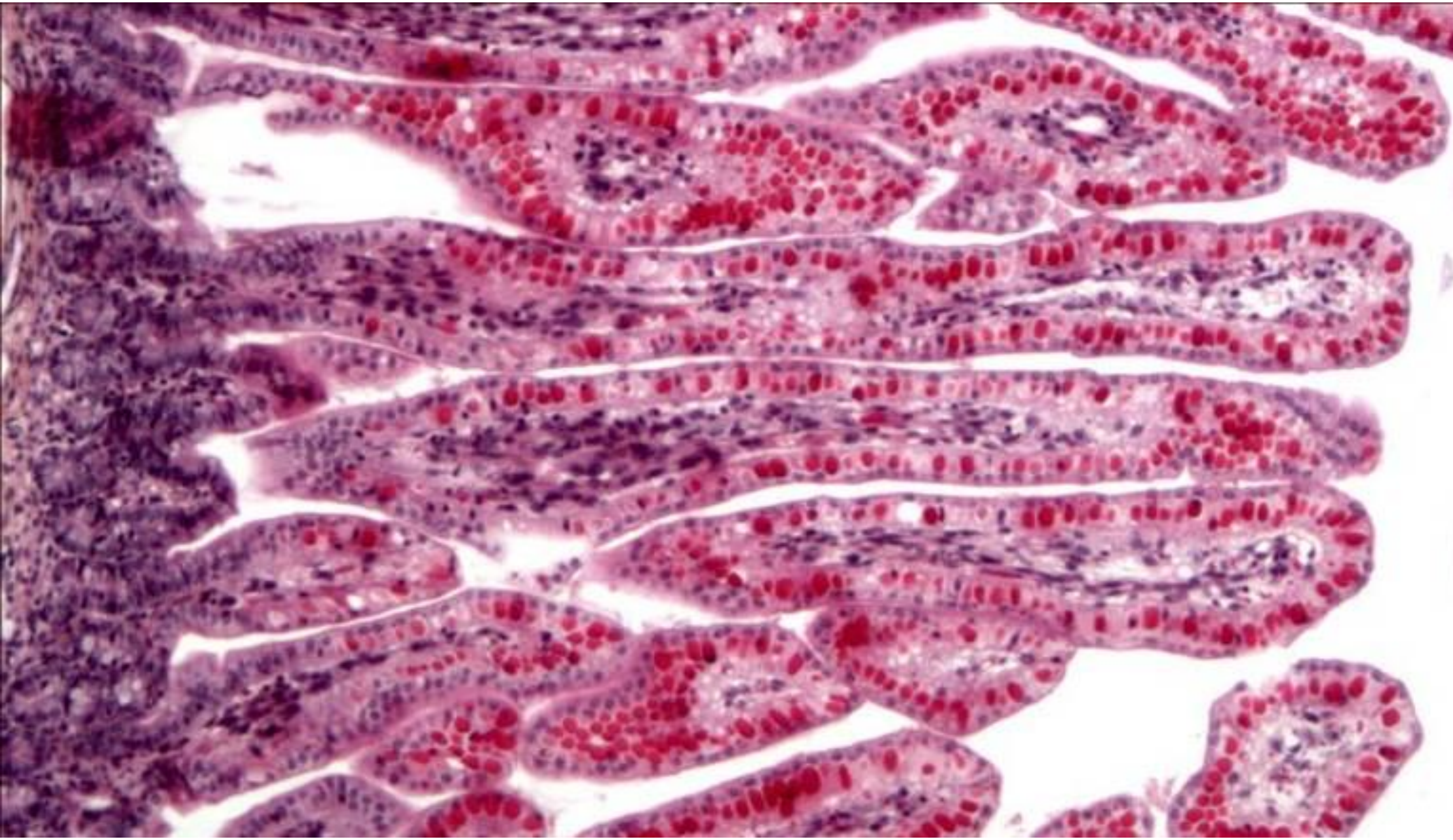

Colostrum (summary)

- Minimum: 200g/24 first hours
  - Normal variation
    - 250-300g/d
      - Allow 50g of growth/24 first hours
    - but Δ from 0 to >700g/d
  - Sow production: 3.3 to 3.7 kg/d but …
    - 250g/d * 14 piglets = 3.5kg
    - But 33% to 50% of the sow do not give enough colostrum (without any symptoms)
- If <150g/d => growth = 0

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FACULTEIT DIERGENEESKUNDE
approved by EAEVE

Factors at farm and sow level associated with colostrum production

Declerck I., Dewulf J., Piepers S., Maes D.
Department of Obstetrics, Reproduction and Herd Health
Faculty of Veterinary Medicine, Ghent University, Belgium
Ilse.declerck@ugent.be

Results

- Colostrum production per sow was 4,75 kg (0,65kg - 9,42 kg)
- Parity, gestation length, parturition duration: no significant effect
- Litter size (P < 0,01) significant and positively correlated
- Breed significant correlated (P = 0,03)
- Total variance of colostrum production per sow: 61% farm level + 39% sow level
- Breed and litter size 80% of variance at farm level

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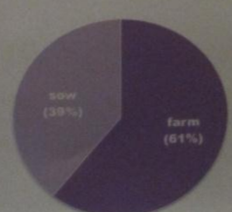
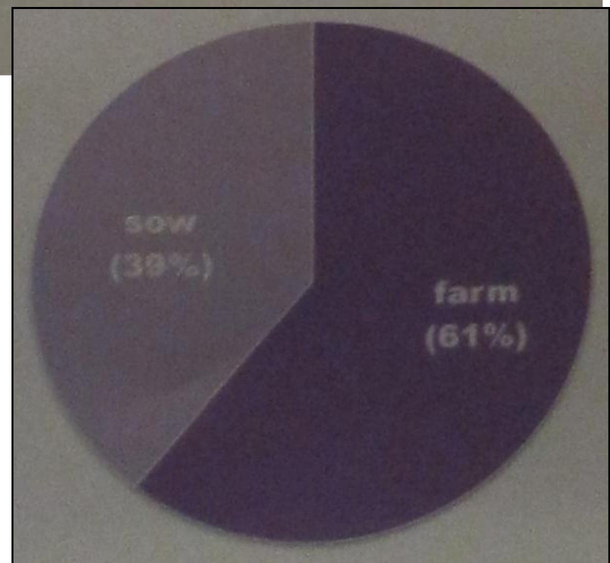
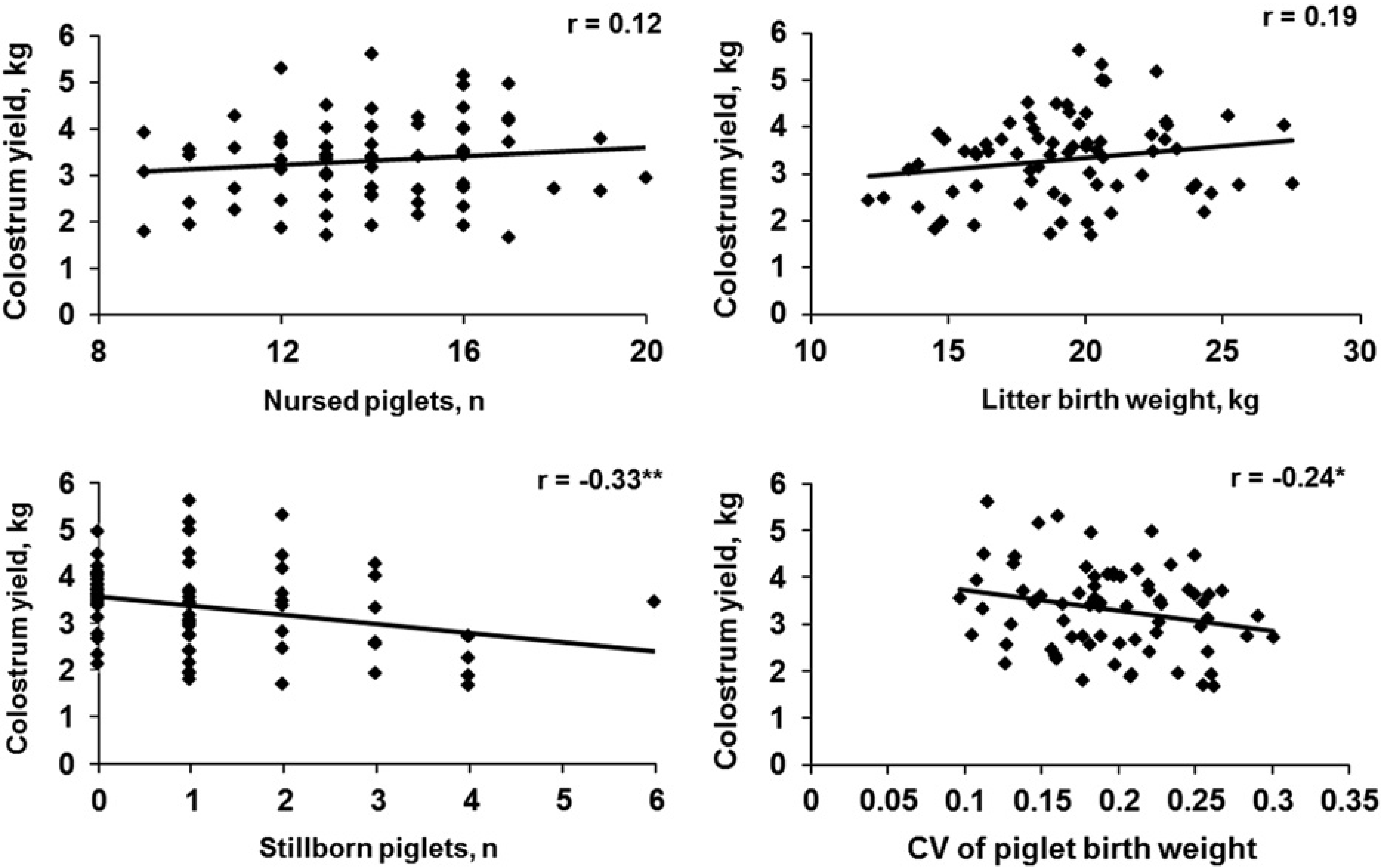
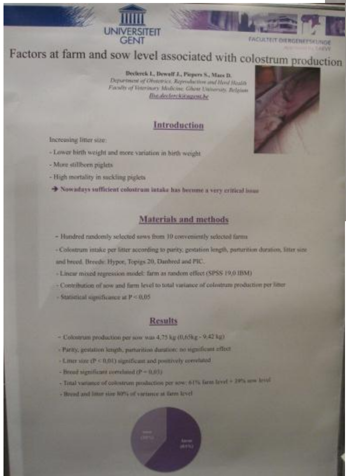




Relations between colostrum yield during the first 24h postpartum and litter characteristics (Quesnel, 2011)





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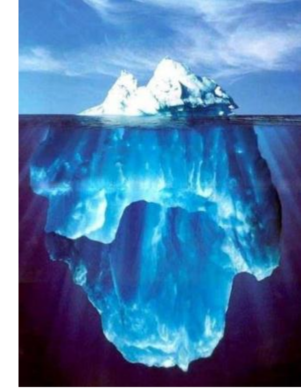

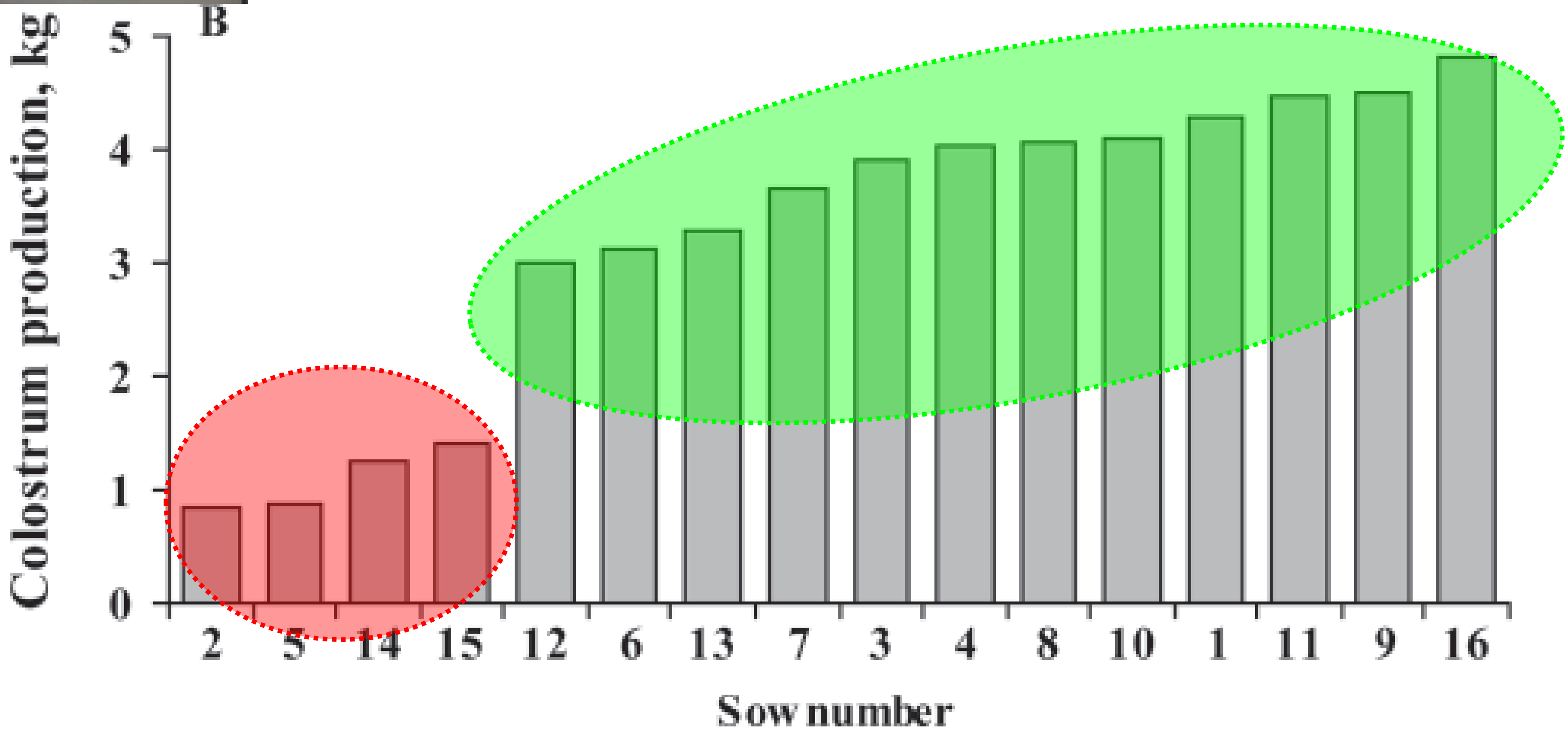

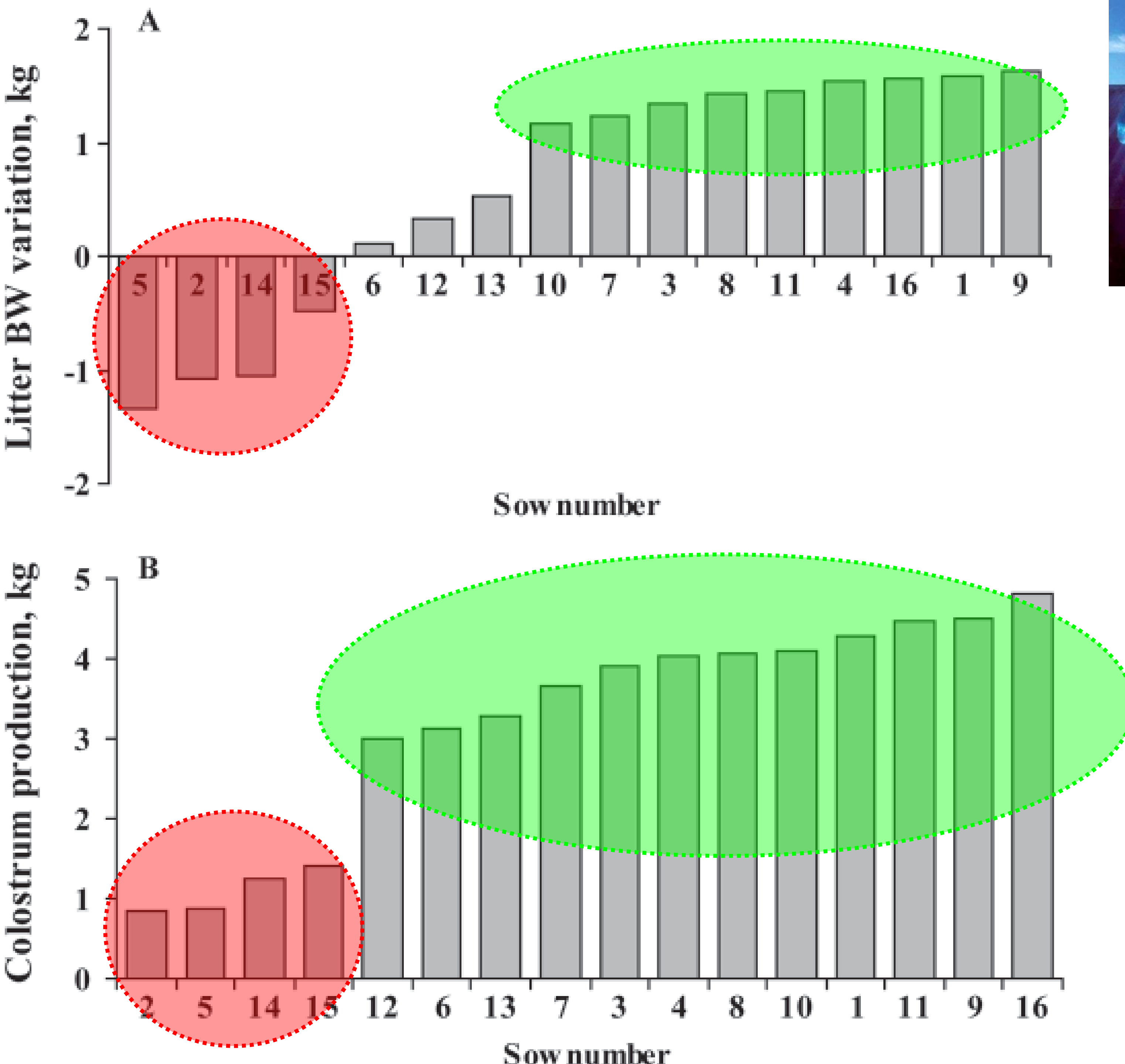
A
Litter BW variation, kg
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-2
5 2 14 15 6 12 13 10 7 3 8 11 4 16 1 9
Sow number
B
Colostrum production, kg
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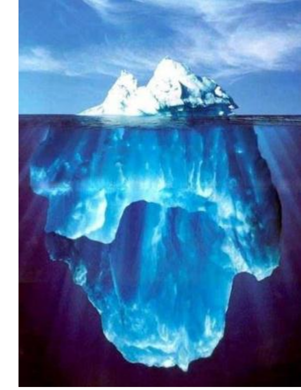
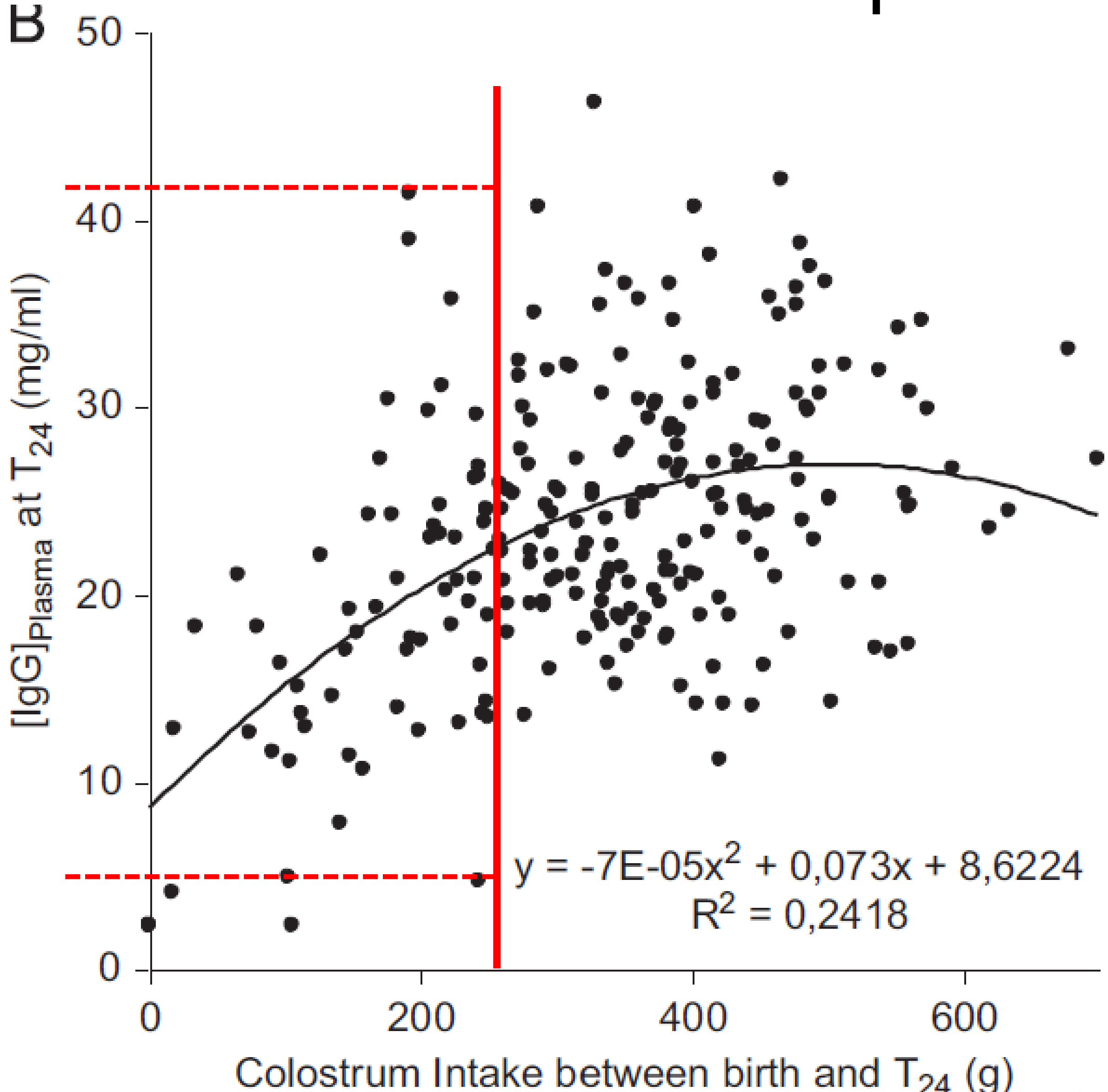
3
2
1
0
2 5 14 15 12 6 13 7 3 4 8 10 1 11 9 16
Sow number

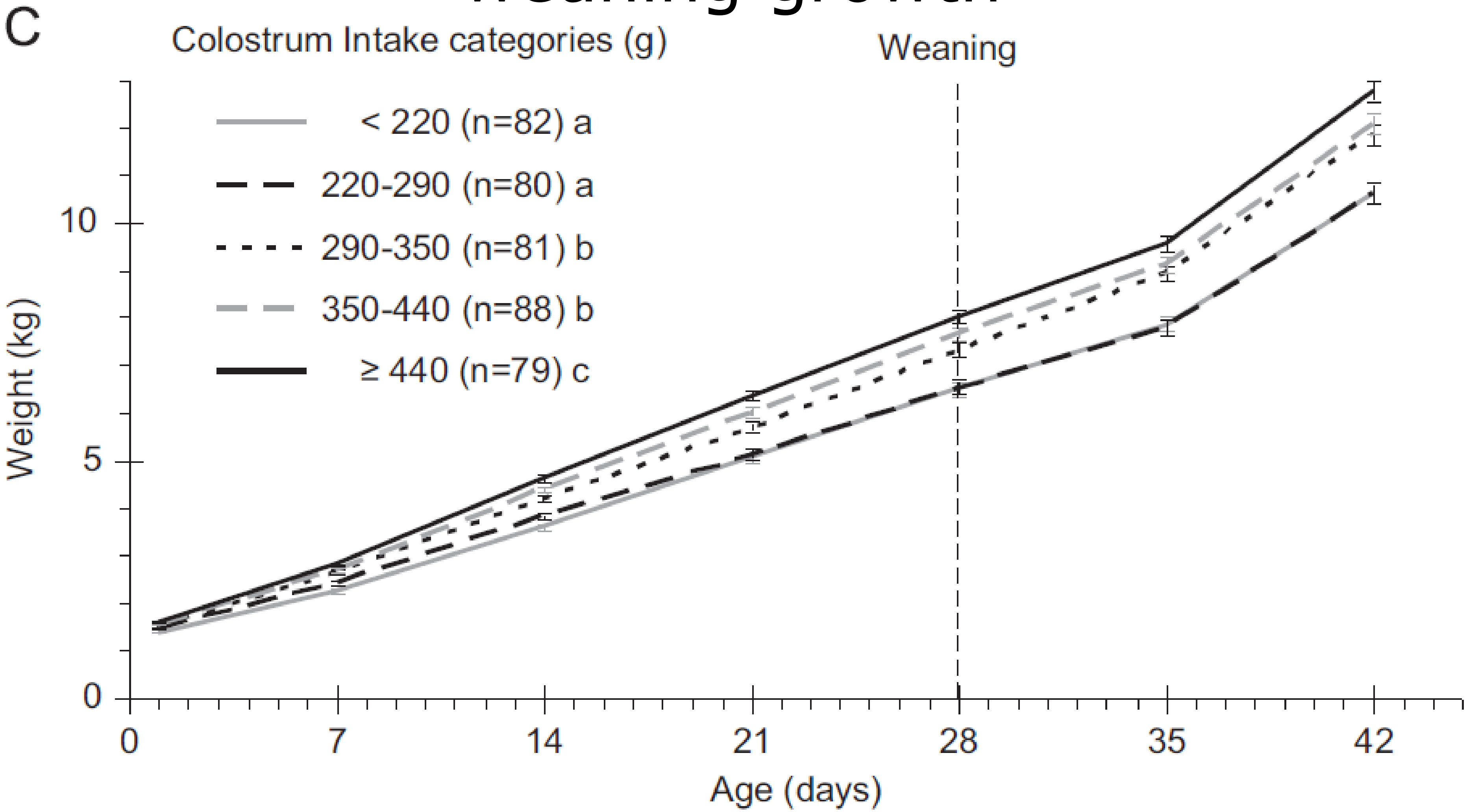


Colostrum intake and plasma IgG



Quesnel et al., 2012

Colostrum intake and pre- and post-weaning growth



Quesnel et al., 2012

Act 2: On-farm immunological investigations

- 10 other herds (Brittany), 7 different coops
- One week/herd (from farrowing till one week of age)
- Following of >200 litters
- Exams
  - Necropsies (histo and microbiological investigations)
  - Immunological analysis
    - Sow colostrum (n=135) (before < 3^{rd} piglet)
    - Piglets' sera (at one week of age)
      - 16 affected litters
      - 22 unaffected litters

Act 2: major results

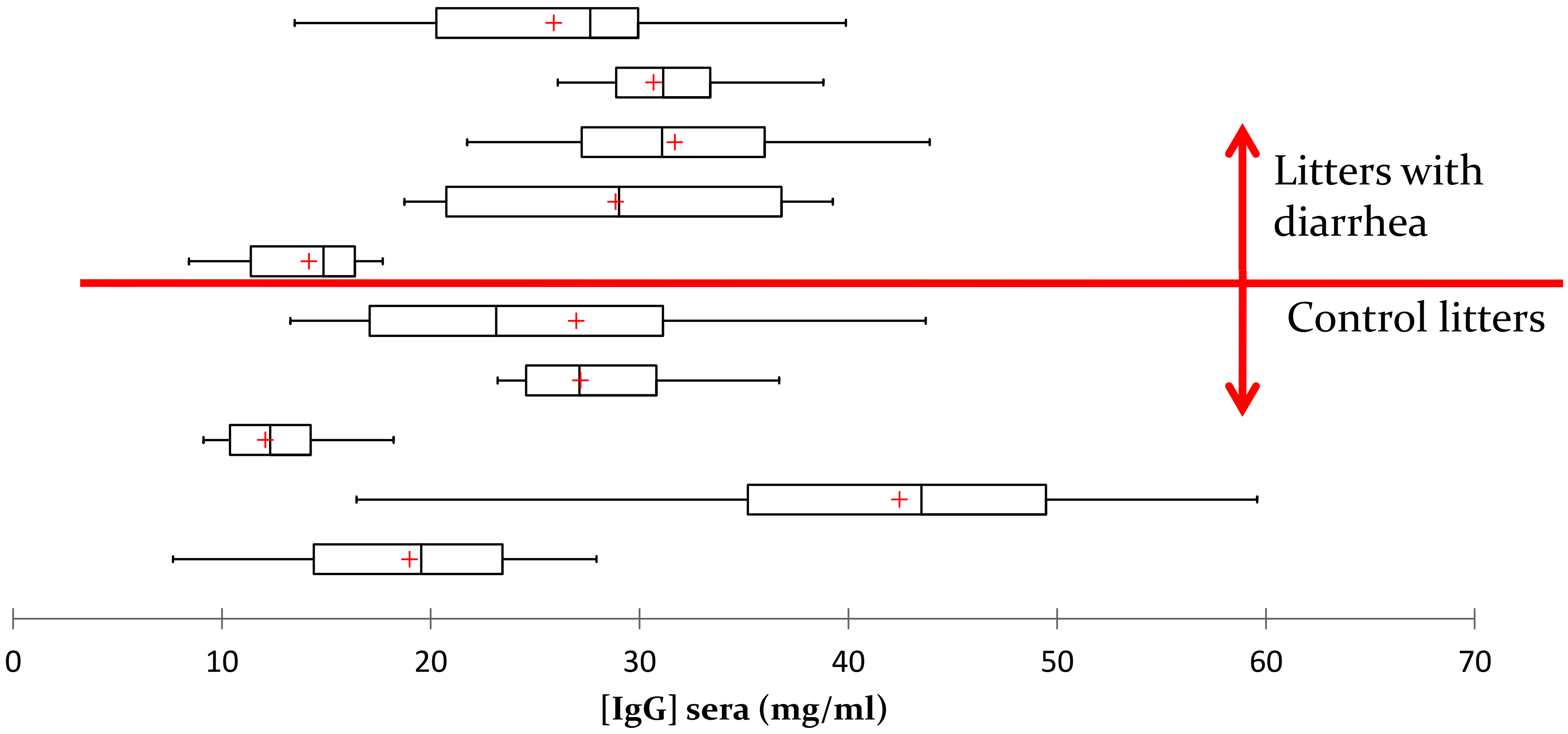
- <u>From piglets blood samples</u>: **[IgG] sera**
  - Litters with diarrhea: 22.2 mg/ml, SE=0.84
  - Control litters: 24.8 mg/ml, SE=0.83
  - Non significant difference: $p>0.05$
- From sows colostrum: **[IgG] colostrum**
  - Sows with diarrhea litters: 70.8 mg/ml, SE=3.5
  - Sows with control litters: 85.8 mg/ml, SE=3.1
  - Significant difference: $p=0.005$

	Non affected litters		Affected litters	
Sow colostral IgG (mg/ml)			60	48
Piglets' sera IgG (mg/ml) (one week of age)			18	16
			18	16
			17	16
			16	14
			16	10
			15	10
			15	9
			14	
			11	
			11	
			10	
			8	
Mean			14,2	12,9
SD			3,1	3,2
Sera IgG / Colostral IgG			0,24	0,27

	Non affected litters		Affected litters	
Sow colostral IgG (mg/ml)	62	71	60	48
Piglets' sera IgG (mg/ml) (one week of age)	28	22	18	16
	27	19	18	16
	24	18	17	16
	23	16	16	14
	20	15	16	10
	20	13	15	10
	17	12	15	9
	15	8	14	
	14	6	11	
	14	2	11	
	8		10	
			8	
Mean	19,0	13,1	14,2	12,9
SD	6,2	6,1	3,1	3,2
Sera IgG / Colostral IgG	0,31	0,19	0,24	0,27

Act 2: major results

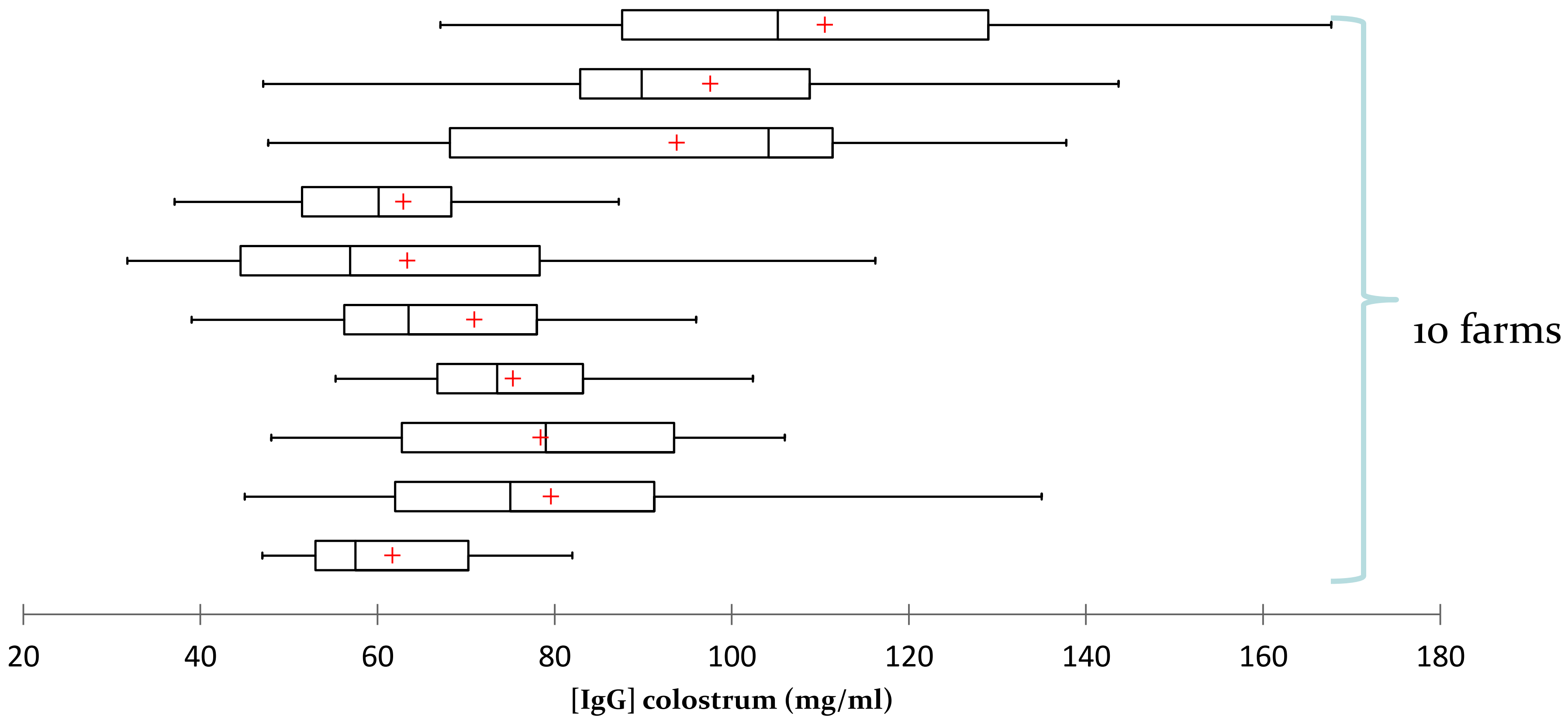
[IgG] sera, per litter



Within-litter variation

Act 2: major results

[IgG] colostrum, per farm



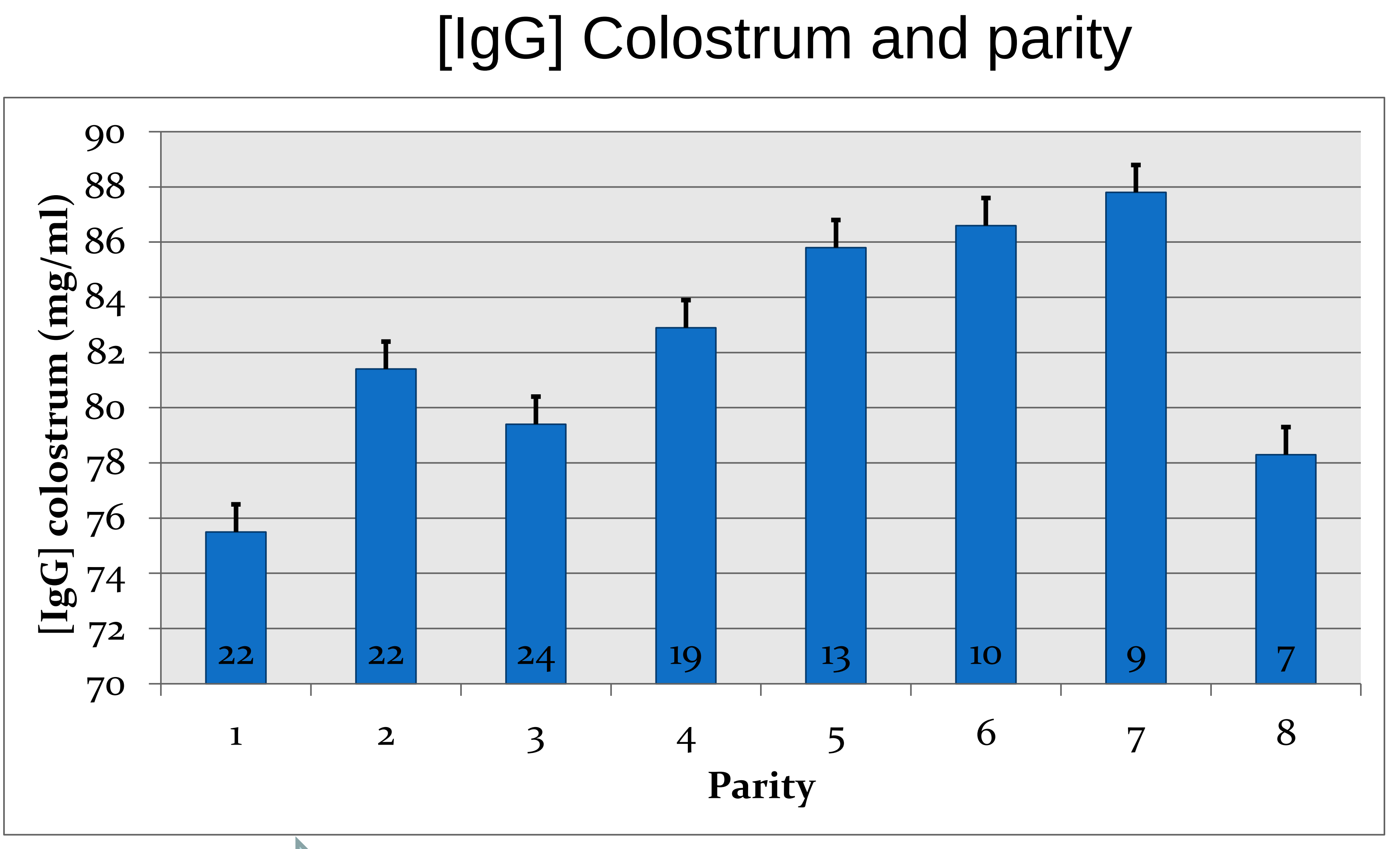
Between-sow variation

Act 2: major results … are well known

Hyper-prolificacy

- Within-litter variation:
  - Birth order (Le Dividich et al., 2004)
  - Birth weight (Devillers et al., 2007)
  - Vitality at birth (Devillers et al., 2007)
- Between-sow variation:
  - Gestation length / Farrowing induction (Devillers et al., 2007)
  - Parity (Devillers et al., 2007)
  - Genetics (Voisin et al., 2006)

Act 2: major results



No significant difference ($p>0.05$)

Parity and colostrum IgG (one herd, 2500 sows)

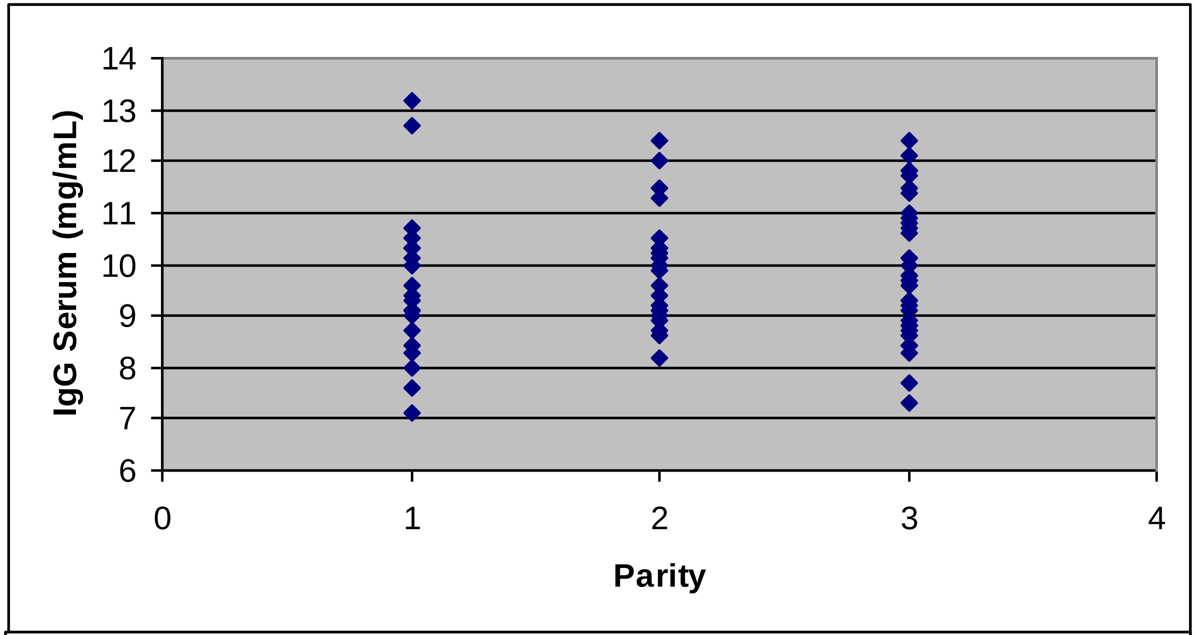
Parity (# sows)	[IgG] ± SD (mg/L)
P1 (n=21)	70 ± 26
P2 (n=20)	85 ± 25
P3 (n=20)	83 ± 22
P4 (n=6)	71 ± 22
P5 (n=4)	100 ± 30
P6 (n=2)	75 ± 1

Voisin and Martineau, IPVS 2006

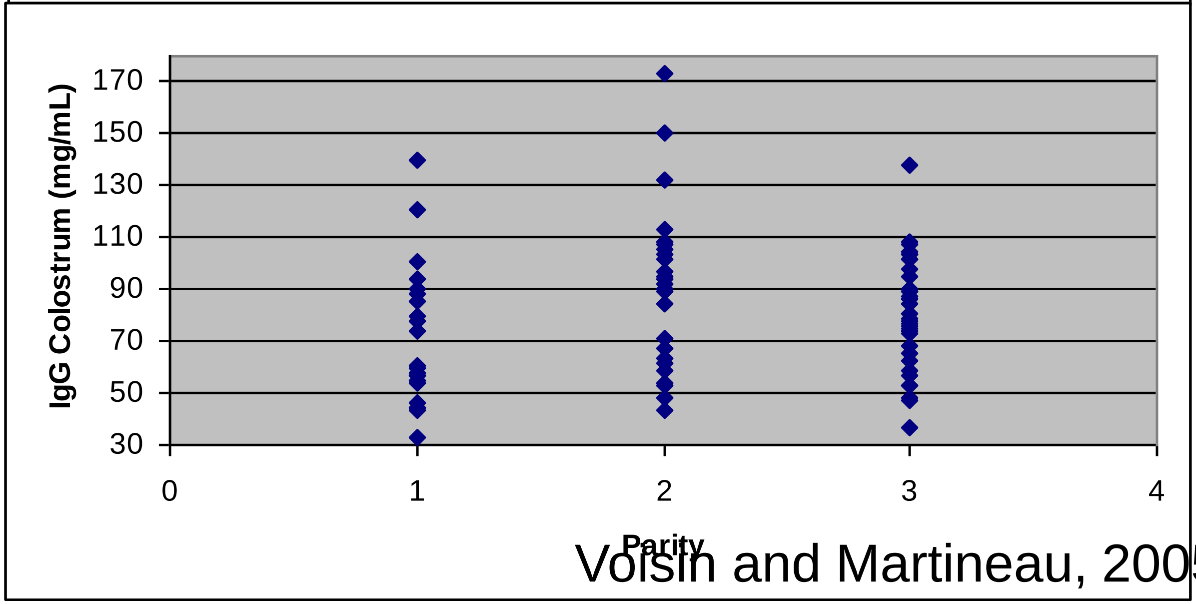
Parity effect and [IgG]

Sow sera

(4 weeks before farrowing)



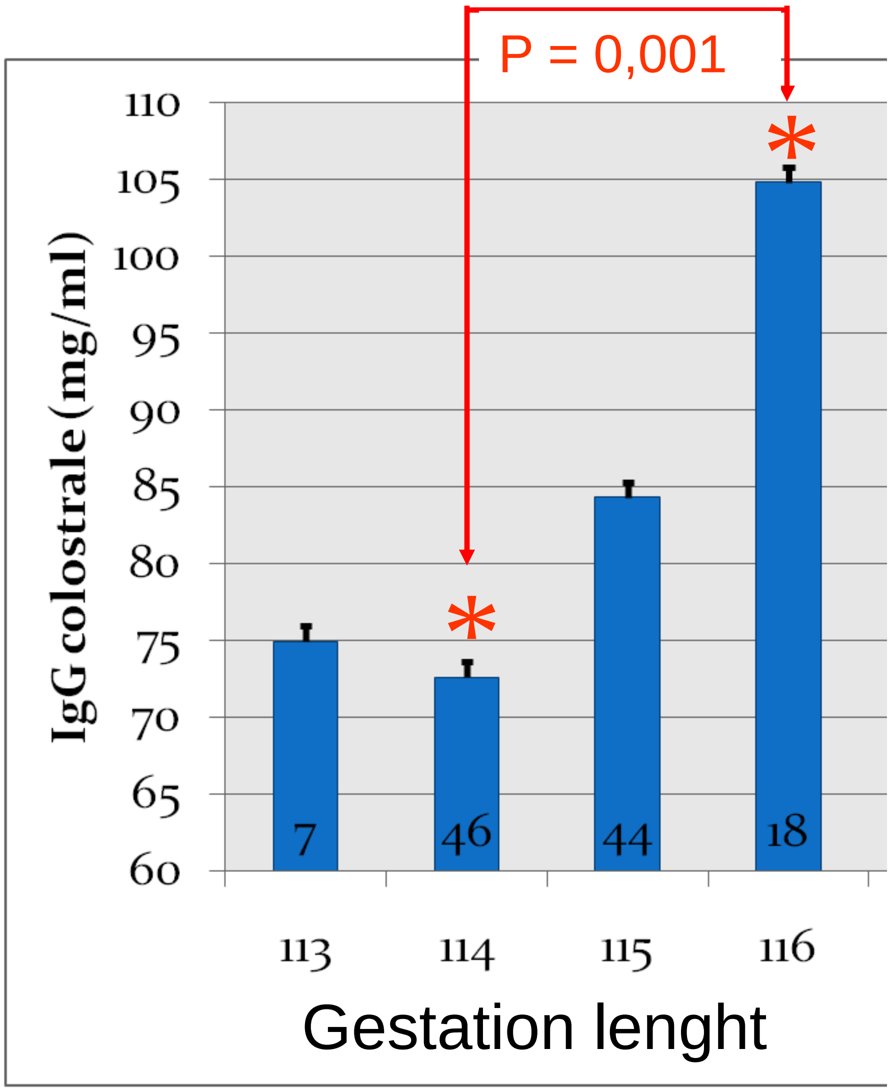
Colostrum



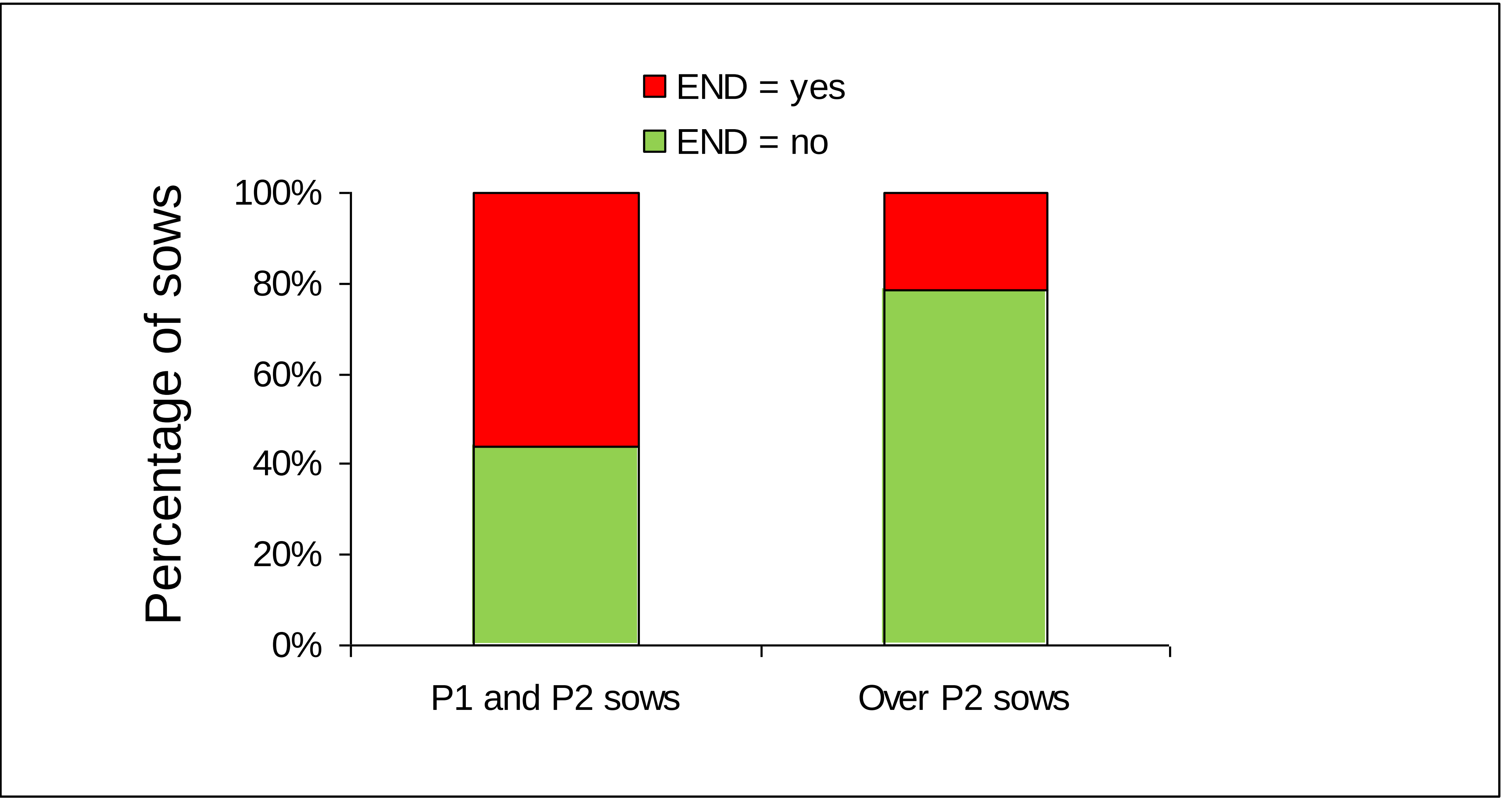
Voisin and Martineau, 2005

Act 2: major results

[IgG] Colostral IgG and gestation lenght



Act 3: On-farm study (in Brittany)



Odds Ratio : 3.6 (P<0,05)

Sialelli et al., 2009

Act 3: On-farm study (in Brittany)

	P1-P2				Over P2			
Herd status	Control	Affected			Control	Affected		
Sow status	Control	Control	Affected	p	Control	Indemne	Affected	p
# sows								
Back fat								
Total born								
Born alive								
Farrowing (min)								
Interval								
% Pig born> 3h								
Weight D0								
ADG 0-24								
Colostrum (ml)								
Colostral IgG								

Sialelli et al., 2009

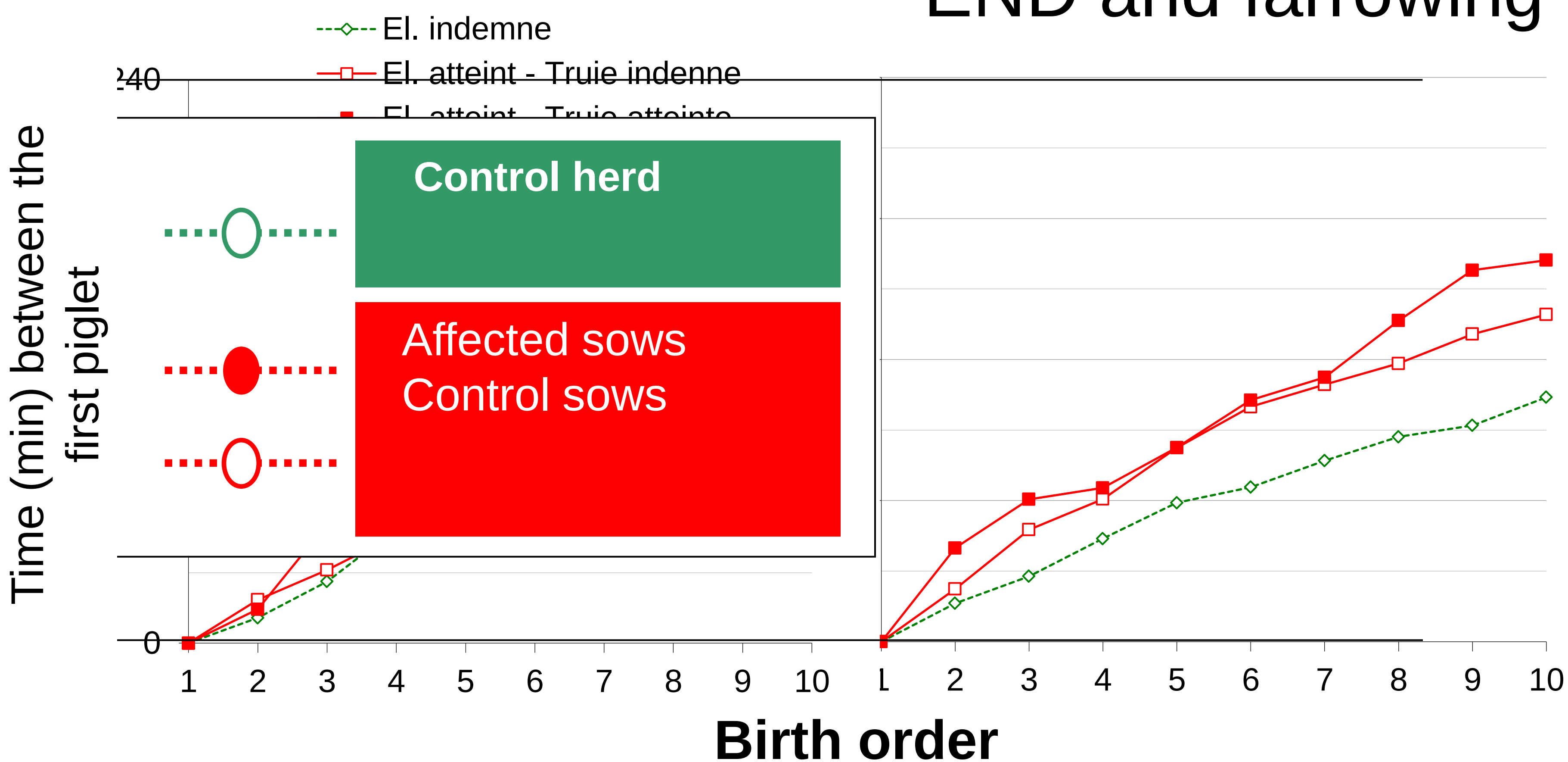
Act 3: On-farm study (in Brittany)

	P1-P2				Over P2			
Herd status	Control	Affected			Control	Affected		
Sow status	Control	Control	Affected	p	Control	Indemne	Affected	p
# sows	10	7	9		23	29	8	
Back fat	18	20	20		15,9	17,1	17,7	
Total born	14	13,1	14,8		15,3	15,4	13,1	
Born alive	13,5	12,4	13,7		14,1	14	12,9	
Farrowing (min	151	246	229		161	185	196	
Interval	13	22	20		11	13	16	
% Pig born > 3h	5	39	34		8	15	17	
Weight D0	1386	1335	1369		1443	1312	1404	
ADG 0-24	70	34	72		77	74	70	
Colostrum (ml)	2956	2623	3365		3558	3647	3369	
Colostral IgG	372	494	544		382	496	564	

Sialelli et al., 2009

Act 3: On-farm study (in Brittany)

END and farrowing

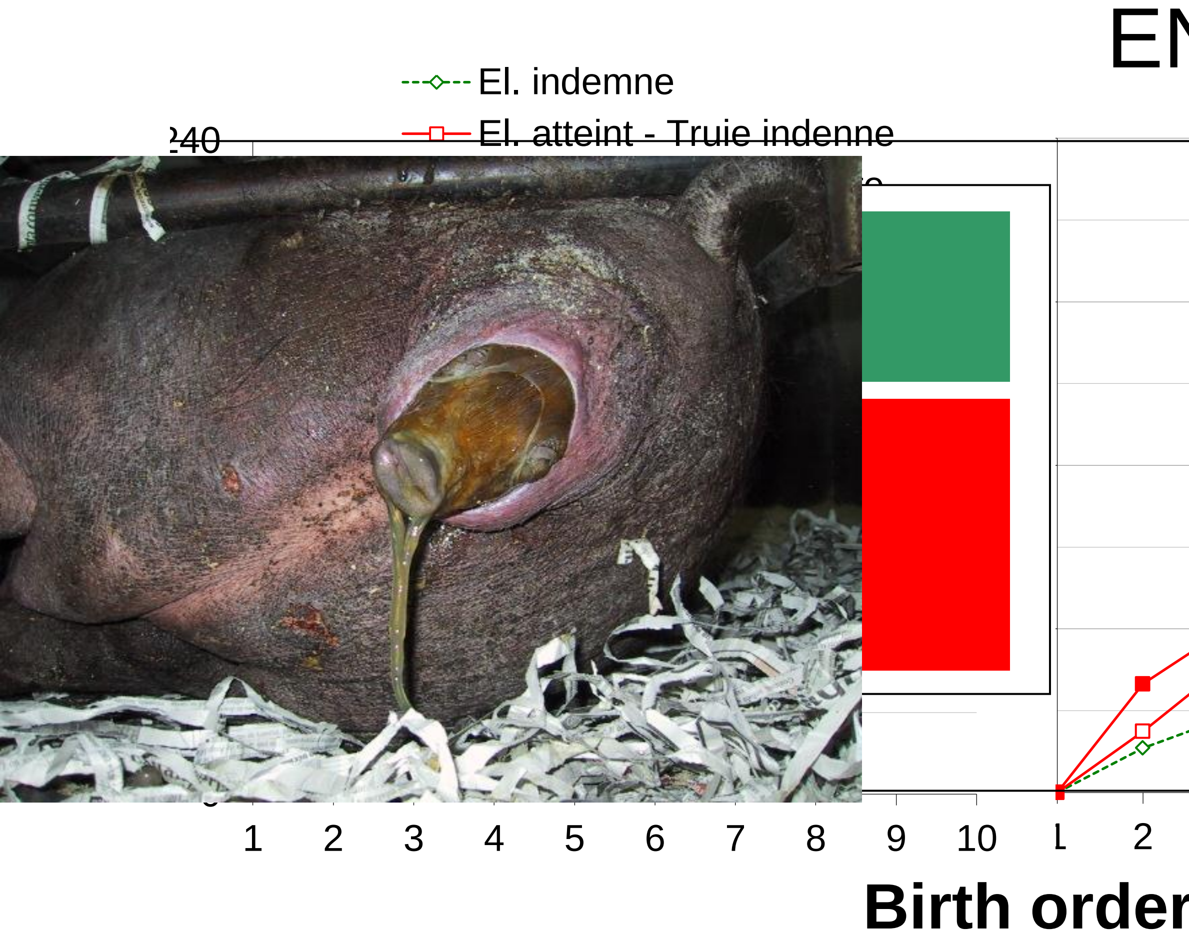


<13 Total born

> 14 Total born

Sialelli et al., 2009

Act 3: On-farm study (in Brittany)

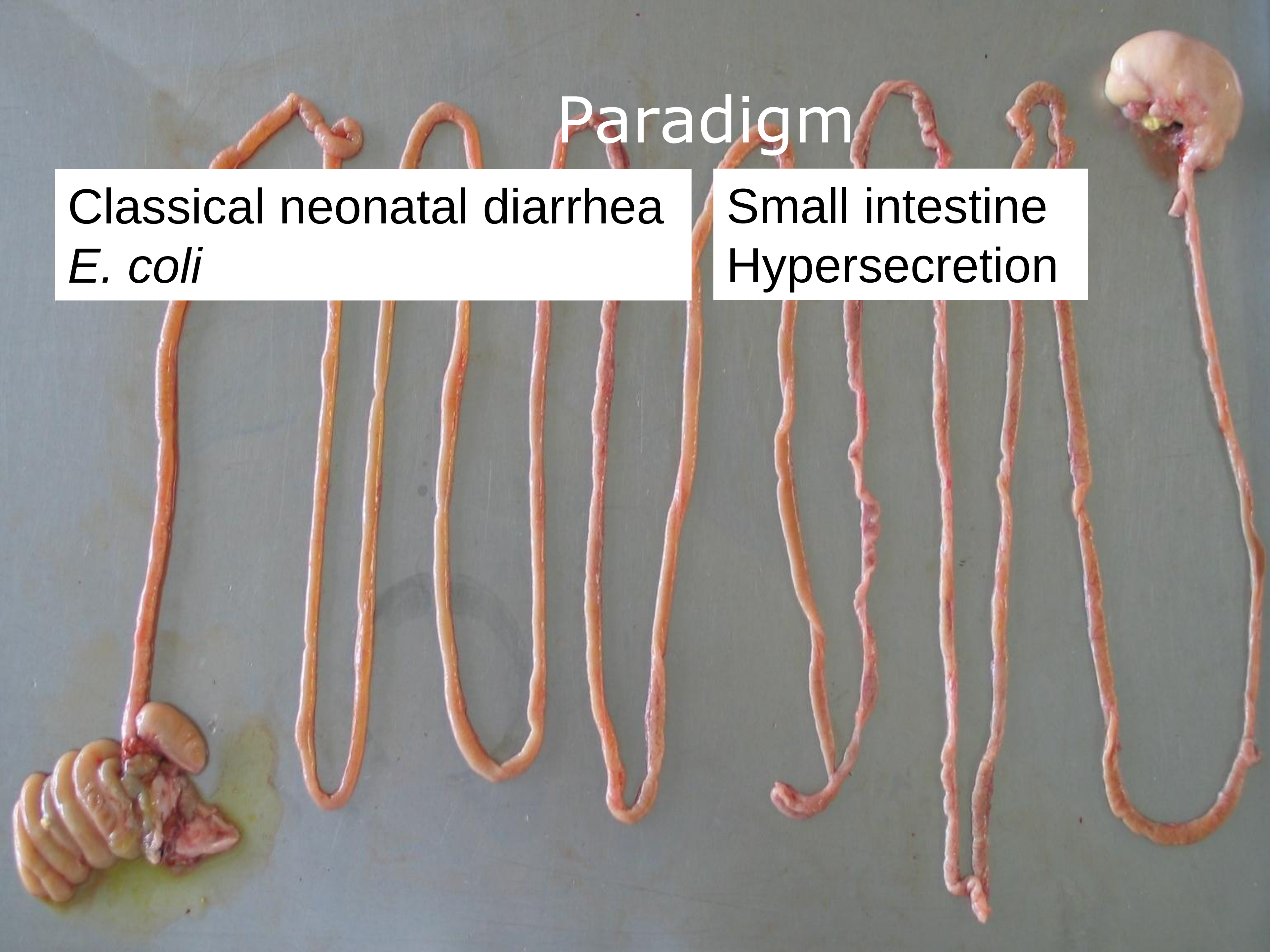


<13 Total born

> 14 Total born

Sialelli et al., 2009

- Act 1, 2 and 3: Preliminary conclusions on Enzootic Neonatal Diarrhea (END)
  - is a paradoxal disease because occurs in herds with very good performances and very good stockmanship
  - is a new disease and we need to change our paradigm (Kuhn refer to the set of practices that define a scientific discipline during a particular period of time)
    - Indeed, in our veterinary formated brain, porcine neonatal diarrhea is a primary infectious disease
    - Microbiological investigations give enough informations


Paradigm
Classical neonatal diarrhea
E. coli
Small intestine
Hypersecretion

Colonic pathophysiology

Colonic pathophysiology

Colonic bacterias

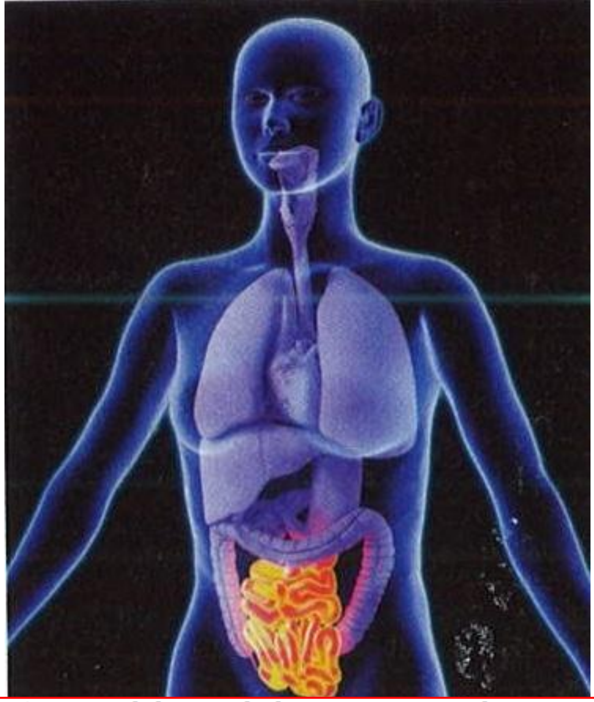
10^{12} anaerobic bacteria / g feces
10^{8} aerobic bacteria / g feces
10^{5} aerobic bacteria Gram neg / g feces
10^{3} to 10^{6} *E. coli* / g / feces

↓

Necessary

- -for mucosal integrity
- -for colonocyte renewal
- -for local immune system development

- Human genome
  - 23,000 genes
- Intestinal microbiota
  - 3,000,000 genes



Intestinal Microbiota in Healthy Adults: Temporal Analysis Reveals Individual and Common Core and Relation to Intestinal Symptoms

Jonna Jalanka-Tuovinen[1¶], Anne Salonen[1*¶], Janne Nikkilä[1¤], Outi Immonen[1], Riina Kekkonen[2], Leo Lahti[1], Airi Palva[1], Willem M. de Vos[1,3]

1 Department of Veterinary Biosciences, University of Helsinki, Helsinki, Finland, 2 Research & Development, Valio Ltd, Helsinki, Finland, 3 Laboratory of Microbiology, Wageningen University, Wageningen, The Netherlands

Abstract

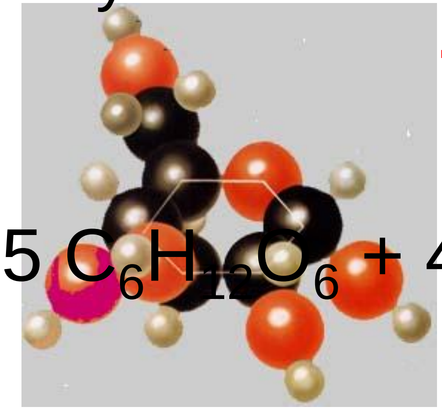
Background: While our knowledge of the intestinal microbiota during disease is accumulating, basic information of the microbiota in healthy subjects is still scarce. The aim of this study was to characterize the intestinal microbiota of healthy adults and specifically address its temporal stability, core microbiota and relation with intestinal symptoms. We carried out a longitudinal study by following a set of 15 healthy Finnish subjects for seven weeks and regularly assessed their intestinal bacteria and archaea with the Human Intestinal Tract (HIT)Chip, a phylogenetic microarray, in conjunction with qPCR analyses. The health perception and occurrence of intestinal symptoms was recorded by questionnaire at each sampling point.

Principal Findings: A high overall temporal stability of the microbiota was observed. Five subjects showed transient microbiota destabilization, which correlated not only with the intake of antibiotics but also with overseas travelling and temporary illness, expanding the hitherto known factors affecting the intestinal microbiota. We identified significant correlations between the microbiota and common intestinal symptoms, including abdominal pain and bloating. The most striking finding was the inverse correlation between Bifidobacteria and abdominal pain: subjects who experienced pain had over five-fold less Bifidobacteria compared to those without pain. Finally, a novel computational approach was used to define the common core microbiota, highlighting the role of the analysis depth in finding the phylogenetic core and estimating its size. The in-depth analysis suggested that we share a substantial number of our intestinal phylotypes but as they represent highly variable proportions of the total community, many of them often remain undetected.

Conclusions/Significance: A global and high-resolution microbiota analysis was carried out to determine the temporal stability, the associations with intestinal symptoms, and the individual and common core microbiota in healthy adults. The findings provide new approaches to define intestinal health and to further characterize the microbial communities inhabiting the human gut.

Colonic pathophysiology

Carbohydrates — Colonic bacteria → Lactic acid and SCFA*



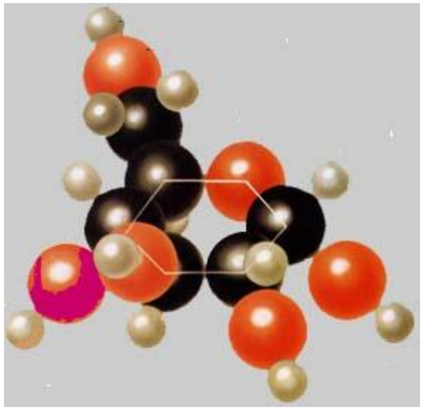
$57,5\ C_6H_{12}O_6 + 45\ H_2O$ → 65 acetates
+ 20 propionates
+ 15 n-butyrates
+ 140 H_20 + 95 CO_2
+ 288 ATP

*Short Chains Fatty Acids: acetate, butyrate, propionate

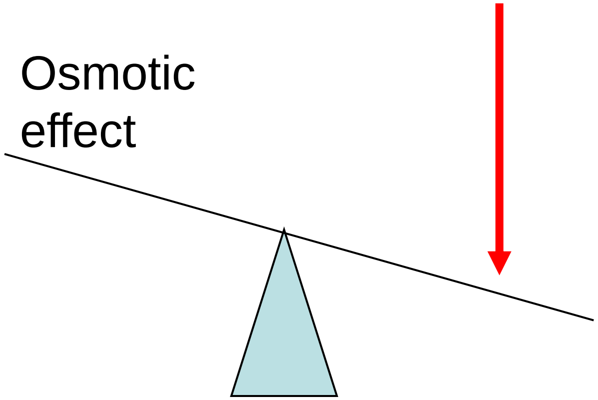
Colonic pathophysiology

Colonic bacteria

Carbohydrates → Lactic acid and SCFA*

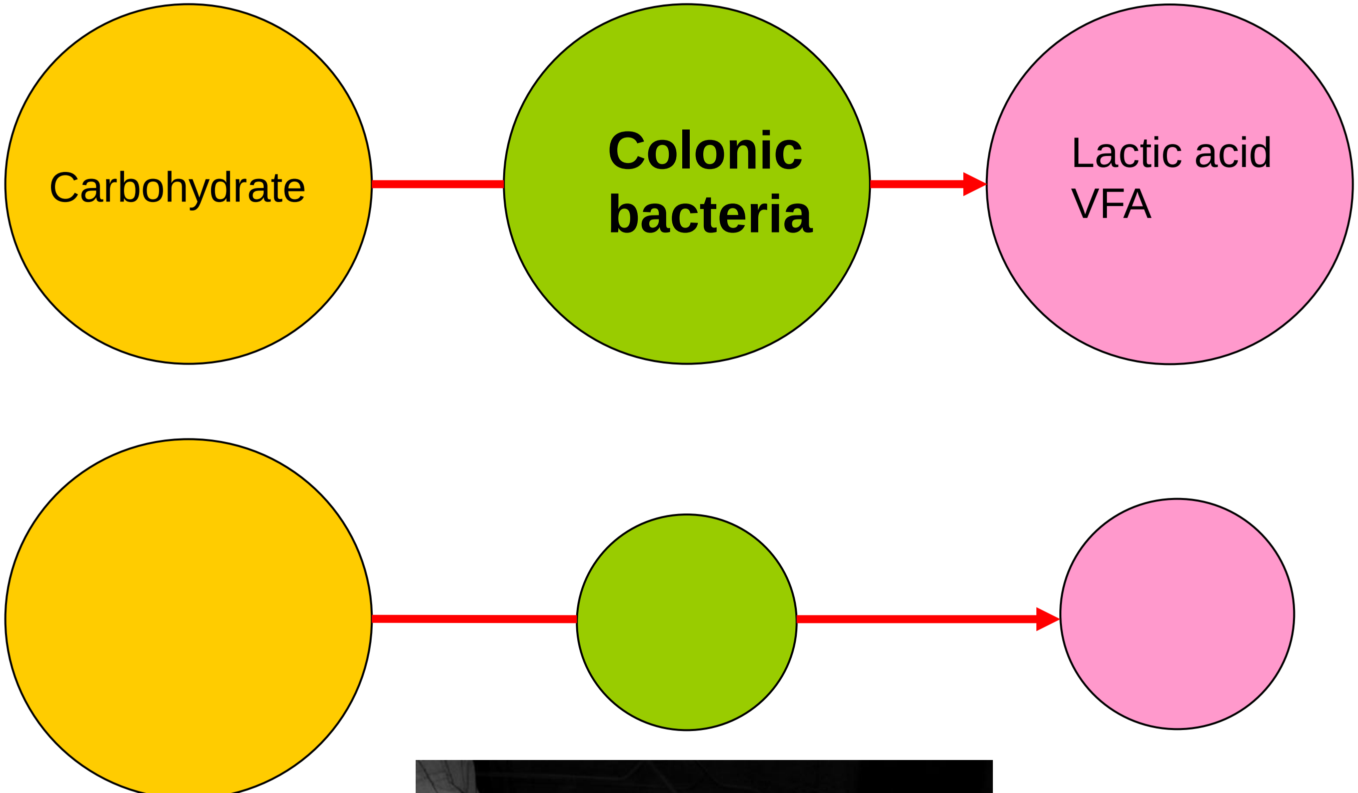


Osmotic effect



Effect on absorption
-Water
-Electrolytes

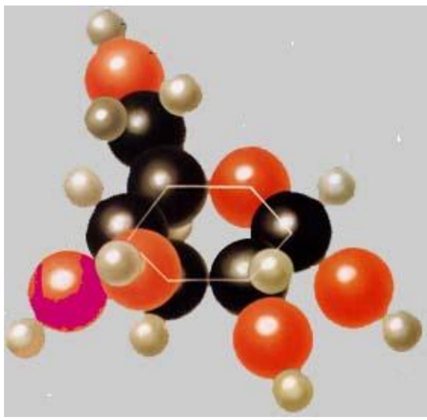
*Short Chains Fatty Acids: acetate, butyrate, propionate


Carbohydrate
Colonic bacteria
Lactic acid
VFA

H_{o1} Colonic pathophysiology

Antibiotics

Carbohydrate



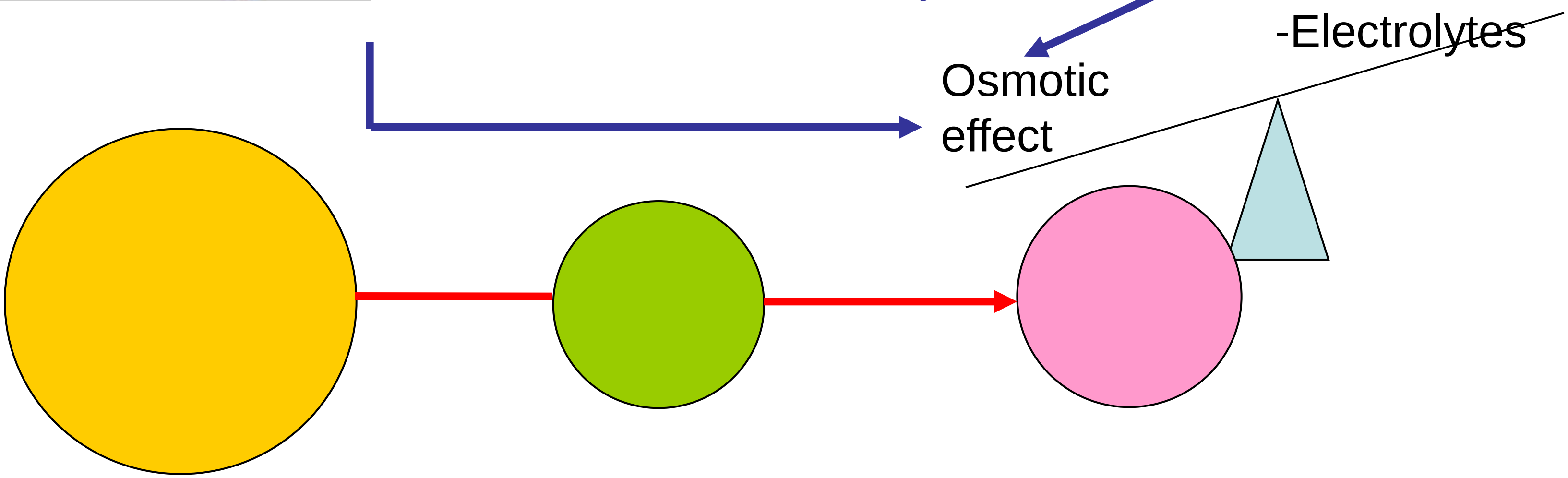
Colonic bacteria

Lactic acid and SCFA*

Less energy
for colonocytes

Less absoprtion
-Water
-Electrolytes

Osmotic
effect



*Short Chains Fatty Acids: acetate, butyrate, propionate

H_o Hypothesis AAD « Antibiotic Associated Diarrhea »

Direct effect of Ab on the gut

Alteration of the ecosystem

Alteration of digestive processes by colonic bacteria (carbohydrate fermentation and modification of biliary acids metabolism)

Proliferation of pathogens

Functional Diarrhea

Gut infection

Producer and the « Too Well Done Job Syndrome »

- Anxiety
- Hyper-intervention:
  - Zootechnical (cross-fostering
  - Medical (systematic antibiotics …)

Producer and the « Too Well Done Job Syndrome »

- Anxiety
- Hyper-intervention:
  - <u>Zootechnical</u> (cross-fostering
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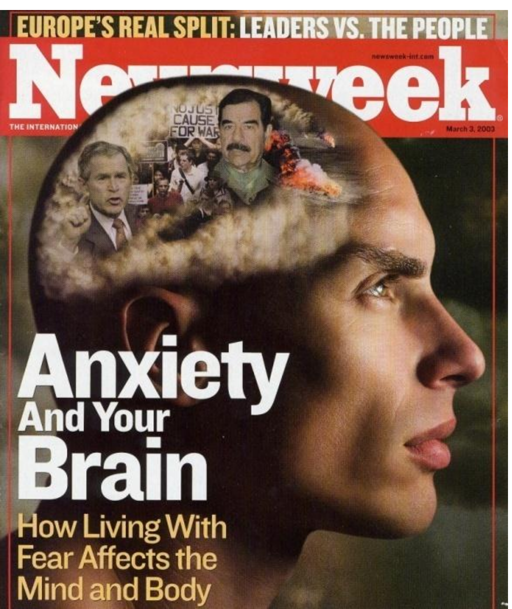
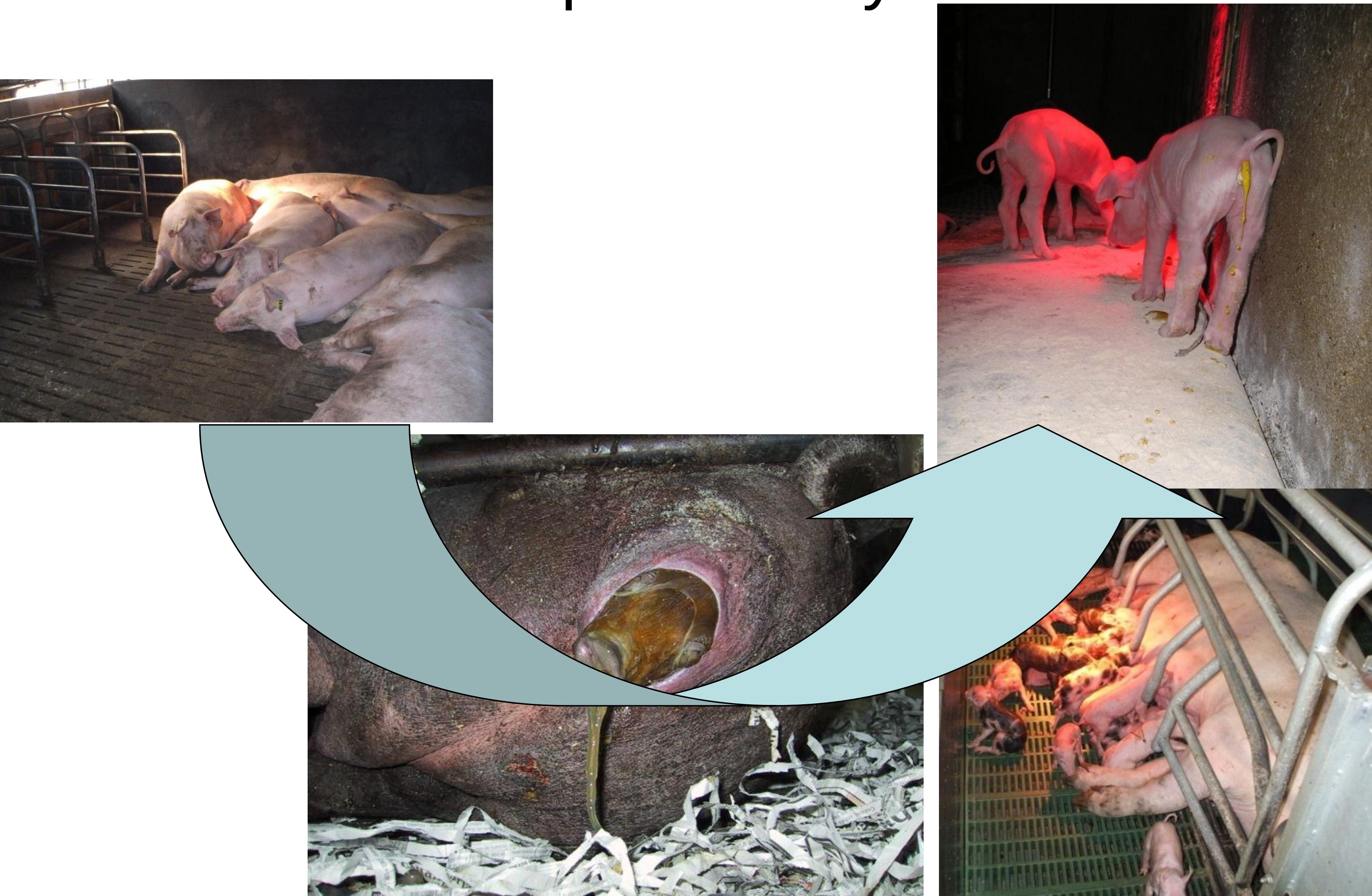


Act 1 & 2 & 3: preliminary conclusion



Effects of nutrient supply, plasma metabolites, and nutritional status of sows during transition on performance in the next lactation[1]

A. V. Hansen, C. Lauridsen, M. T. Sørensen, K. E. Bach Knudsen, and P. K. Theil[2]

Department of Animal Science, Faculty of Science and Technology, Aarhus University, DK-8830 Tjele, Denmark

ABSTRACT: The aim of the present study was to evaluate the effects of nutrient supply, plasma metabolites, and nutritional status of sows during the transition from gestation to lactation on performance of piglets during the colostral period and throughout lactation. Forty second-parity sows were fed 1 of 4 gestation diets containing a different quantity of dietary fiber (171 to 404 g/kg of DM) from mating until d 108 of gestation. From d 108 of gestation until weaning (d 28 of lactation), sows were fed 1 of 5 lactation diets with a different quantity of dietary fat [3 or 8% with different proportions of medium- (MCFA) and long-chain fatty acids (LCFA)]. Blood was obtained by jugular venipuncture on d 108 and 112 of gestation and on d 1 of lactation, and concentrations of plasma glucose, NEFA, lactate, acetate, propionate, butyrate, and fatty acids were analyzed. Piglet growth and mortality were noted throughout lactation. Piglet mortality during the colostral period (0 to 24 h) was affected by the lactation diets and was positively related to sow backfat (d 108) and plasma lactate (d 112) and negatively related to mean piglet birth weight ($P < 0.05$). Mean piglet live BW gain (LWG) was recorded in the periods 0 to 24 h, 7 to 10 d, 14 to 17 d, and 17 to 28 d relative to parturition as indirect measures of colostrum yield (0 to 24 h), milk yield in early lactation (d 7 to 10), and at peak lactation (d 14 to 17 and d 17 to 28). Effects of gestation and lactation diets on studied sow traits were tested on selected days during the transition period and the next lactation, and tested statistically on separate days. The LWG in the colostral period was positively correlated with mean piglet birth weight ($P < 0.001$), plasma concentrations of propionate and MCFA ($P < 0.05$), and plasma acetate and butyrate ($P < 0.1$) on d 1 of lactation. The LWG in early lactation was inversely correlated with plasma lactate on d 108 ($P < 0.05$), plasma glucose on d 112, and backfat thickness on d 108 ($P < 0.10$). The LWG at peak lactation was positively correlated with MCFA intake of the sow on d 113 to 115 and backfat thickness on d 108 during the transition, and negatively correlated with intake of LCFA and ME intake on d 108 to 112 ($P < 0.05$). In conclusion, feeding and body condition of sows during the transition from gestation to lactation is important for neonatal piglet survival, lactation performance of sows, and piglet growth during the next lactation.

Key words: backfat thickness, colostrum, milk yield, periparturient period, suckling piglet

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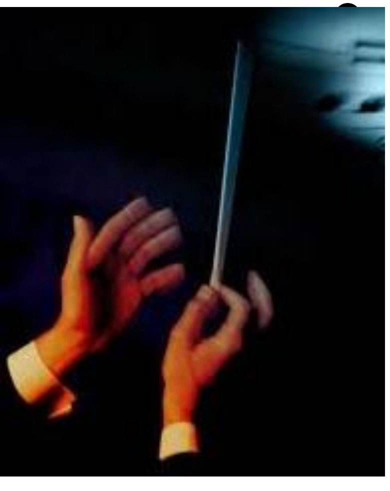
Key words: backfat thickness, colostrum, milk yield, periparturient period, suckling piglet

J. Animal Science 2012

Homeorhesis

- **Homeorhesis**, coordinated changes in metabolism of body tissues necessary to support physiological state



- There is a change of priorities between pregnancy (fetuses) and lactation (mammary glands)

18 Regulation of Nutrient Partitioning During Lactation: Homeostasis and Homeorhesis Revisited

D.E. BAUMAN

Department of Animal Science, Cornell University, Ithaca, New York, USA

Act 1 & 2 & 3: preliminary conclusion

Homeorhesis of gestation

Homeorhesis of lactation

Colostrum phase

Farrowing

Partitioning of Nutrients During Pregnancy and Lactation: A Review of Mechanisms Involving Homeostasis and Homeorhesis

DALE E. BAUMAN and W. BRUCE CURRIE
Department of Animal Science
Cornell University
Ithaca NY 14853

ABSTRACT

Control of metabolism during pregnancy and lactation involves two types of regulation—homeostasis and homeorhesis. Homeostatic control involves maintenance of physiological equilibrium or constancy of environmental conditions within the animal. Homeorhesis is the orchestrated or coordinated control in metabolism of body tissues necessary to support a physiological state. Regulation

OPEN ACCESS Freely available online

PLoS one

Intrauterine Growth Retarded Progeny of Pregnant Sows Fed High Protein:Low Carbohydrate Diet Is Related to Metabolic Energy Deficit

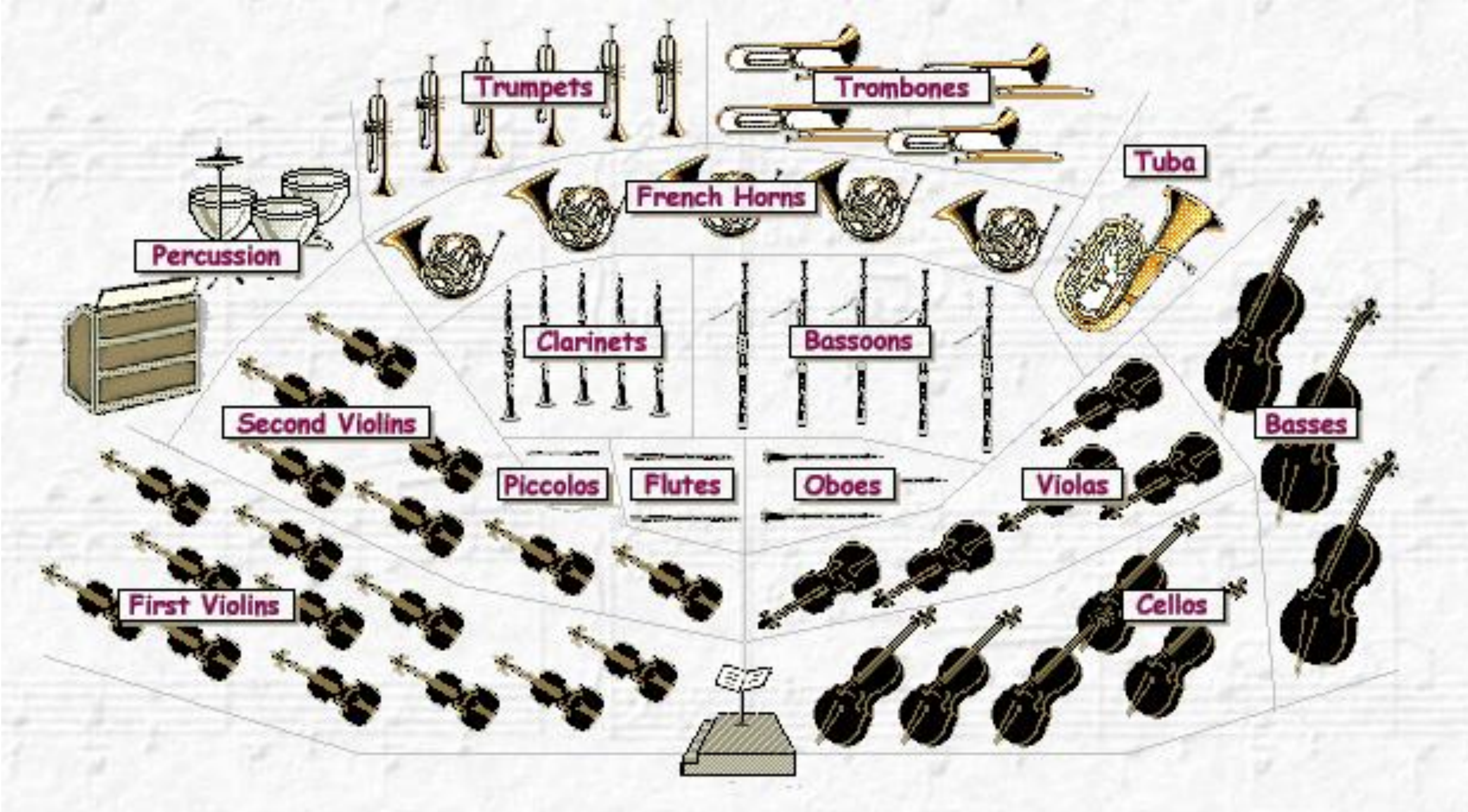
Cornelia C. Metges[1], Iris S. Lang[1], Ulf Hennig[1], Klaus-Peter Brüssow[2], Ellen Kanitz[3], Margret Tuchscherer[3], Falk Schneider[2], Joachim M. Weitzel[2], Anika Steinhoff-Ooster[4], Helga Sauerwein[4], Olaf Be

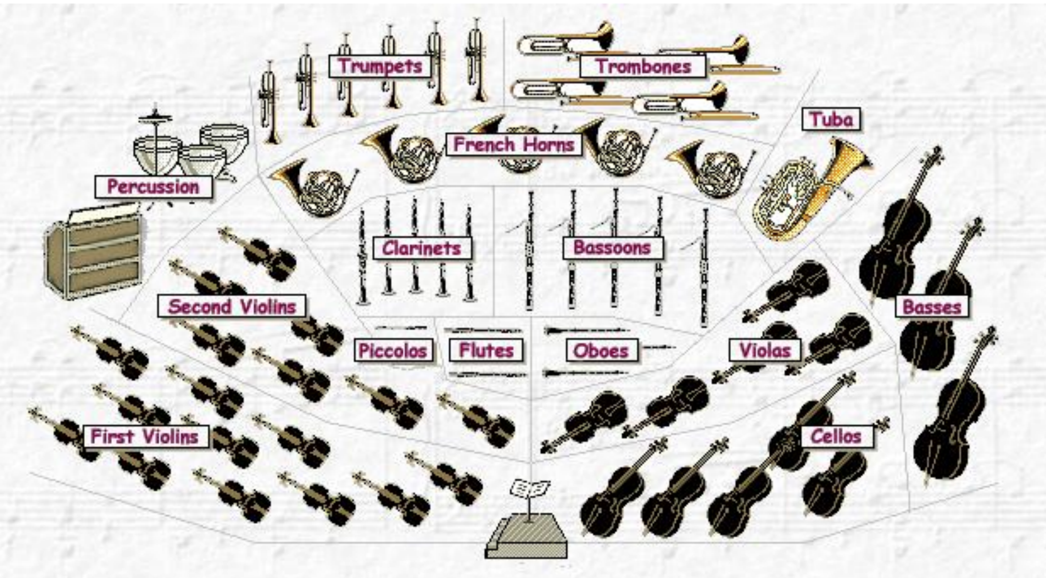
The superimposition of pregnancy on the increased nutritional requirements for the maintenance of maternal growth together with fetal growth can lead to maternal-fetal competition for nutrients as mentioned previously [1,2]. In addition, in immature gravid dams over- and undernourishment (i.e. food oversupply and food restriction) predisposes the still growing adolescent individuals to adverse pregnancy outcome [3]. We have recently developed a model of intrauterine growth restriction (IUGR) by modulating the dietary protein: carbohydrate ratio, i.e. high protein and low protein:carbohydrate ratios, in adolescent pregnant sows [4,5]. These diets cause reduced maternal body

and negatively with glucagon/insulin at 66 dpc, whereas in HP sows LW associated positively with NEFA. In conclusion, IUGR in sows fed high protein:low carbohydrate diet was probably due to glucose and energy deficit whereas in sows with low protein:high carbohydrate diet it was possibly a response to a deficit of indispensable amino acids which impaired lipoprotein metabolism and favored maternal lipid disposal.

Metges et al., 2012

INSTRUMENTS OF THE ORCHESTRA


Trumpets
Trombones
Tuba
French Horns
Percussion
Clarinets
Bassoons
Second Violins
Basses
Piccolos
Flutes
Oboes
Violas
First Violins
Cellos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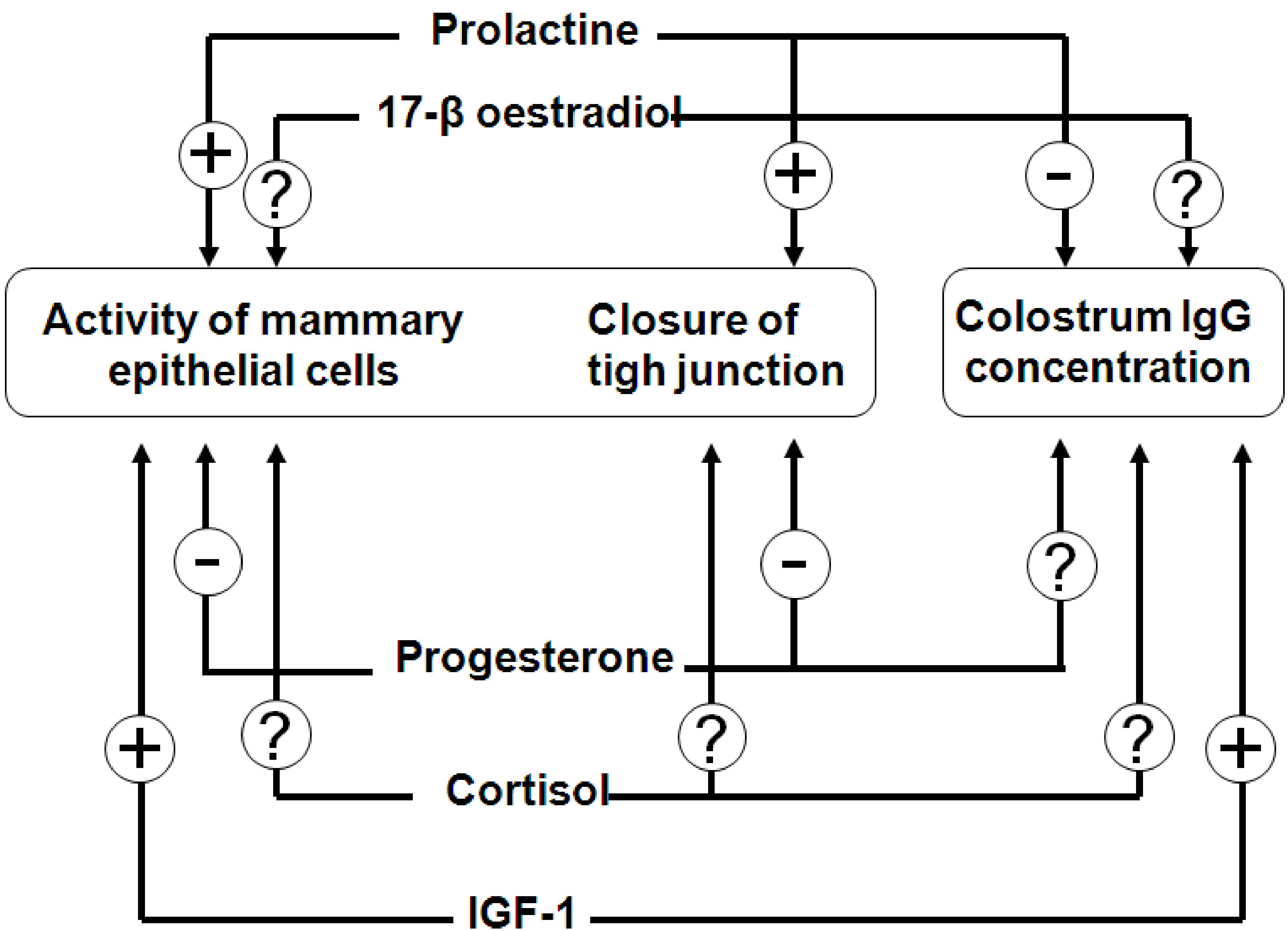
Bassoons
Second Violins
Basses
Piccolos
Flutes
Oboes
Violas
First Violins
Cellos

Homeorhesis of gestation

Homeorhesis of lactation

Colostrum phase

Farrowing



Prolactine
17-β oestradiol
+
?
+
-
?
Activity of mammary epithelial cells
Closure of tigh junction
Colostrum IgG concentration
-
-
?
Progesterone
+
?
?
?
+
Cortisol
IGF-1

Partial conclusion

- END are paradoxals
  - The best herds, the best producers,
  - Inflation of management measures… without results
  - frustrations (producers, vets, technicians, labs)
- END need to reconsider our paradigms on neonatal diarrhea
- END are linked with an event occuring before birth
- END are associated with different « opportunistic » bacterias

Act 4: On-farm investigation on “easy” farrowing and “difficult” farrowing sows

Cooperl Arc Atlantique

INRA

ifip

INP Toulouse ECOLE NATIONALE VETERINAIRE

farm'apro

SENAH

Act 4: On-farm investigation on “easy” farrowing and “difficult” farrowing sows

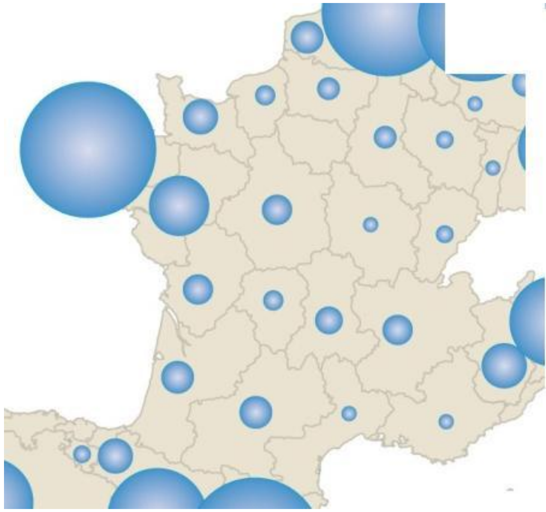
- Risk factors
  - Oliviero et al., 2009, 2010
  - Solignac et al., IPVS 2010
- Consequences on piglets
  - Vitality
  - Colostral intake
  - Enzootic Neonatal diarrhea (Gin et al., 2010, Sialelli et al., 2010)
  - Pre-weaning mortality
- Consequences on sows
  - PDS (Klopfenstein et al., 2006; Martineau et al., 2011; Maes et al., 2010; Papadopoulos et al., 2010)

Act 4: On-farm investigation on “easy” farrowing and “difficult” farrowing sows

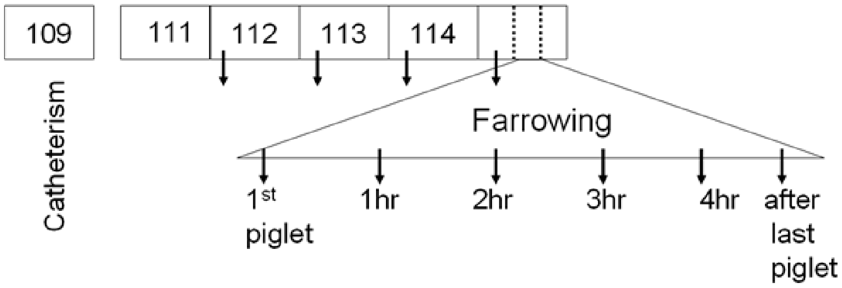
Objective

- In conventional & commercial herds affected by history of « difficult » farrowing, establish physiological, biochemical and hormonal follow-up in “easy” farrowing and “difficult” farrowing sows
- Give pathophysiological hypothesis proposal

Act 4: Localisation, Actors & Actions

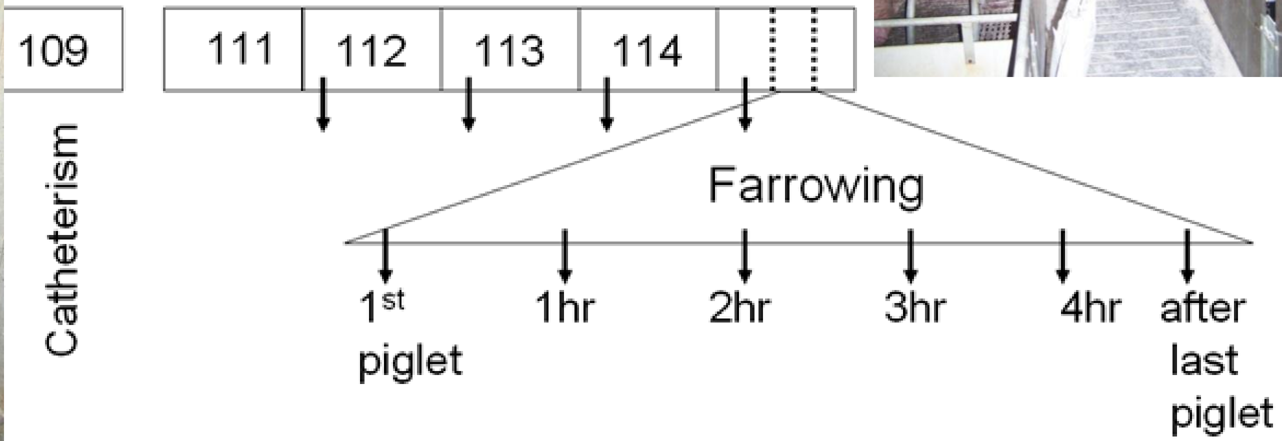


- 4 commercial herds (LW x LR)
  - Stillbirth > 1.2
  - History of difficult farrowing
  - Good management, no identification of classical major risk factors
- Young sows (19 P1 and 9 P2) in 5 batches
  - 28 sows
  - Catheterisation D109



Act 4: Localisation, Actors & Actions

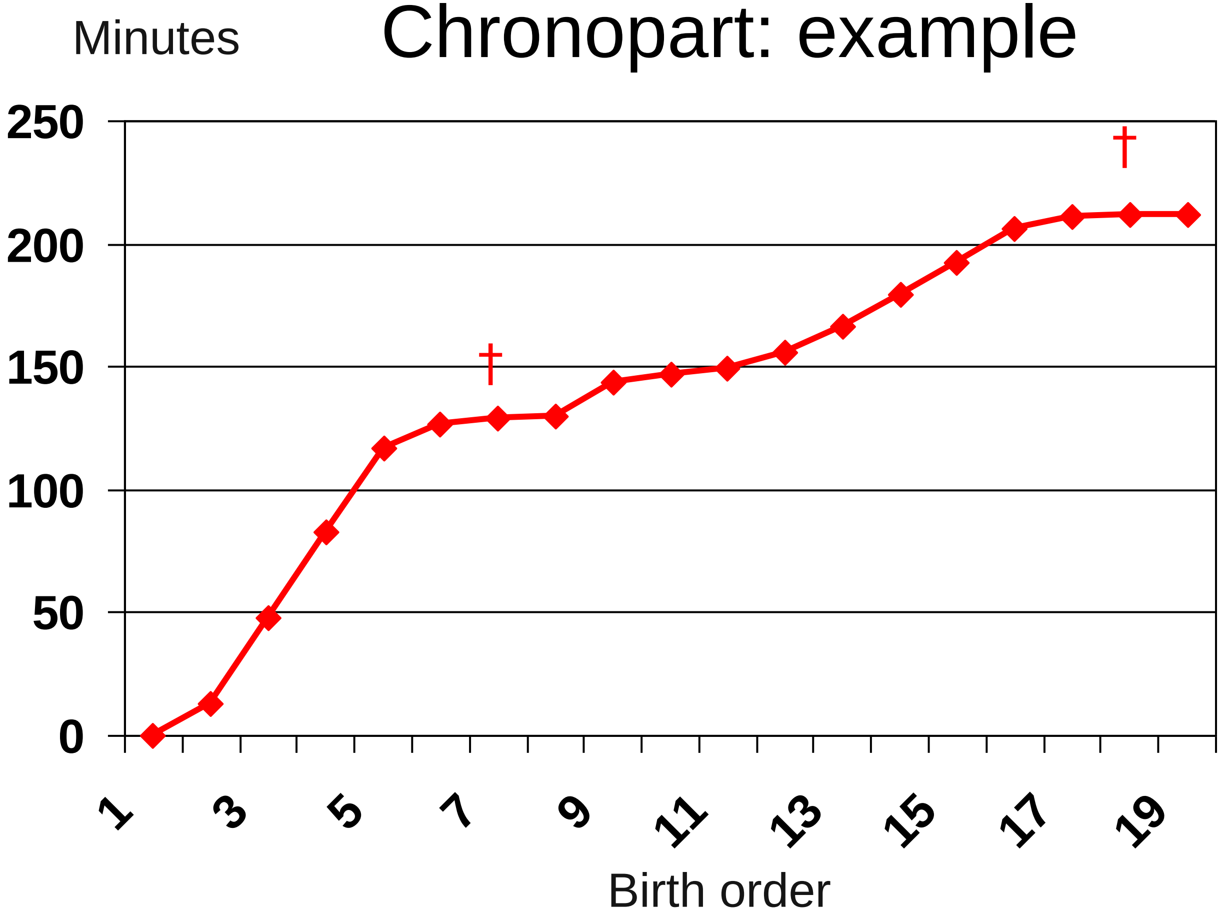
- Chronopart (natural farrowing)
  - Time, piglet's birth weight, identification, …
- Blood sample (until farrowing: fasted sows)



Act 4: Localisation, Actors & Actions

P	Time	Birth W	Live or dead		Sexe
1	14.58	1320	V		F
2	15.11	700	V		F
3	15.46	660	V		F
4	16.21	1200	V		F
5	16.55	970	V		F
6	17.05	1470	MN		M
7	17.07	640	V		M
8	17.08	830	V		M
9	17.22	1510	V		F
10	17.25	920	V		F
11	17.27	1100	V		F
12	17.35	960	V		M
13	17.45	1640	V		M
14	17.58	1690	V		M
15	18.11	1560	V		M
16	19.25	710	V		F
17	19.30	1580	V		M
18	19.31	20 CM	Mo		
19	19.31	1270	V		M

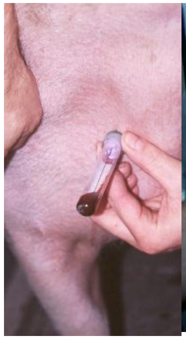
Chronopart: example



Act 4: Localisation, Actors & Actions

- Dosages
  - On-farm : Hemoglobine (Hb), Hematocrite (Ht)
  - On frozen whole blood
    - Estradiol (E2), Progesterone (P4)
    - Total proteines (Prot), Glucose (Glu), NEFA
    - Lactate (Lact), Bicarbonates (HCO_3)
    - Calcium (Ca), Magnesium (Mg)
    - Creatine Phosphokinase (CK)



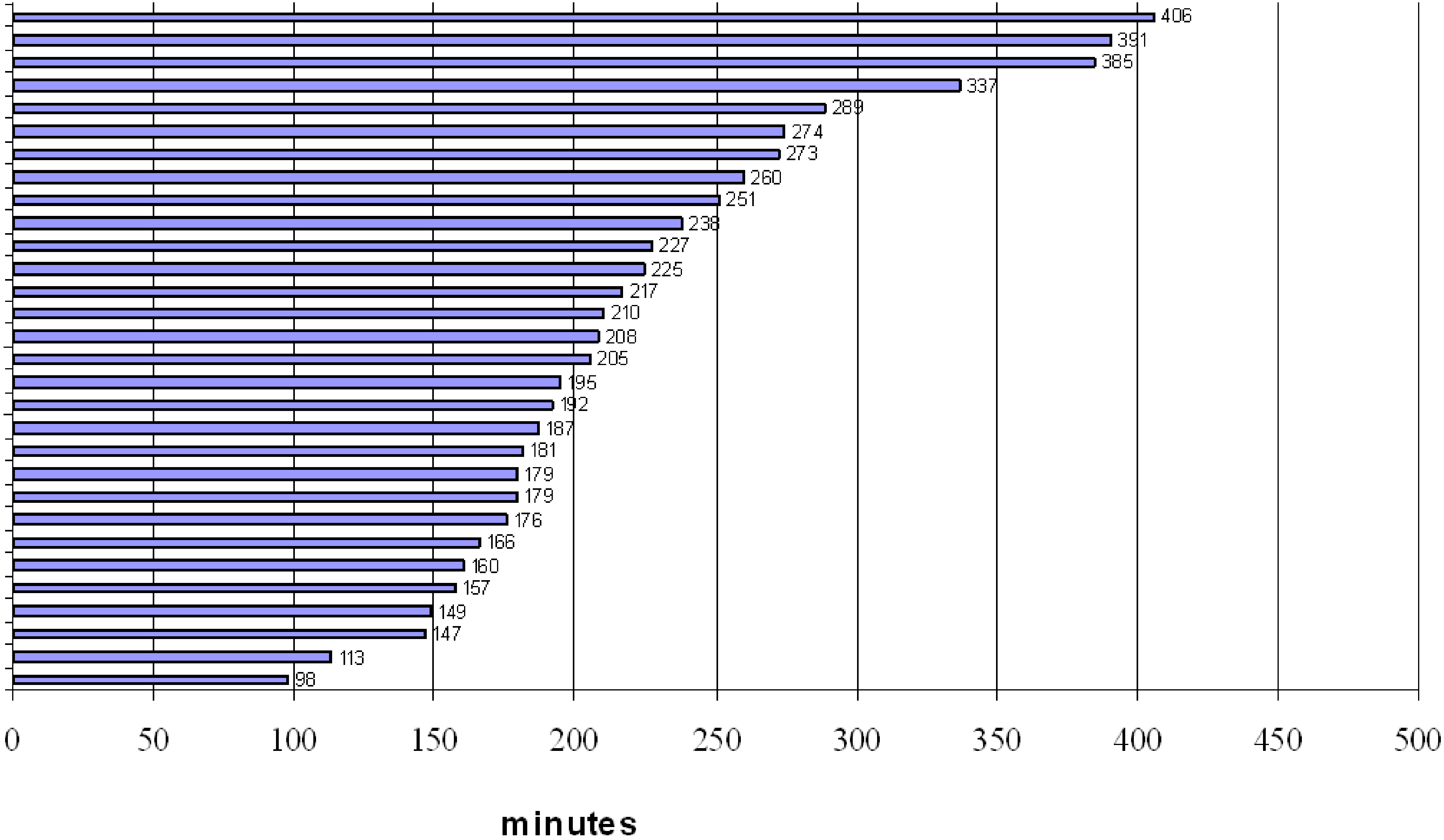




Definition of difficult farrowings

- Three criterias
  - Chronopart (C)
  - Intrapartum stillborn (SB)
  - Hand manipulation (HM)
- Classification
  - Easy farrowing
    - Chronopart: C<3 hrs
    - Chronopart: 3 hrs<C<4 hrs **without** HM and SB
  - Difficult farrowing
    - Chronopart: C>4 hrs
    - Chronopart: 3 hrs<C<4 hrs **with** HM and/or SB

Act 4: Major results



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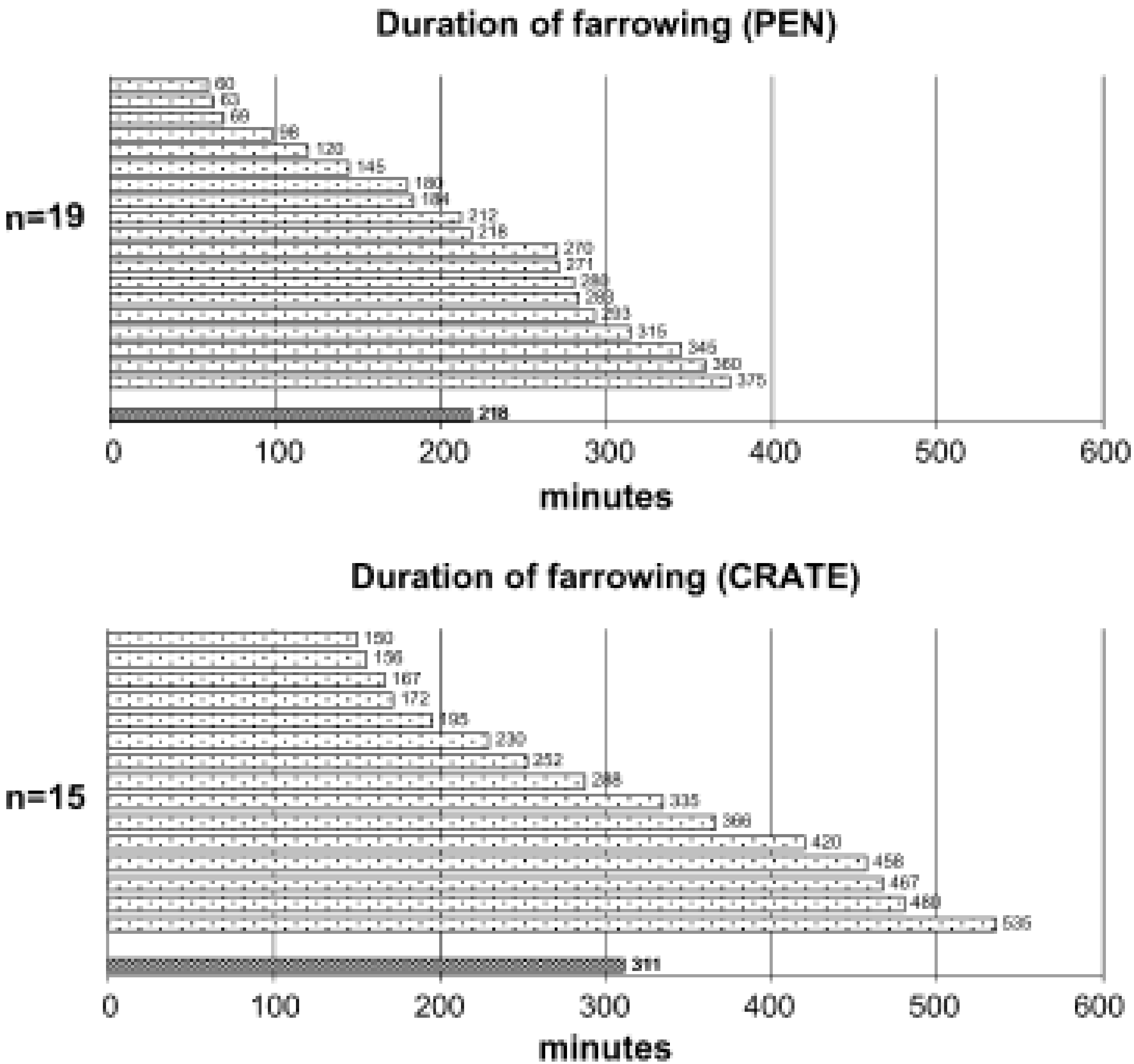
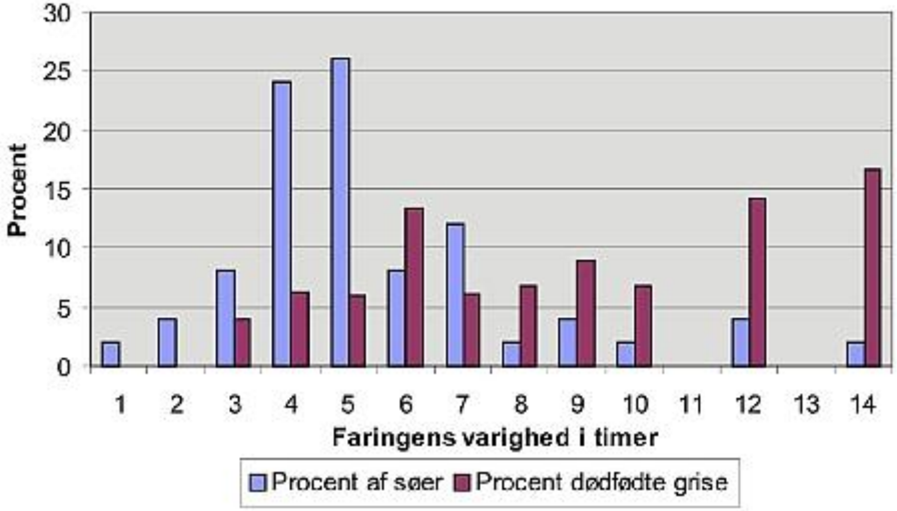
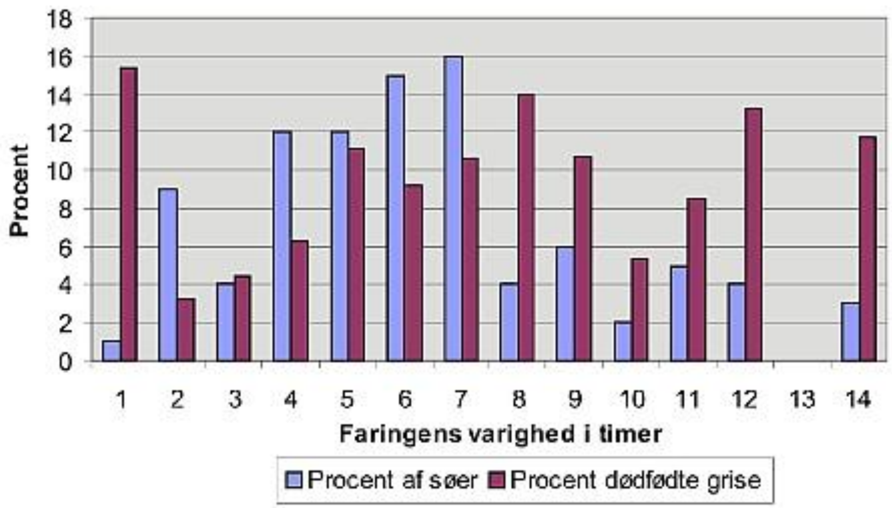

Duration of farrowing (PEN)
n=19
60
63
69
98
120
145
180
184
212
218
270
271
293
315
345
360
375
218
0
100
200
300
400
500
600
minutes
Duration of farrowing (CRATE)
n=15
150
156
167
172
195
230
252
288
335
366
420
458
467
480
535
311
0
100
200
300
400
500
600
minutes

P1 and P2 sows: In blue: Duration of farrowings In Red: Stillborn



>P2 sows: In blue: Duration of farrowings In Red: Stillborn

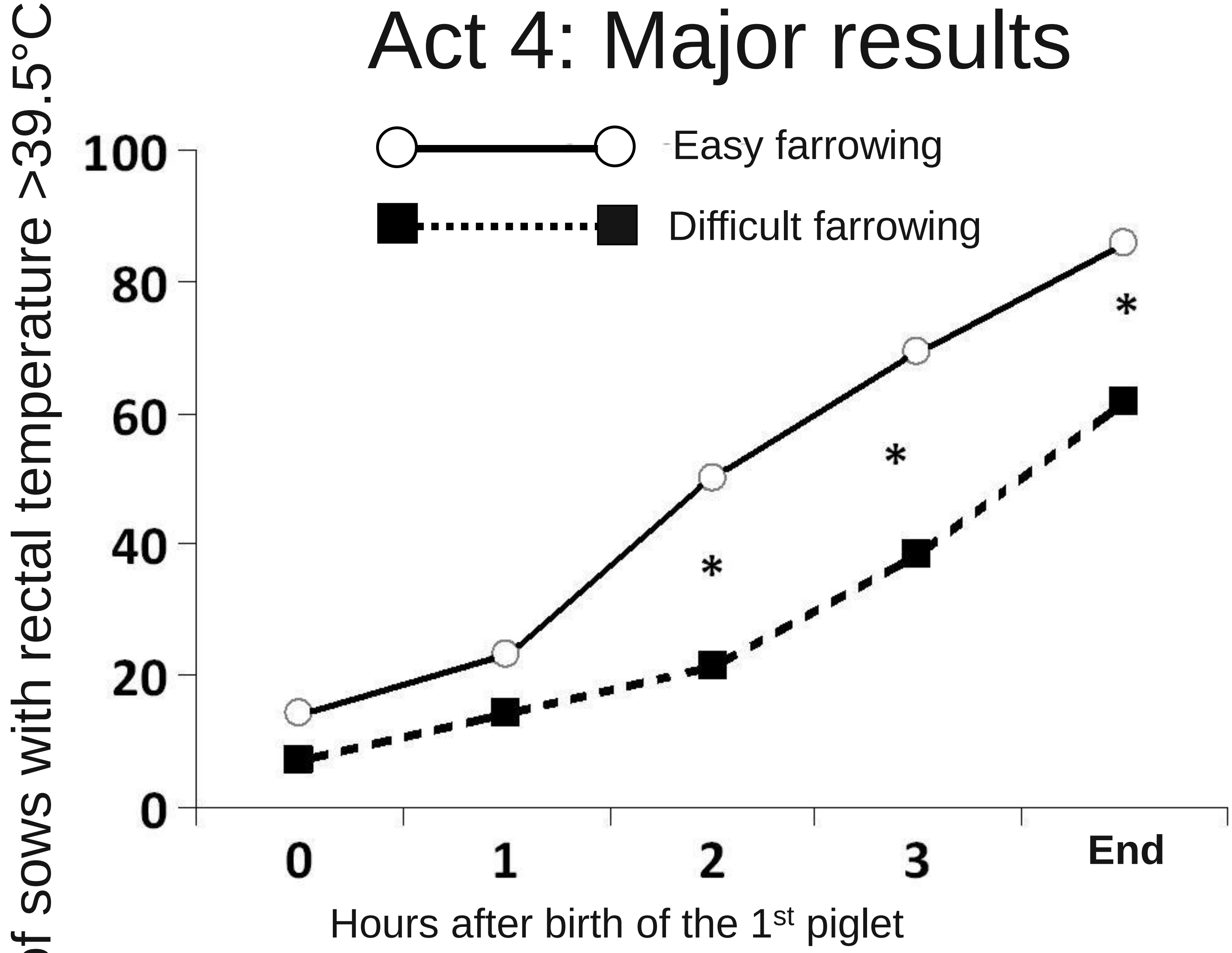


Act 4: Major results

Act 4: Major results

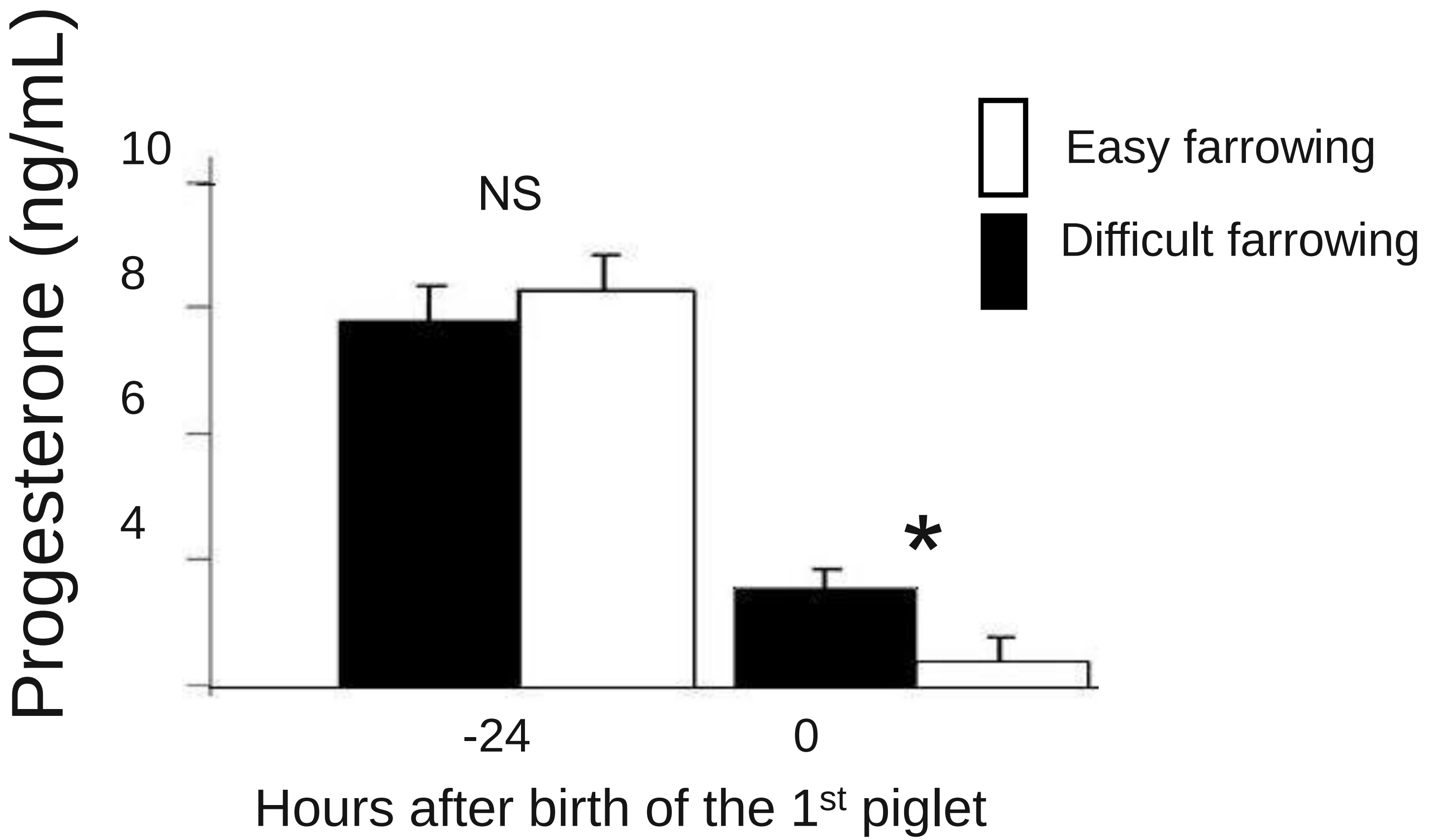
Table 1: data set	Easy farrowing	Difficult farrowing	P*
Number of sows (and P1)	14 (9)	14 (9)	NS
Sow's weight (kg)	226.8	228.8	NS
Back fat (mm)	17.9	18.2	NS
Gestation length (d)	113.9	113.9	NS
Total born	14.1	15.3	NS
Live born	13.8	13.9	NS
Farrowing (min)	173.2	297.0	<0.01
Total litter weight (kg)	16.78	20.11	<0.05
% piglets >1.6 kg BW	12	24.7	NS
% piglets <1.25 kg BW	57.4	46.7	<0.01

Act 4: Major results

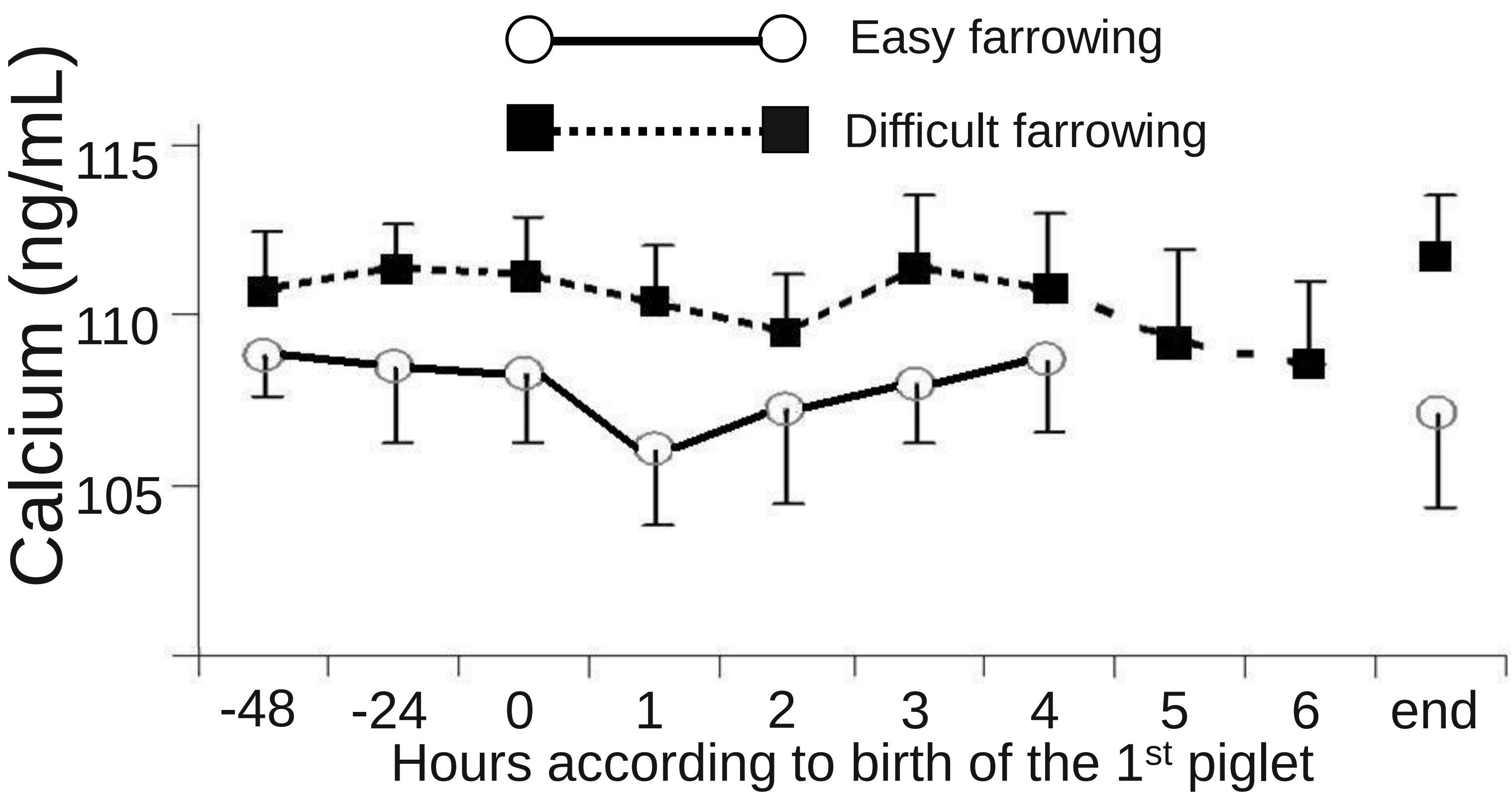


The same in cattle (Kornmatitsuk et al., 2004)
Higher metabolism ?
Higher efficacy of uterine contraction ?

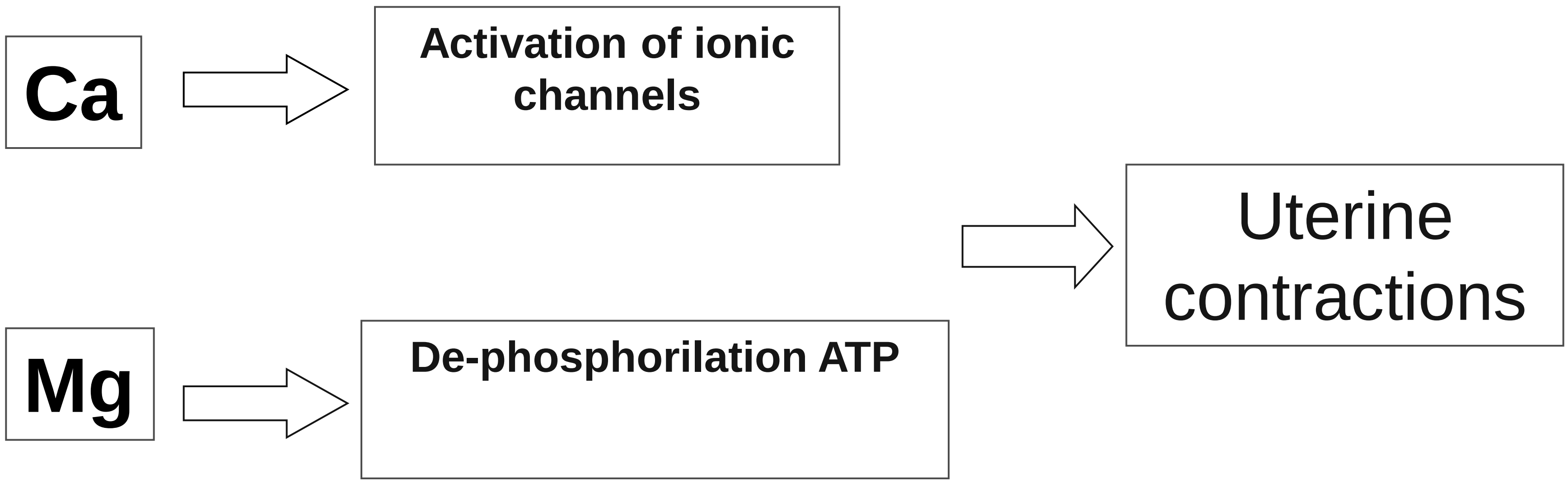
Act 4: Major results



Act 4: Major results



Difficult farrowing and bad utilisation of Calcium and Magnesium ?

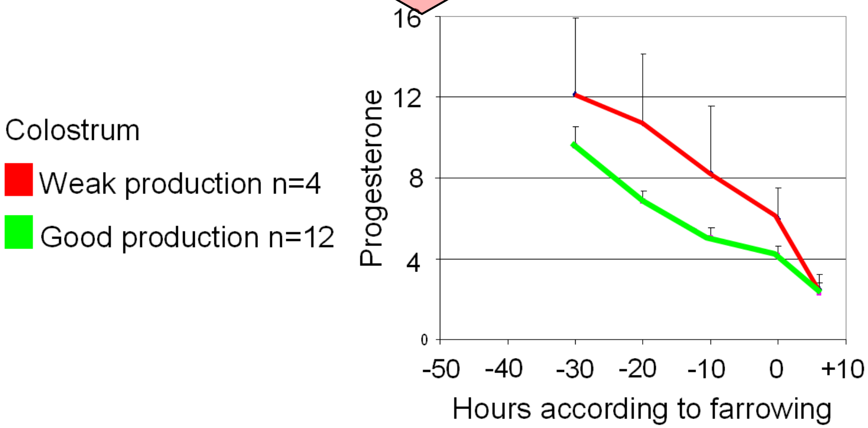


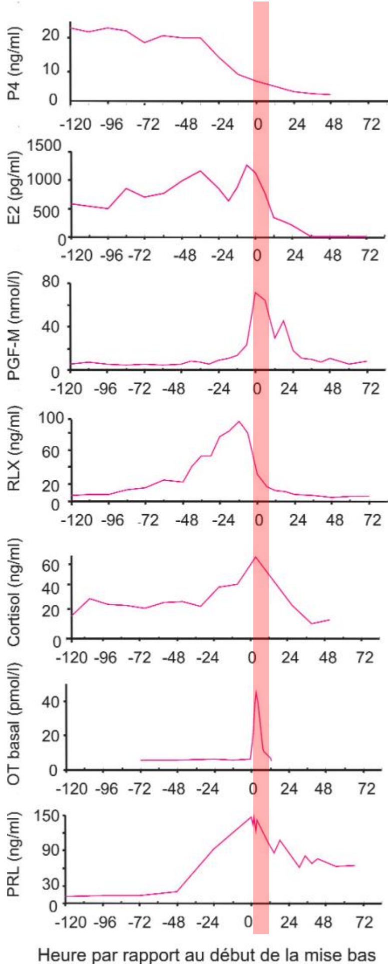
« Easy farrowing »: High Ca & Mg uptake by myometrium

« Difficult farrowing »: Default of Ca & Mg uptake by myometrium

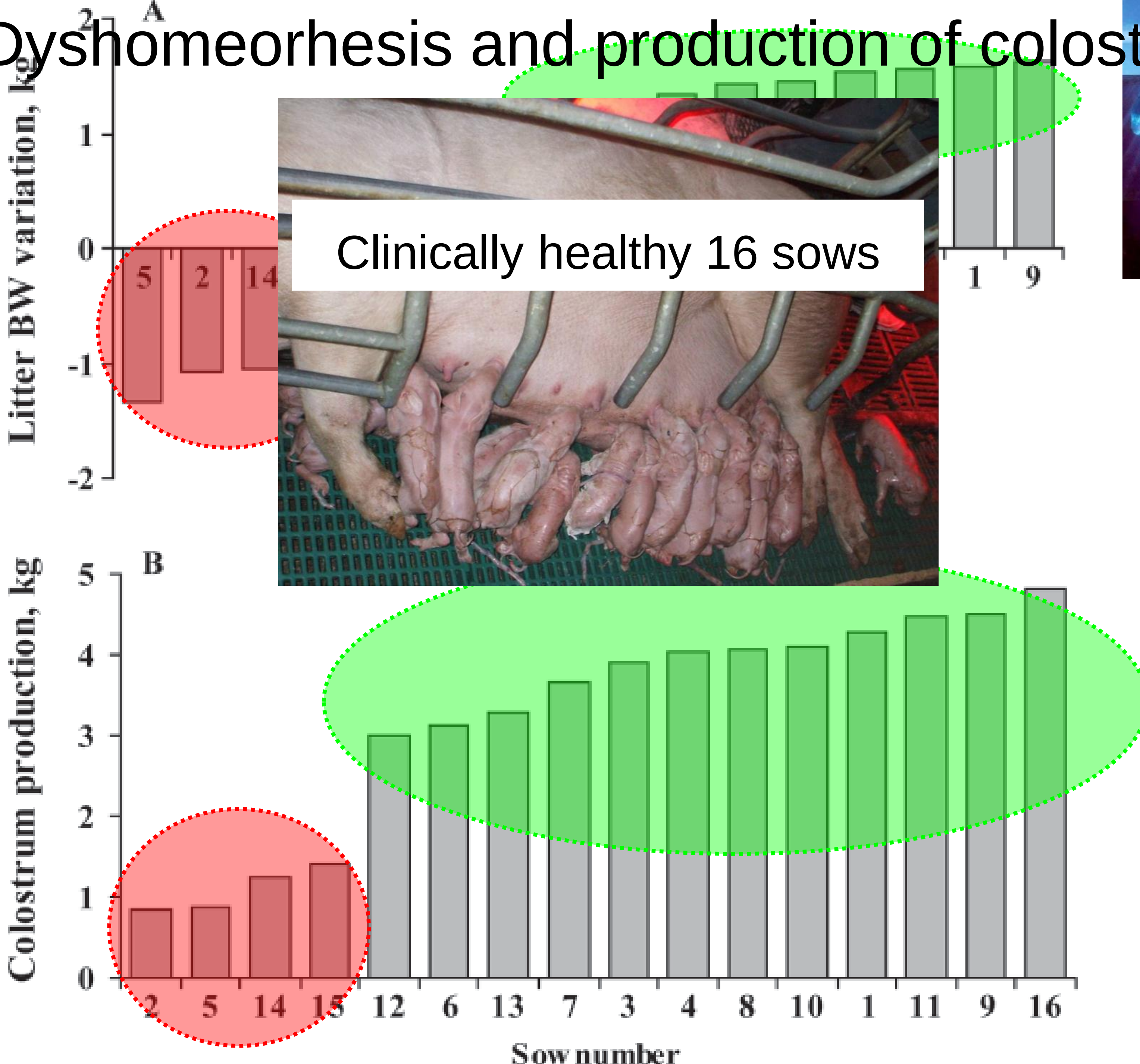
Preliminary conclusions of Act 4 (1/2)

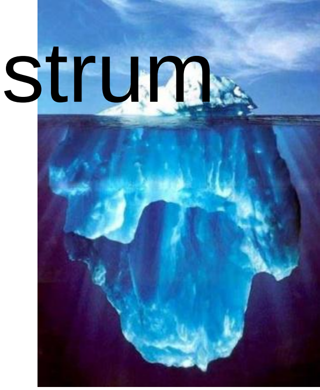
- Difficult farrowing
  - Early (pre-partum) dys-homeorhesis
    - Hormonal (Foisnet et al., 2009, 2010)
    - Biochemical (Ca, Mg, CK)
  - Poor efficacy of myometrium



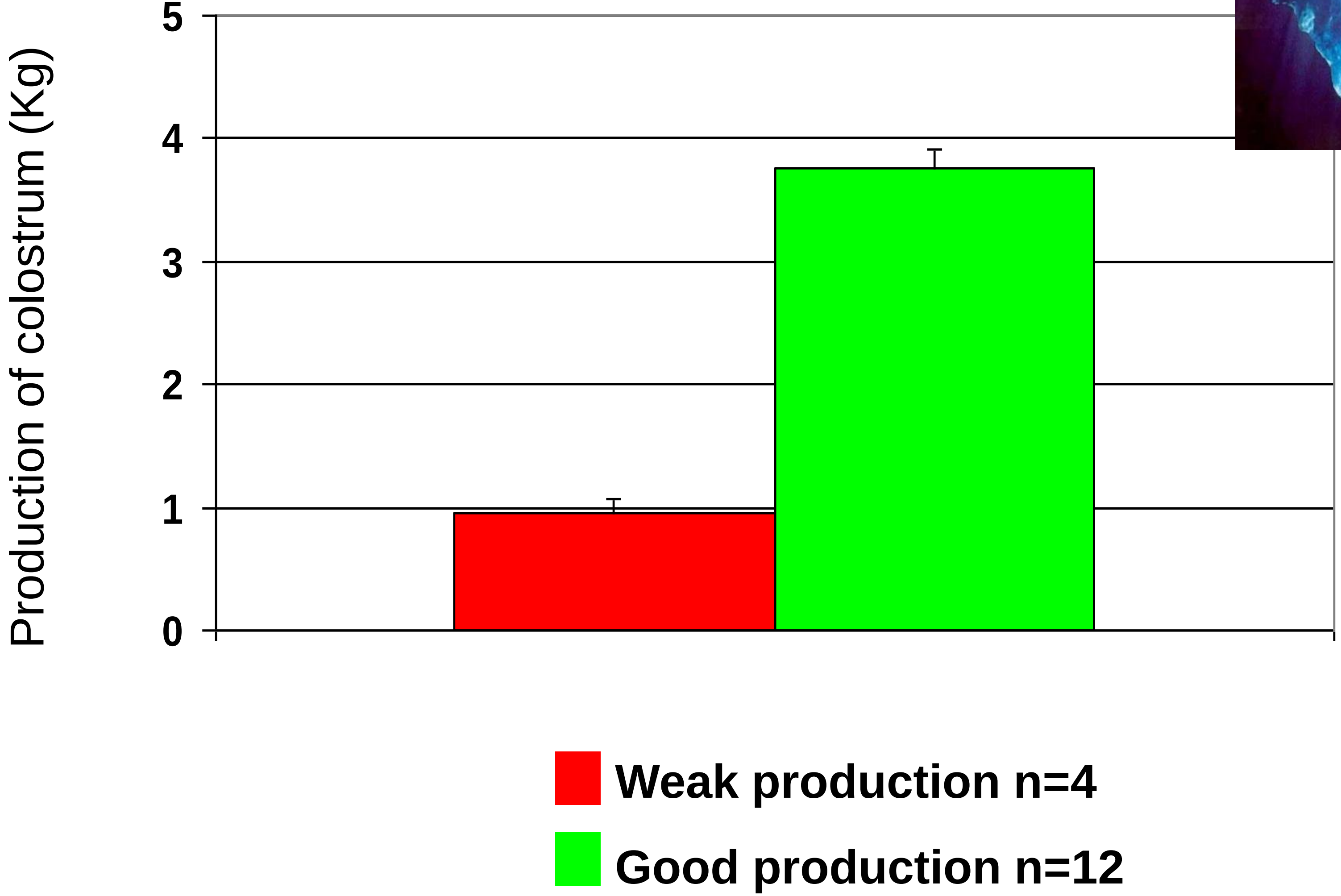


Dyshomeorhesis and production of colostrum





Dyshomeorhesis and production of colostrum

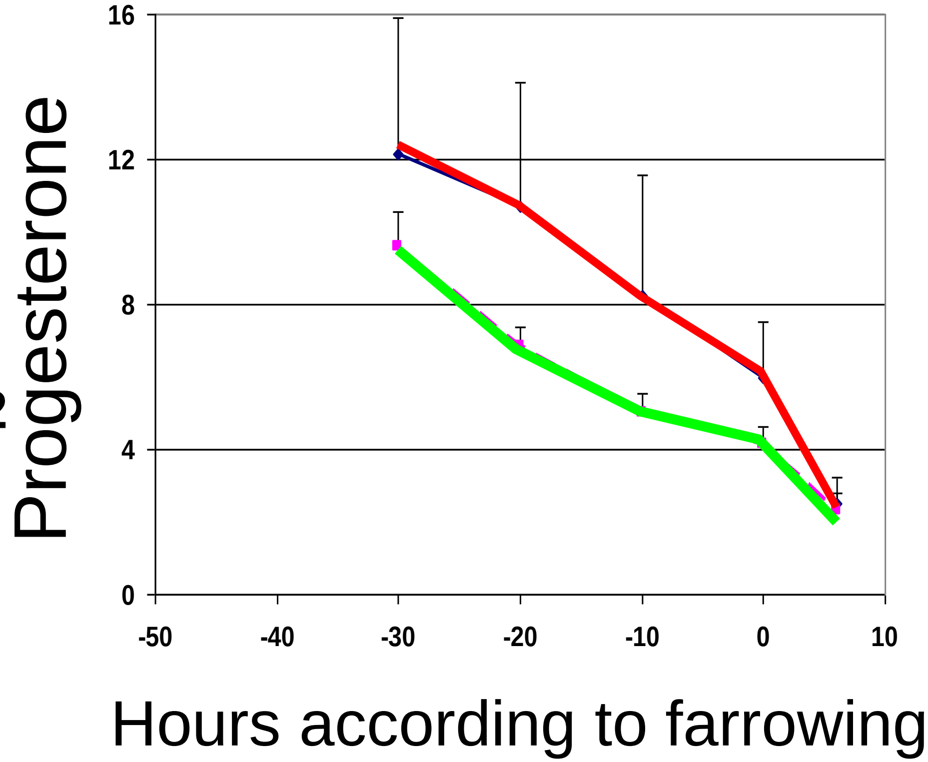


Foisnet, 2010

Dyshomeorhesis and production of colostrum

Weak production n=4

Good production n=12



In ewe:
high P4 => ▼ lactose synthesis
Lactose: High osmotic power
Low lactose: ▼ colostrum volume

Preliminary conclusions of Act 4 (2/2)

- Predictors of difficult farrowing
  - Early predictors: E2/P4, P4, Prot, Ca, Mg
  - Late predictors (post-partum): Lact, NEFA, Proteins
- Prevention of difficult farrowing
  - Ca & Mg myometrial metabolism (intake vs uptake)
  - Pre-partum catabolism (Solignac et al., IPVS 2010)

Act 5: The over-muscled sow syndrome : a new emerging syndrome in a hyperprolific sow herds

Preliminary observations on farrowing duration

Triskalia
la terre, les hommes, la vie.

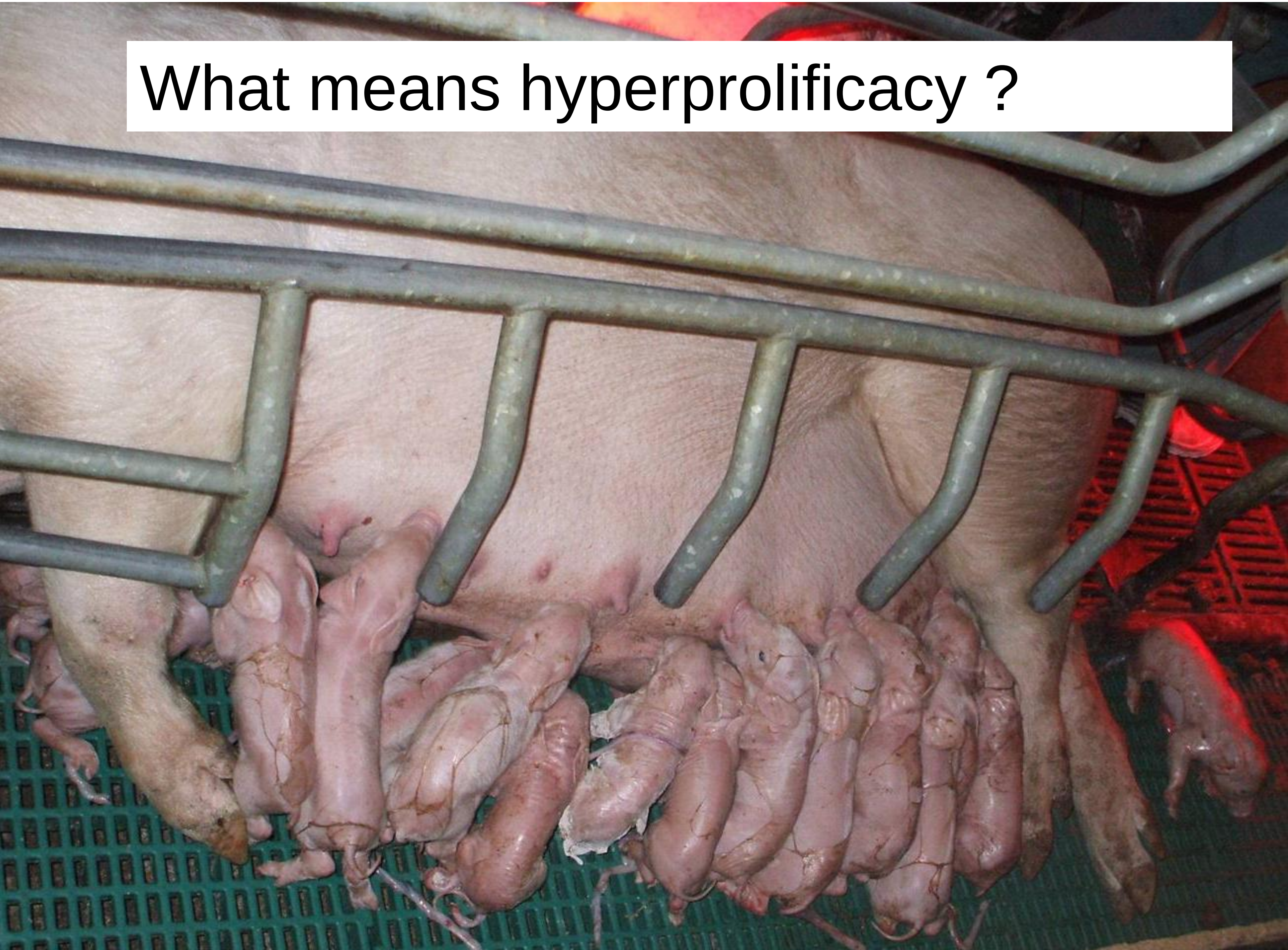
INP TOULOUSE
ECOLE NATIONALE VETERINAIRE

Act 5: The over-muscled sow syndrome : a new emerging syndrome in a hyperprolific sow herds

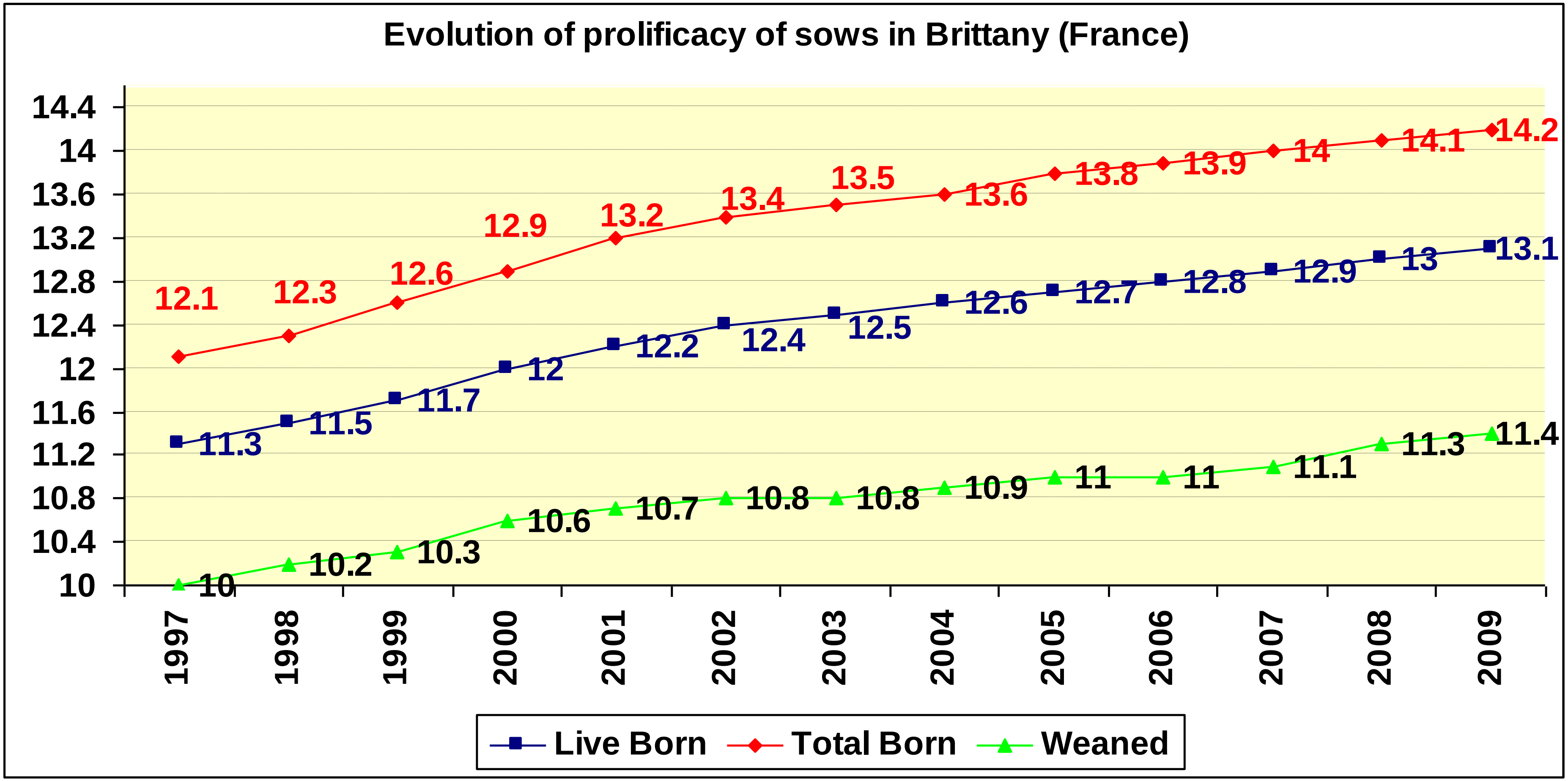
Preliminary observations on farrowing duration

- Many factors can affect duration of farrowing such as breed, litter size, parity, body condition and housing (Farmer and Robert, 2002, Oliveiro et al., 2008, Sialelli et al., 2010).
- Fat or thin sows ?
  - Fat sows are classically reported having long farrowing but the correlation is not very high (Oliviero et al., 2009).
  - Thin sows have also difficult farrowing (Vanderhaeghe, 2010)
- “Over-muscled sow syndrome”emerges as a consequence of the combination of the selection for deposition of lean meat and hyperprolificacy.

What means hyperprolificacy ?



What means hyperprolificacy ?



A continuous progress of the performances but a new deal for each step;
Why ? The genetic potential increase but the sows change too

Recognizing the characteristics of our new dam lines

George Foxcroft[1,2], Eduardo Beltranena[2], Jenny Patterson[2], Noel Williams[3]

...rategies for the breeding sow herd must ...ognize the changes in lean growth per-

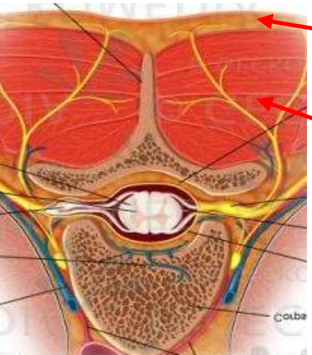
Foxcroft, G.R. 2002. Fine Tuning the Breeding Program. *Saskatchewan Pork Industry Symposium 2002*. Saskatoon,

Accepting the risk of being considered some what heretical, most of our recent experiments with the lactating and weaned sow lead to the conclusion "that from a fertility and prolificacy perspective, fatness is simply not the key risk factor"

In contrast, lean tissue mass is a key consideration for correct management of the gilt, and the lactating and weaned sow, and the experimental evidence to support this contention has been clearly established


18th
Century
1900
1950
1970
1980
1990
2006

The level of Back Fat (BF) is not enough to appreciate the body condition



Back Fat = 21 mm

Back Lean = 51,4 mm

Back Fat = 20 mm

Back Lean = 55,3 mm

The level of BF or BL is not enough to appreciate the body condition («small » or « large » sow)

Sow # 1

Parity 4

BF = 14.6

BL = 33.5

Sow # 2

Parity 4

BF = 19.6

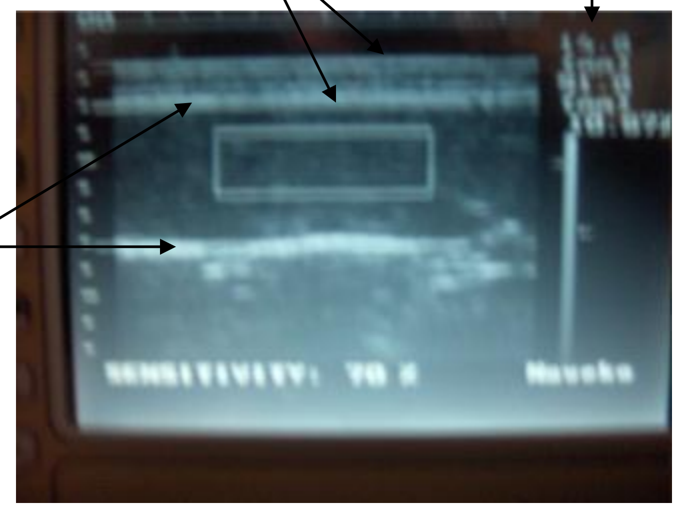
BL = 47.8

Which is the best sow (For a productivity,economical,longevity,labor comfort …point of view) ? Is the sow #1 in a worst body condition than the sow # 2 ?

Mesure of BF and BL : P2 Position

(Noveko AC037L,3.5 MHtz)

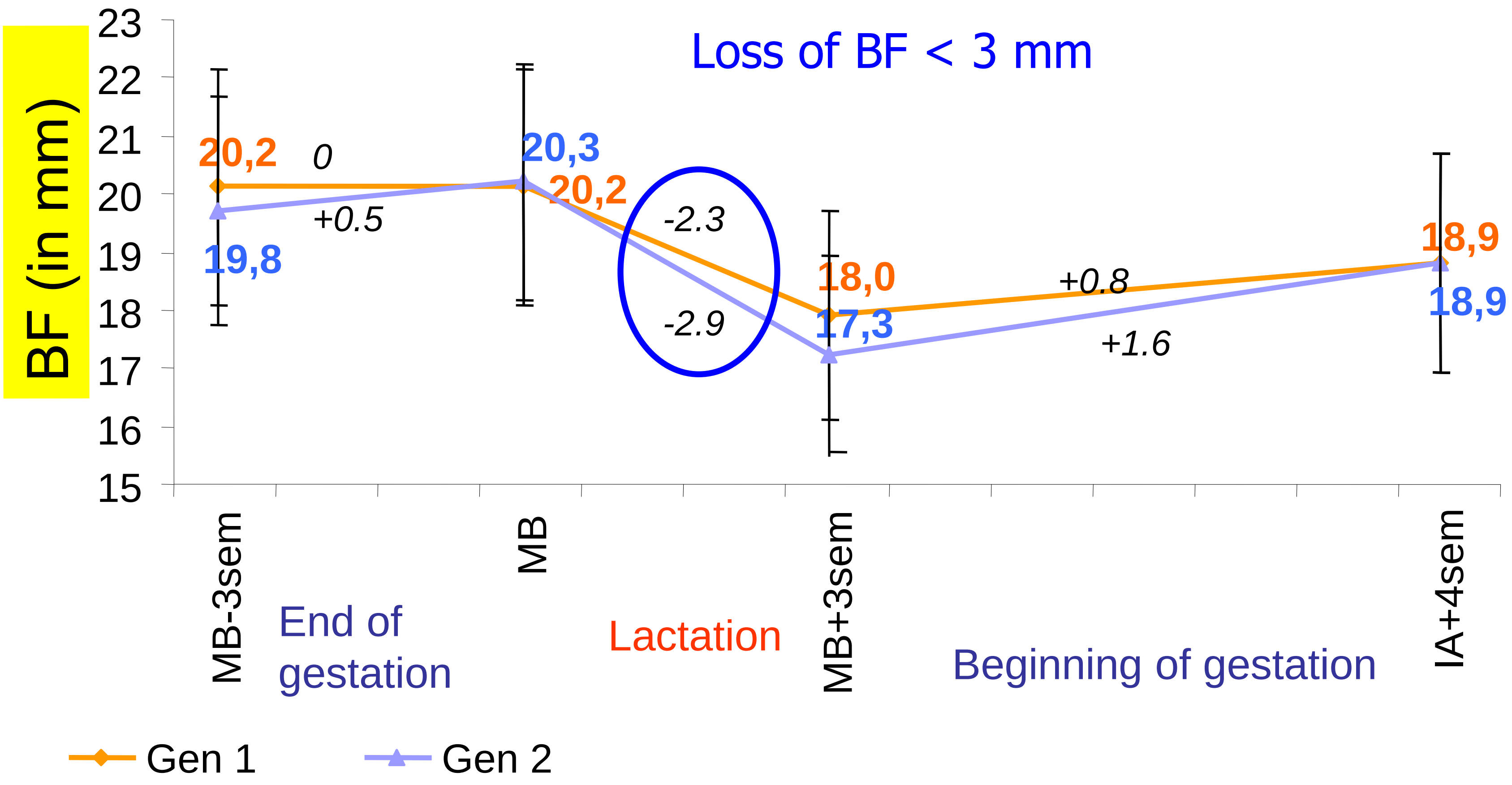
Back Fat = 14,0 mm



Back Lean = 51,0 mm

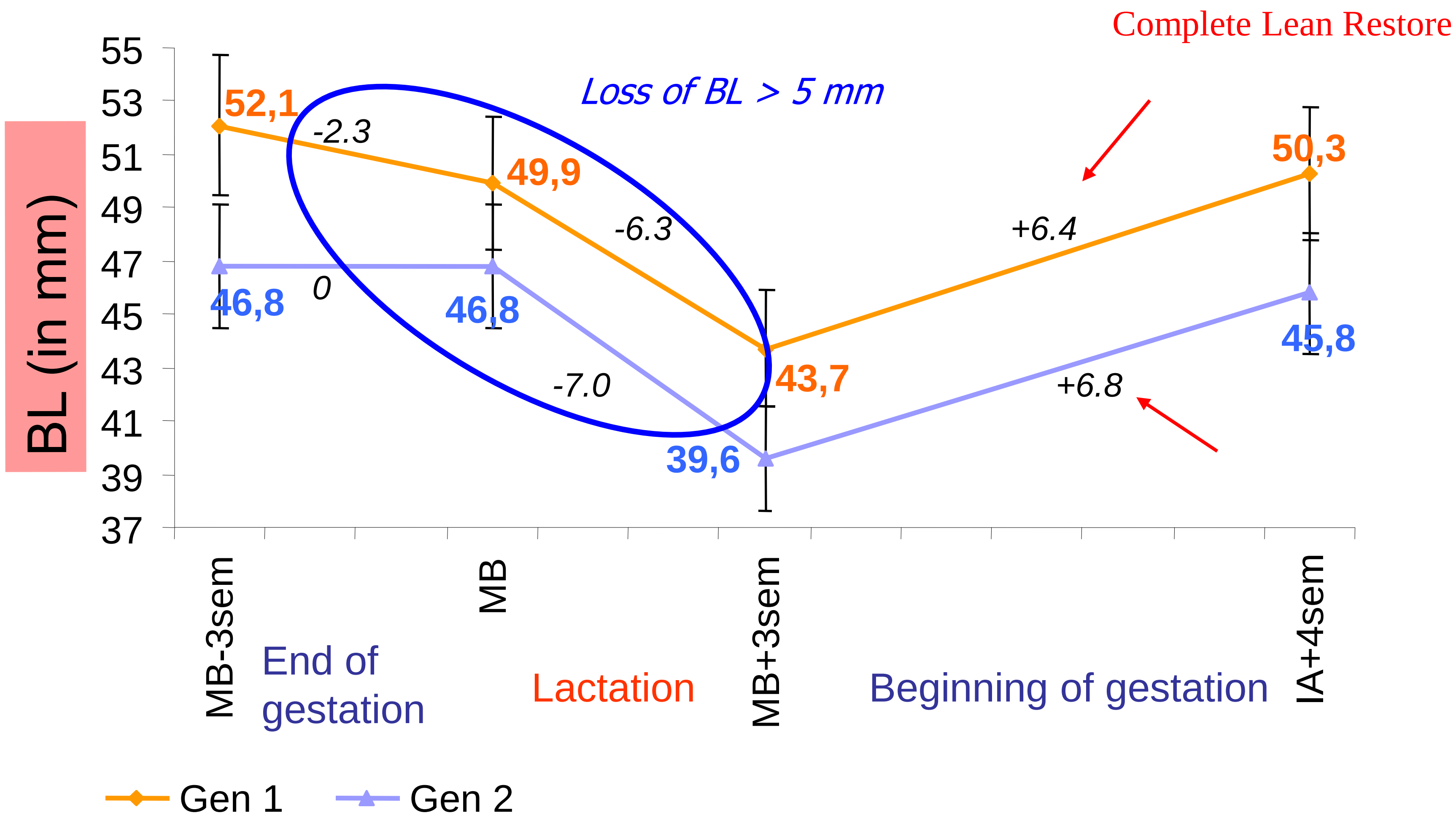
Genetic 1 vs Genetic 2

- Evolution of BF : no differencies

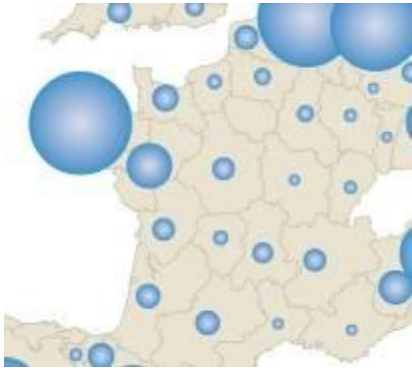


Genetic 1 vs Genetic 2

- Evolution of BL : differences between genetic lines



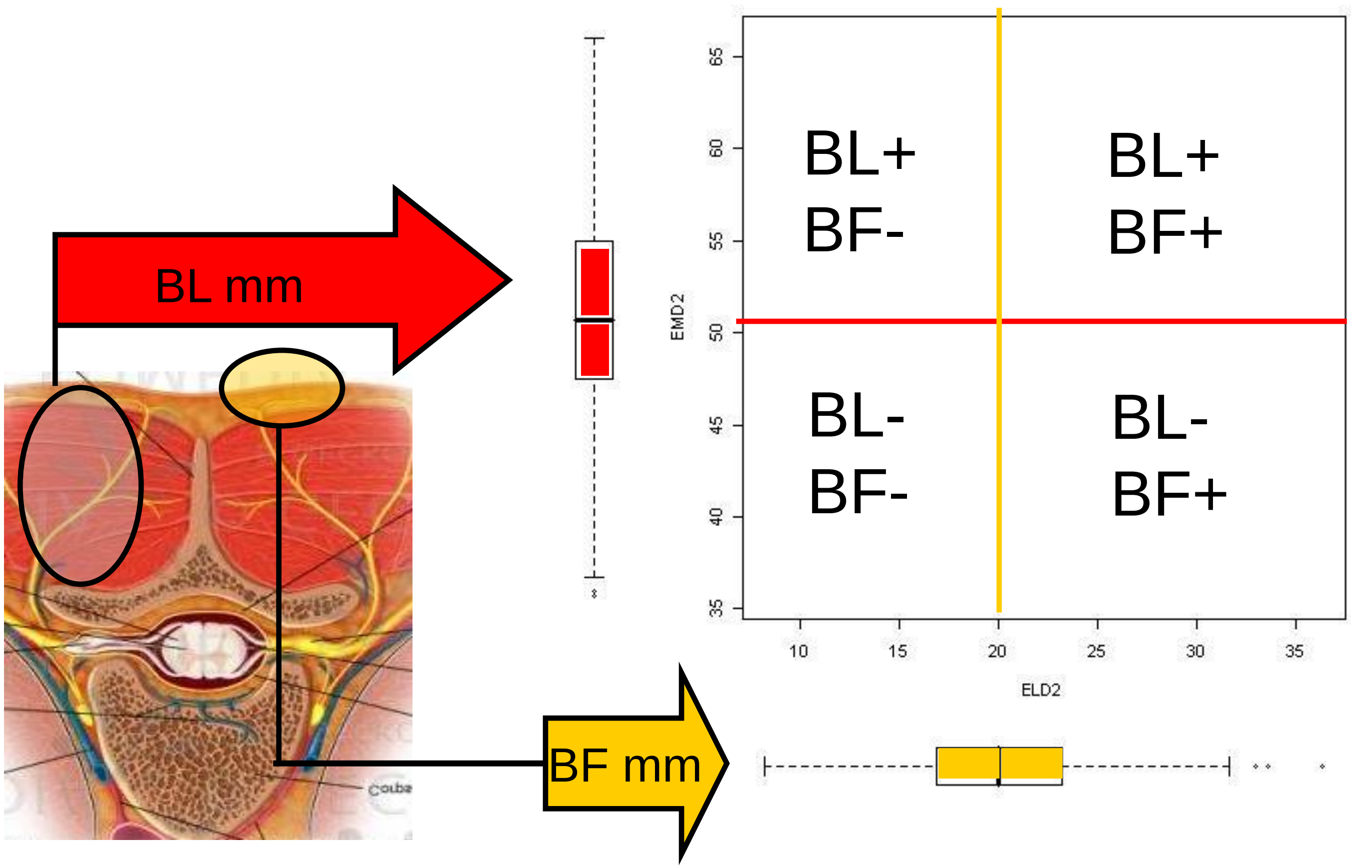
Act 5: Materials and Methods



- 10 commercial herds in Brittany (France) with 3 different hyperprolific lines
- 482 sows
- For each sow
  - Back fat (BF)
  - Back lean (BL) (Noveko AC037L, 3.5 MHtz)
- 4 times:
  - at weaning,
  - 4 weeks after mating
  - 3 weeks before farrowing
  - farrowing ;
- Data were analysed using a 3 factorial (BF, BL and genetic line, A, B and C) ANOVA test with $p<0.05$ as level of significance

Classification of the sows

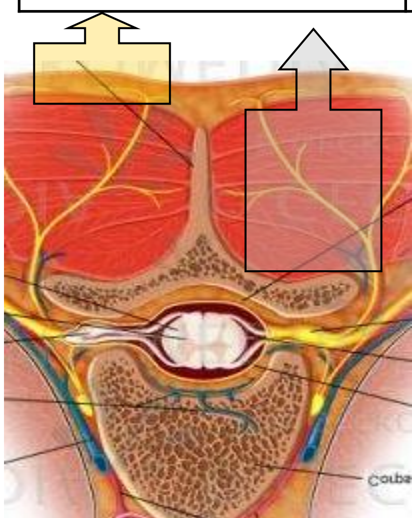
Each sow was classified according to the BF and BL median* values of data



*In probability theory and statistics, a **median** is described as the numeric value separating the higher half of a population from the lower half

Results

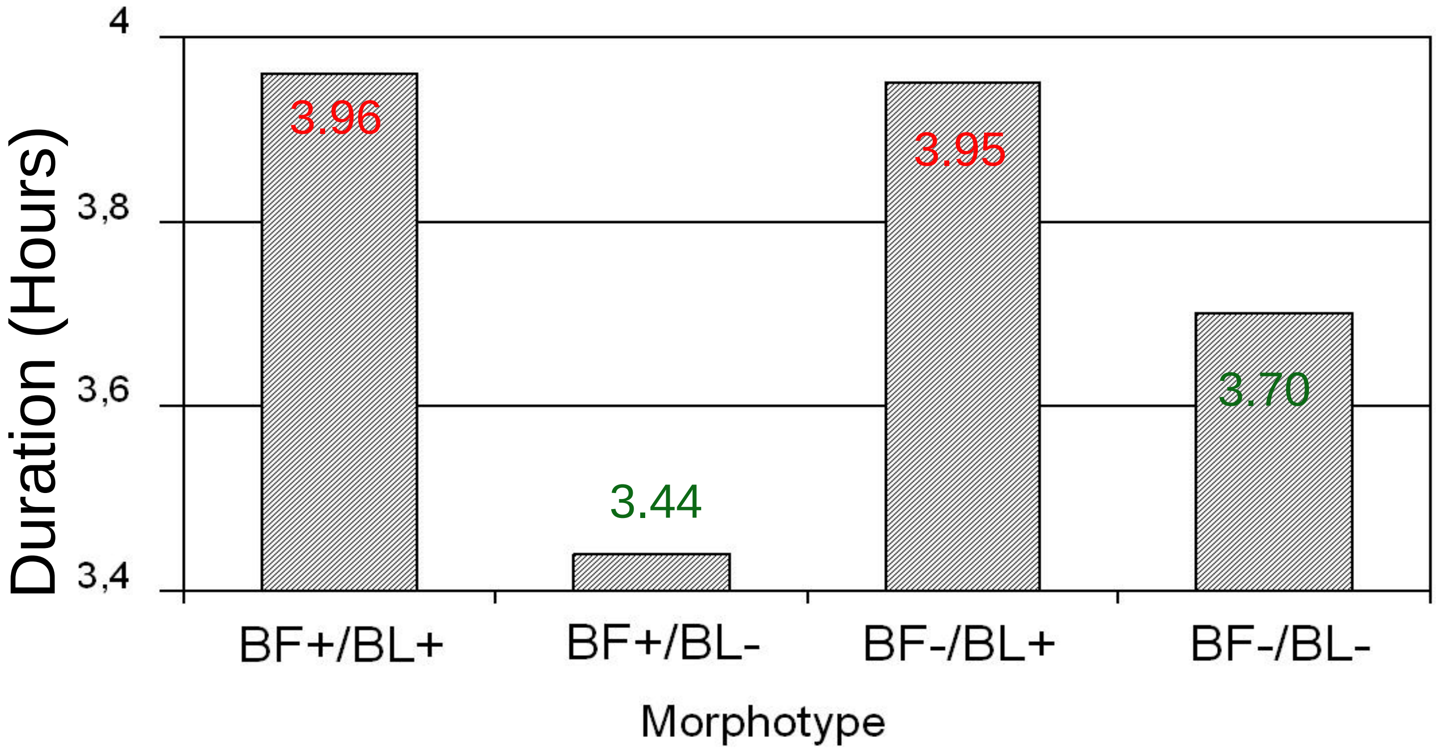
Morphotype	#	% Genetic (A/B/C)	Mean parity	Mean BF (mm)	Mean BL (mm)
BF+ / BL+	154	40/32/28	3.2	24.5	57.7
BF+ / BL-	85	34/39/27	2.9	23.5	49.1
BF- / BL+	104	27/36/37	2.9	17.1	57.1
BF- / BL-	139	44/34/22	2.5	15.9	47.6



BF+

BL+

Results : duration of farrowing

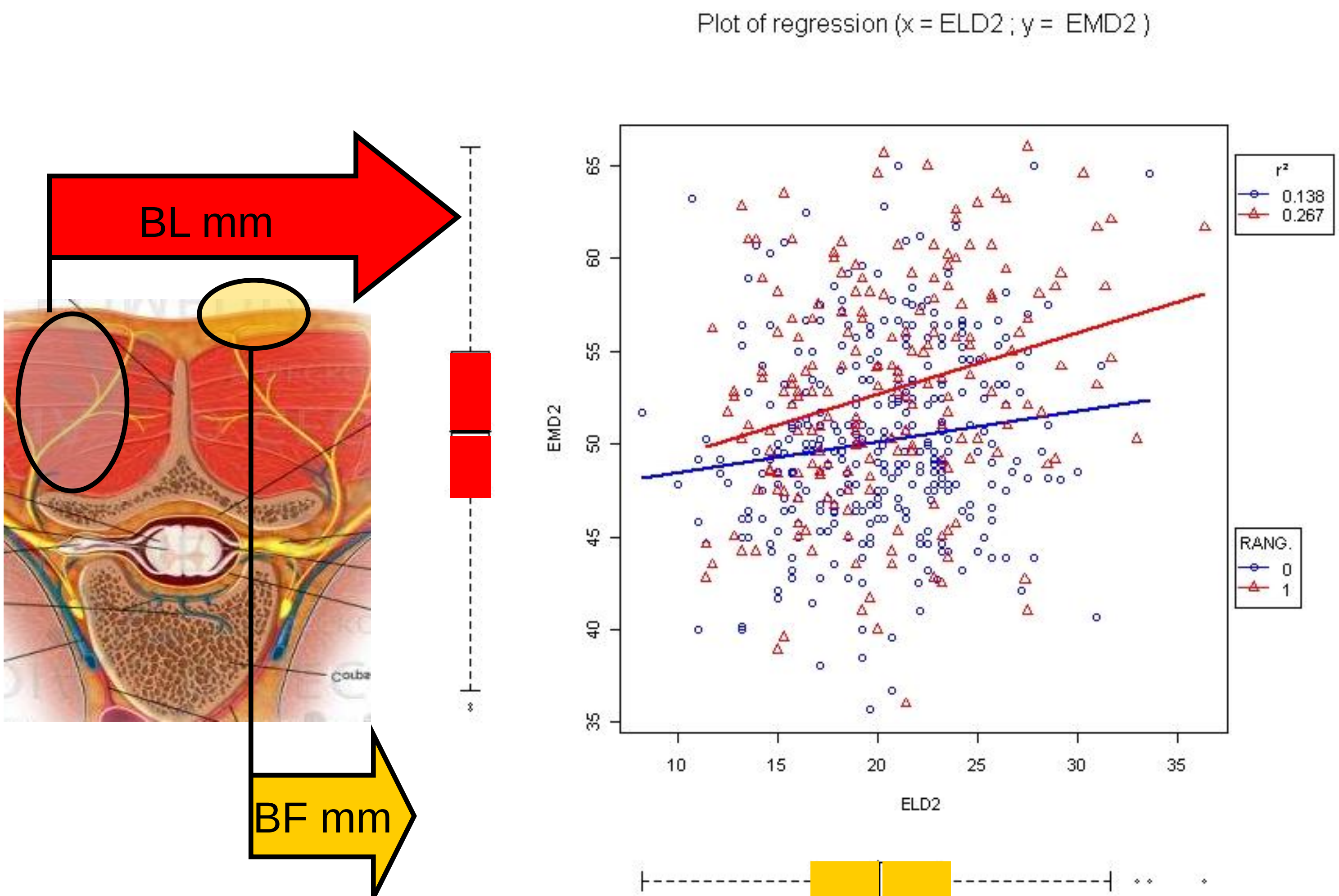


Back fat	BF+	BF+	BF-	BF-
Back lean	BL+	BL-	BL+	BL-

A statistically significant effect of BL on duration of farrowing(p=0.04);
No significant for BF (p=0.599) and genetic (p=0.790)

Act 5: Main results

Relationship between Back fat (BF) and Back Lean (BL) at farrowing in P1 (primiparous) and P2 sows at farrowing



Act 5: Discussion

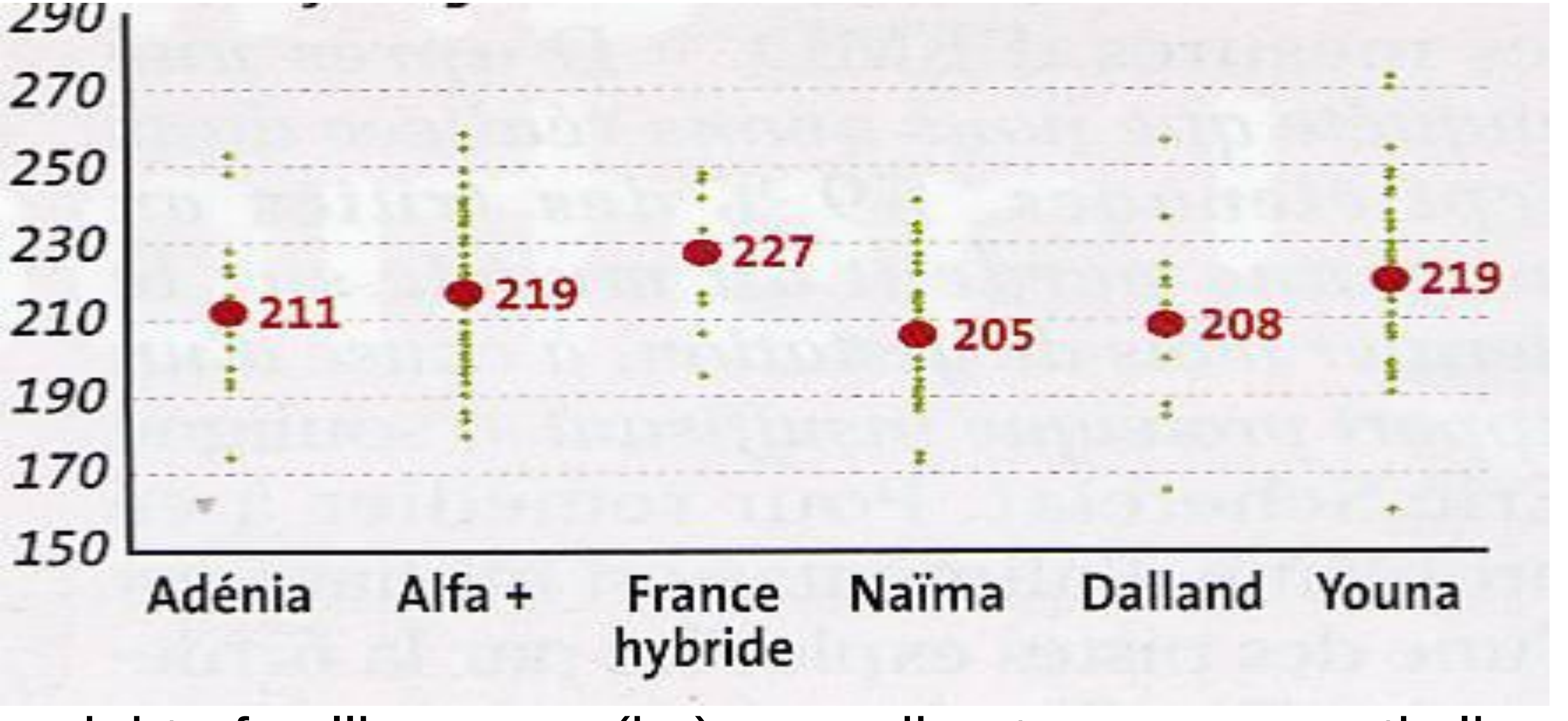
- Genetic selection
  - Growth and body composition
  - Hyperprolificacy
- Consequences:
  - Over-Muscled Sow Syndrome
  - At farrowing: hyperprolific litters
    - Farrowing difficulties;increase of time spent for survey;
    - Mortinatality
    - Partial lactation failure
    - Shoulder sores
    - Low feed intake
      - specially for the primiparous
    - …

Morphotype BF-/BL+
and post-partum
shoulder sores

Genetic effect

ΔW between herds >>> ΔW between genetic lines

=> management



Liveweight of culling sows (kg) according to some genetic lines (INZO, 2009)

each dot is the mean of culling weight sows from a given herd

Act 5: Discussion

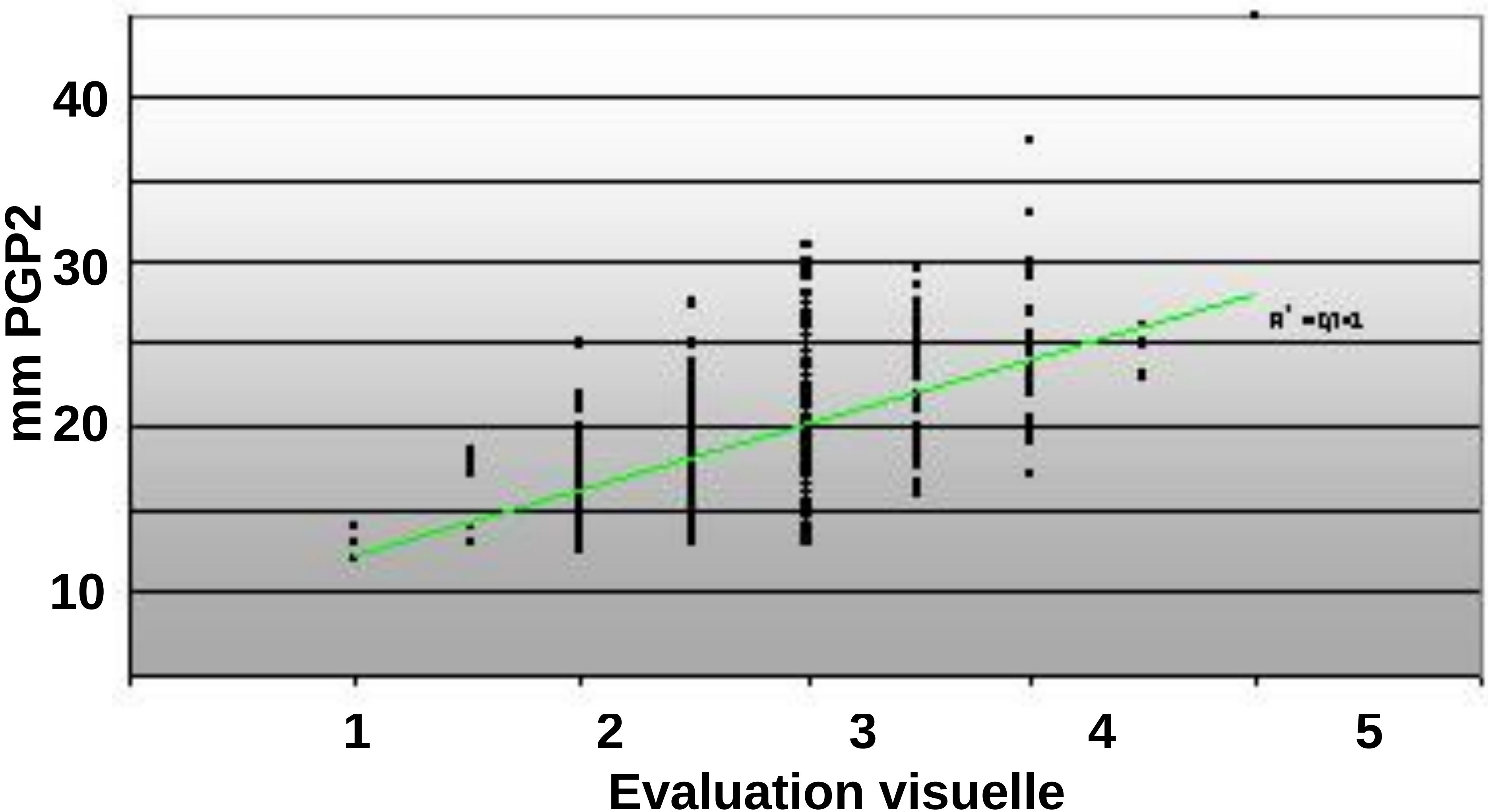
- There are genetic specifications (Foxcroft et al., 2008).
  - We have to take into account, for a given genetic line, BF and BL.
  - Static (such as BF and BL at farrowing) or Dynamic ?
    - we need to have standards on the **evolution** of BF and BL during the sow's cycle (starting at gilt level).

- Our eyes are:
  - Imprecise: huge inter-operators variation
  - Uncertain: BF is totally unpredictable in usual range
  - Incomplete: the visual conformation does not take into account BF and BL
- The eyes can only say whether the sow is "a beautiful sow" or a "ugly sow", but nothing more.

Nos perceptions …

Figure 2. Relationship between body condition score and backfat thickness for gestating sows.

Pottier and Martineau, 1999, Non published results



Morphotypes of the hyperprolific sow (at farrowing)

Morphotypes at farrowing	Prepartum catabolism	Duration of farrowing	Neonatal piglets' quality
BF+ / BL+		Increased	
BF+ / BL-		Normal	
BF- / BL+		Increased	
BF- / BL-		Increased	

Solignac & Martineau IPVS 2010 Poster 1

Solignac & Martineau IPVS 2010 Poster 2

Act 5: Solignac's conclusion

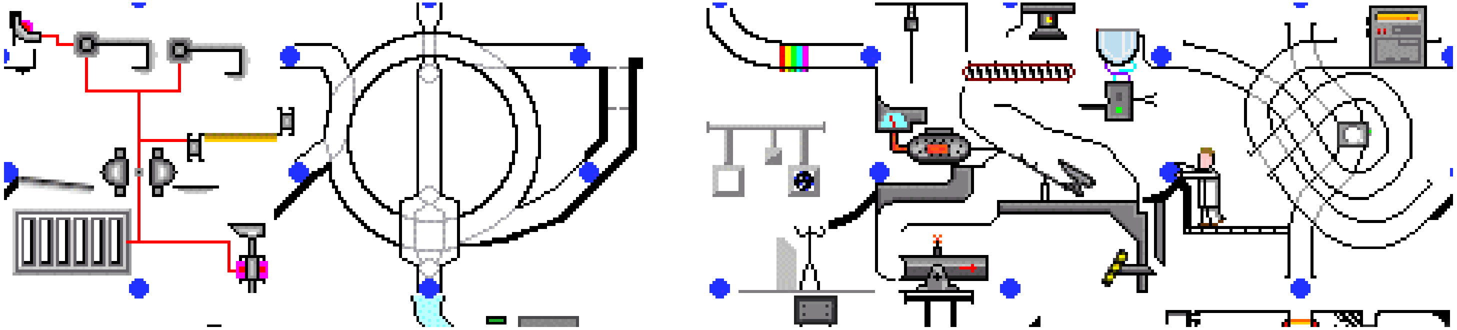
- If the sows' body score is misassessed, their classification will be wrong and consequently, any nutritional strategy doomed.
- This study is a first step to take into account a new parameter (BL),essential for a nutrition and management point of view; there are many interactions;
- A good understanding of the dynamics of BL-BF allows a good nutrition , decrease of many problems like mortinatality,sow mortality,shoulder sores …and increase weaning efficiency;
- It is always a compromise between prolificacy and the ability to wean;
- For a practical aspect,we have elaborated a specific method to evaluate body composition and a specific feeding program to control lean mass on sows;
- But ,first of all,the farmer must choose the type of sows he want to "build"and not to undergo ;

Paradigm and OMSS

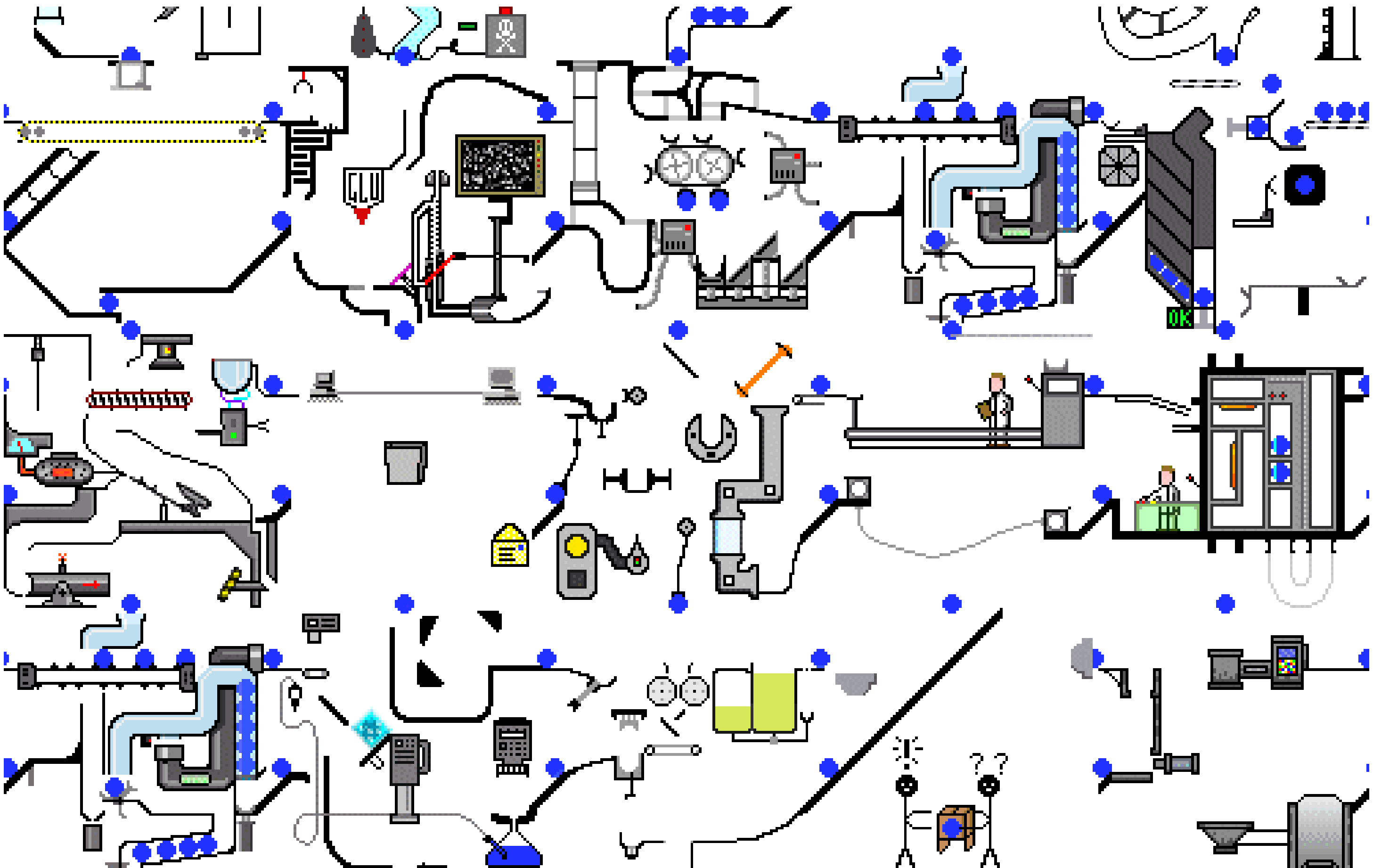
Gilt at selection for reproduction

Farrowing +/-
Milk production +/-

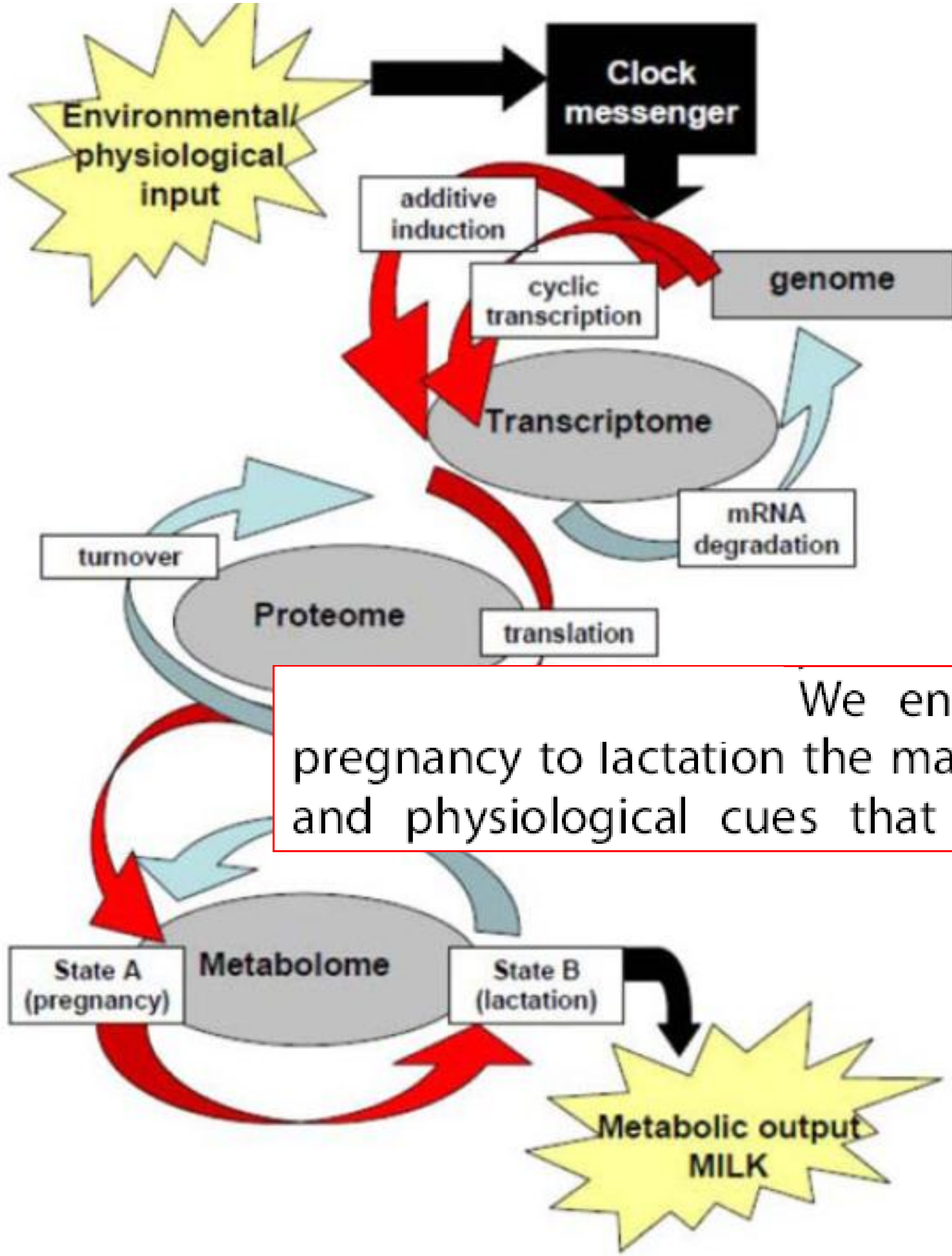
Farrowing +++
Milk production +++



Proposal of a common pathophysiological process using the word homerhesis



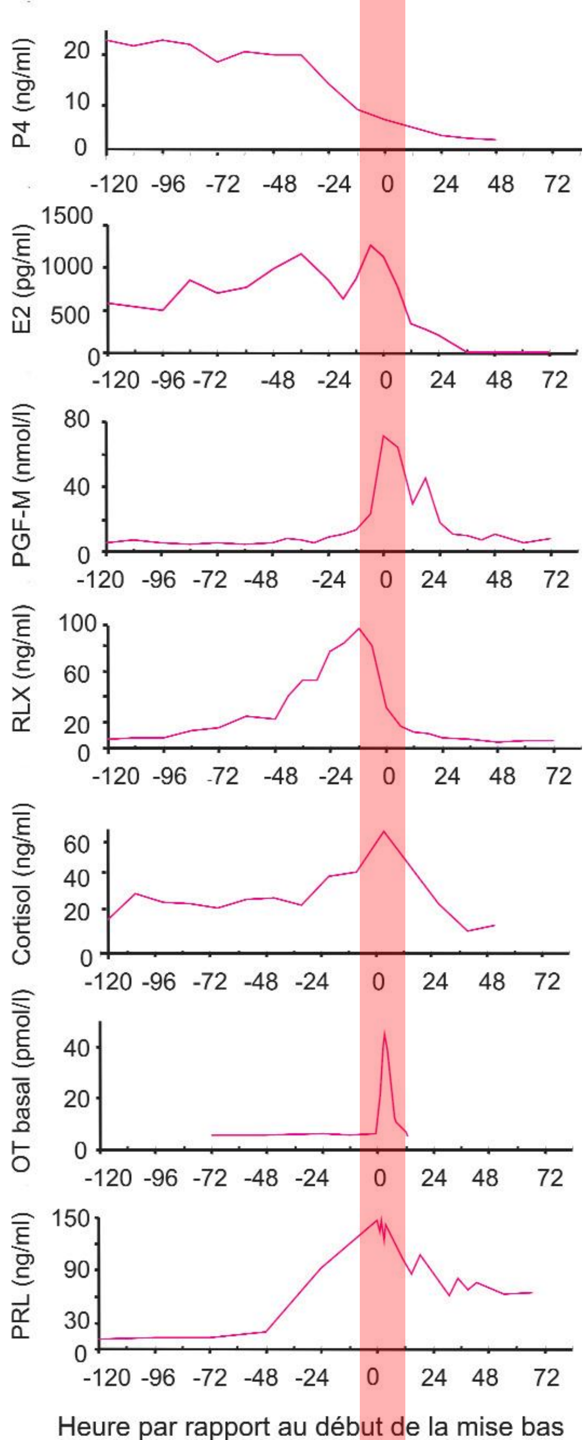
Schematic of how molecular clocks affect metabolic output, as modified from [126]



We envision that during the transition from pregnancy to lactation the master clock is modified by environemental and physiological cues that it receives.

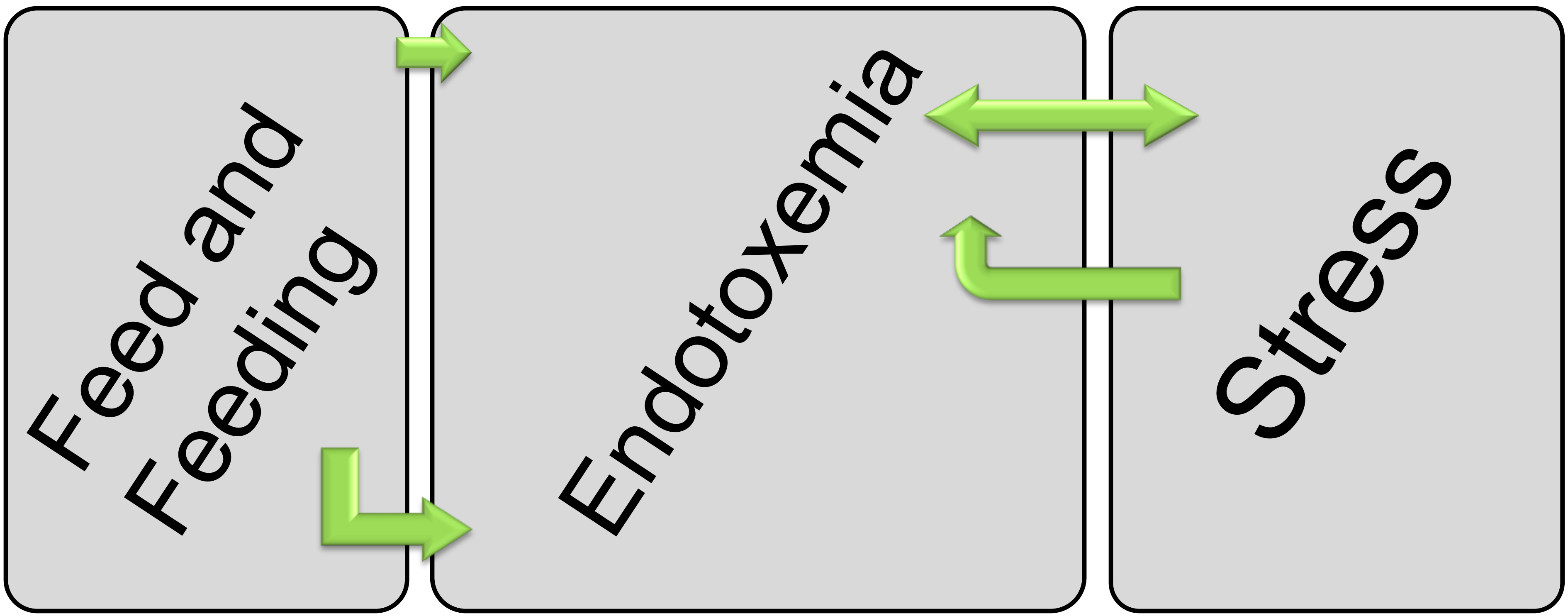
Figure 5. Schematic of how molecular clocks affect metabolic output, as modified from [126]. The master clock receives input from the external environment as well as the mammals physiological state and these factors affect the autoregulatory transcription–translation feedback loop of core clock genes that generate circadian rhythms [70]. Molecular clocks in peripheral tissues are synchronized by

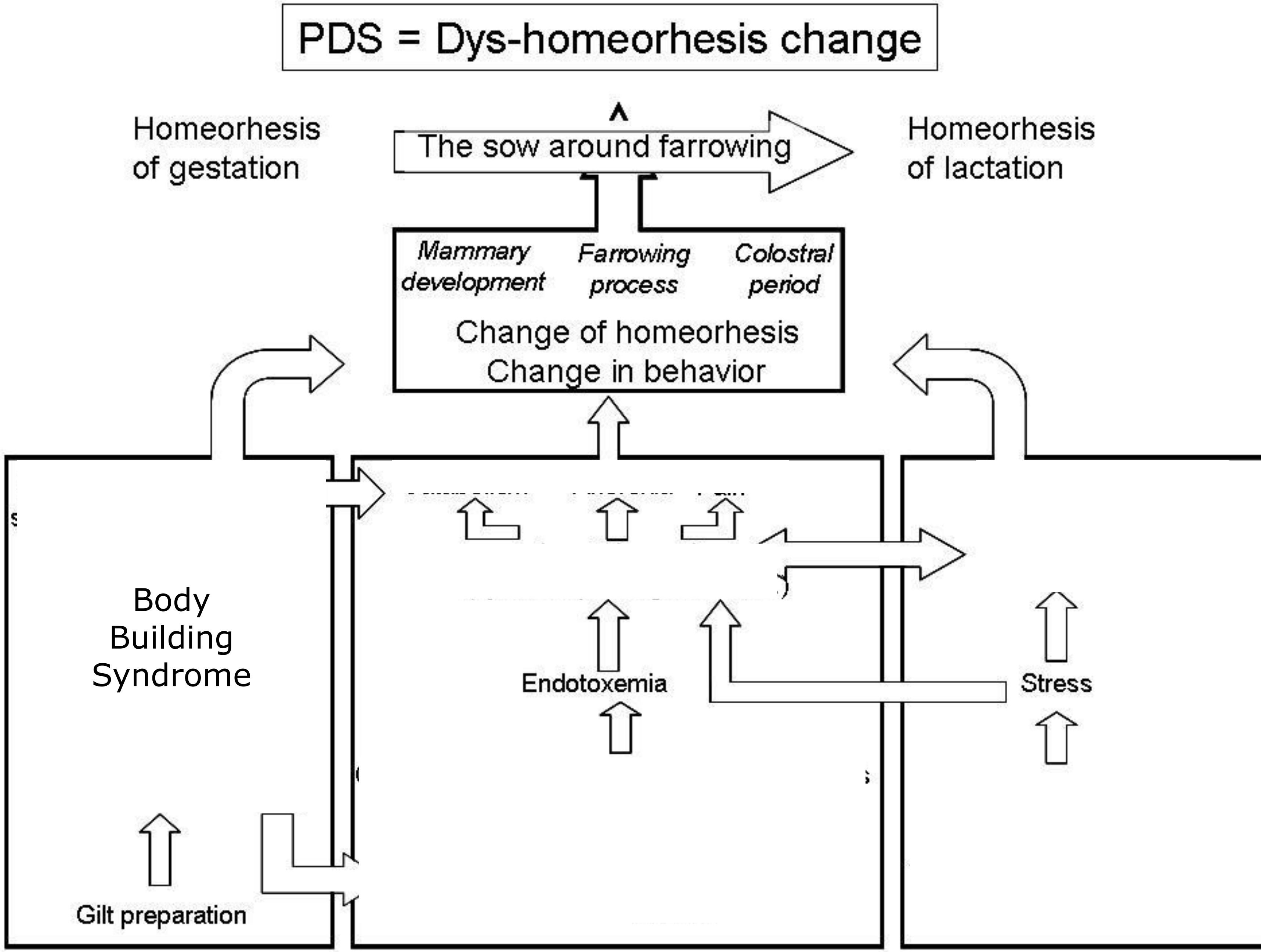
systems that send signals to peripheral tissues. These signals stimulate the induction of expression of the positive limb core clock genes and suppression of expression of the negative limb of core clock genes in mammary, liver and adipose tissues, and result in up regulation of genes that show circadian patterns of expression. These changes are needed to accommodate for the increased metabolic demands of milk synthesis and to stimulate copious milk production.
doi:10.1371/journal.pone.0007395.g005


P4 (ng/ml)
0
10
20
E2 (pg/ml)
0
500
1000
1500
PGF-M (nmol/l)
0
40
80
RLX (ng/ml)
0
20
60
100
Cortisol (ng/ml)
0
20
40
60
OT basal (pmol/l)
0
20
40
PRL (ng/ml)
0
30
90
150
-120 -96 -72 -48 -24 0 24 48 72
Heure par rapport au début de la mise bas

Postpartum dysgalactia in sows: pathophysiology and risk factors

D. Maes; G. Papadopoulos; A. Cools; G. P. J. Janssens
Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium




PDS = Dys-homeorhesis change
Homeorhesis of gestation
The sow around farrowing
Homeorhesis of lactation
Mammary development
Farrowing process
Colostral period
Change of homeorhesis
Change in behavior
Body Building Syndrome
Gilt preparation
Endotoxemia
Stress

ELSEVIER

Livestock Production Science 43 (1995) 243–252

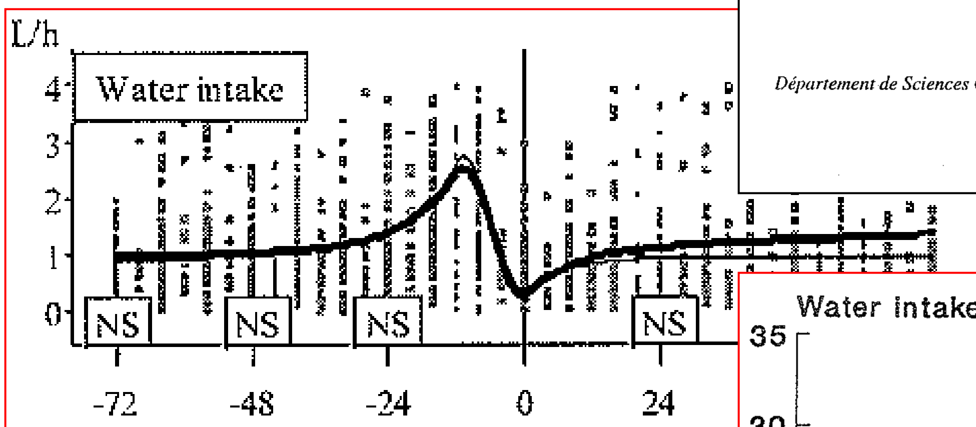
LIVESTOCK PRODUCTION SCIENCE

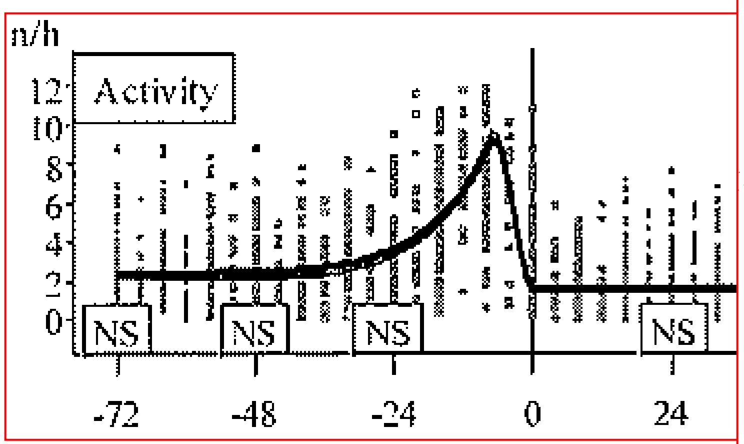
Effect of adaptation to the farrowing crate on water intake of sows

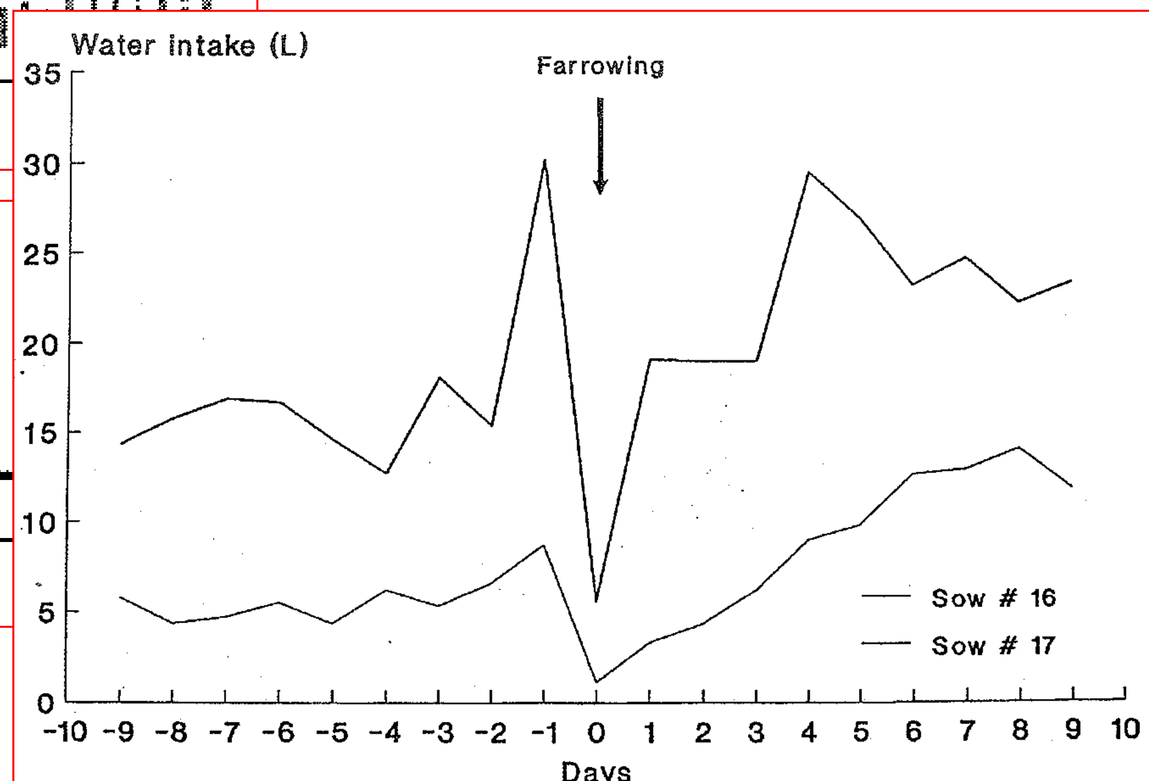
C. Klopfenstein *, S. D'Allaire, G.P. Martineau

Département de Sciences Cliniques, Faculté de médecine vétérinaire, Université de Montréal, C.P. 5000, Saint-Hyacinthe, Québec, Canada, J2S 7C6

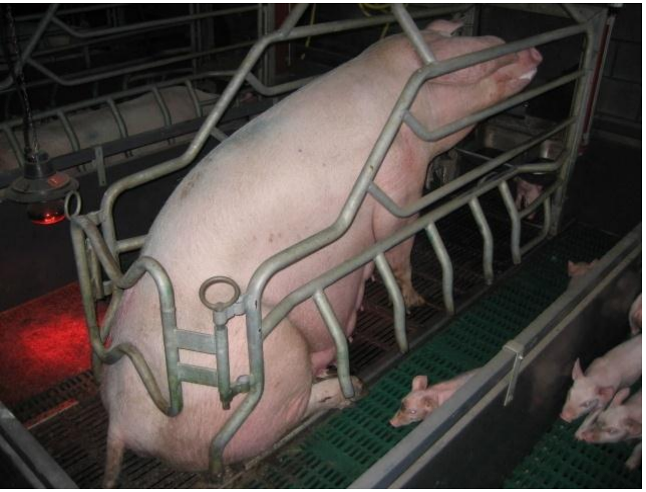
Accepted 1 June 1995



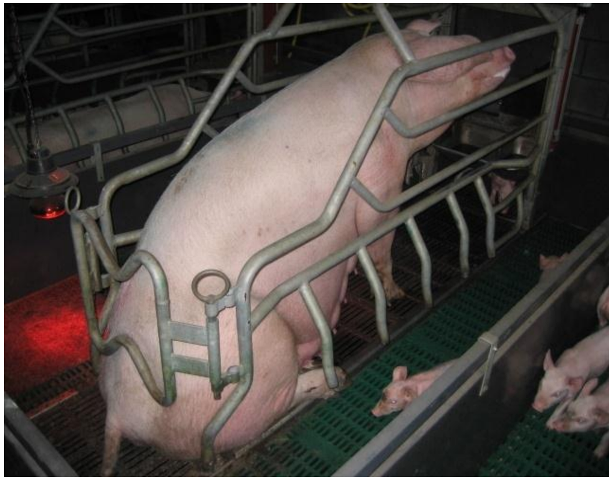




Sow behavior and farrowing





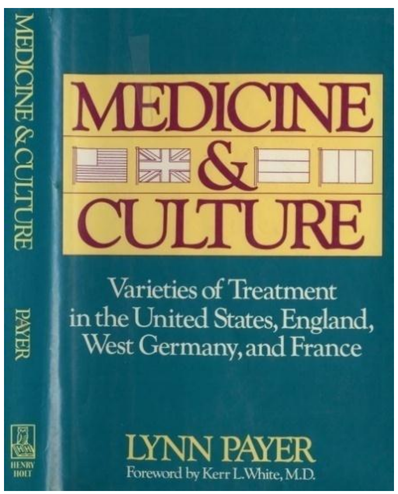



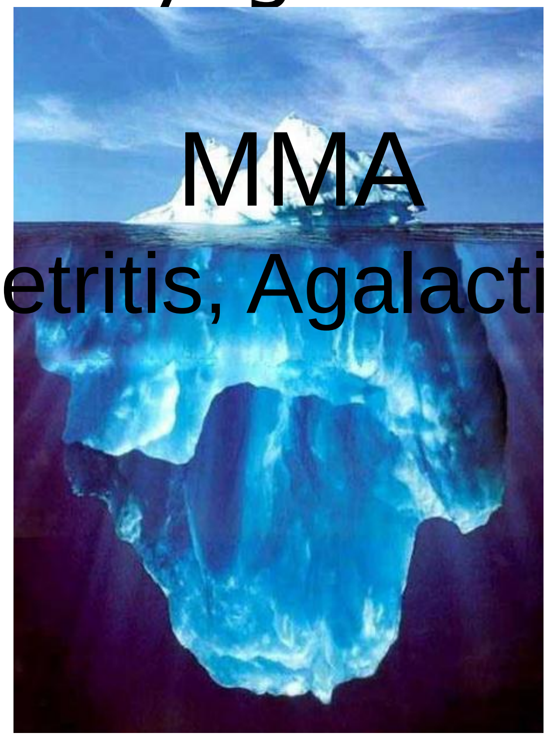
MMA, PDS

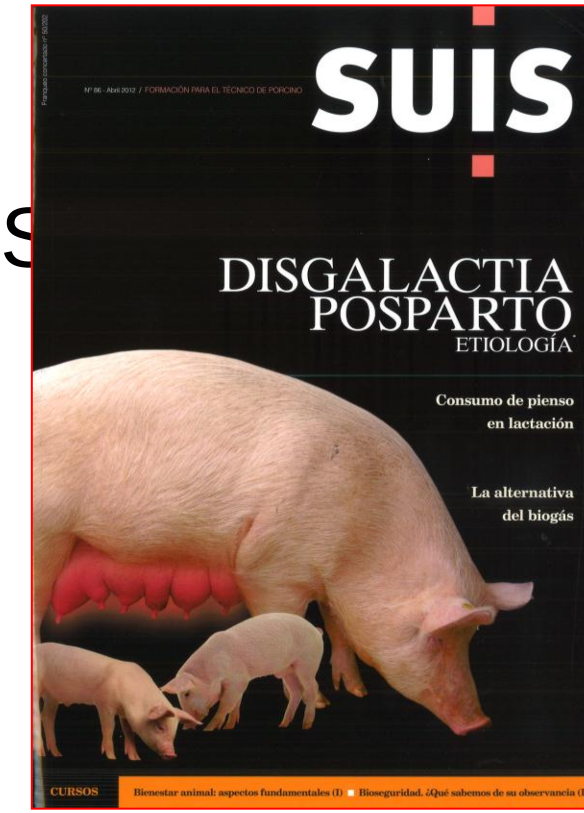
Mastitis, Metritis, Agalactia Syndrome
Postpartum Dysgalactia Syndrome

MMA

Mastitis, Metritis, Agalactia S



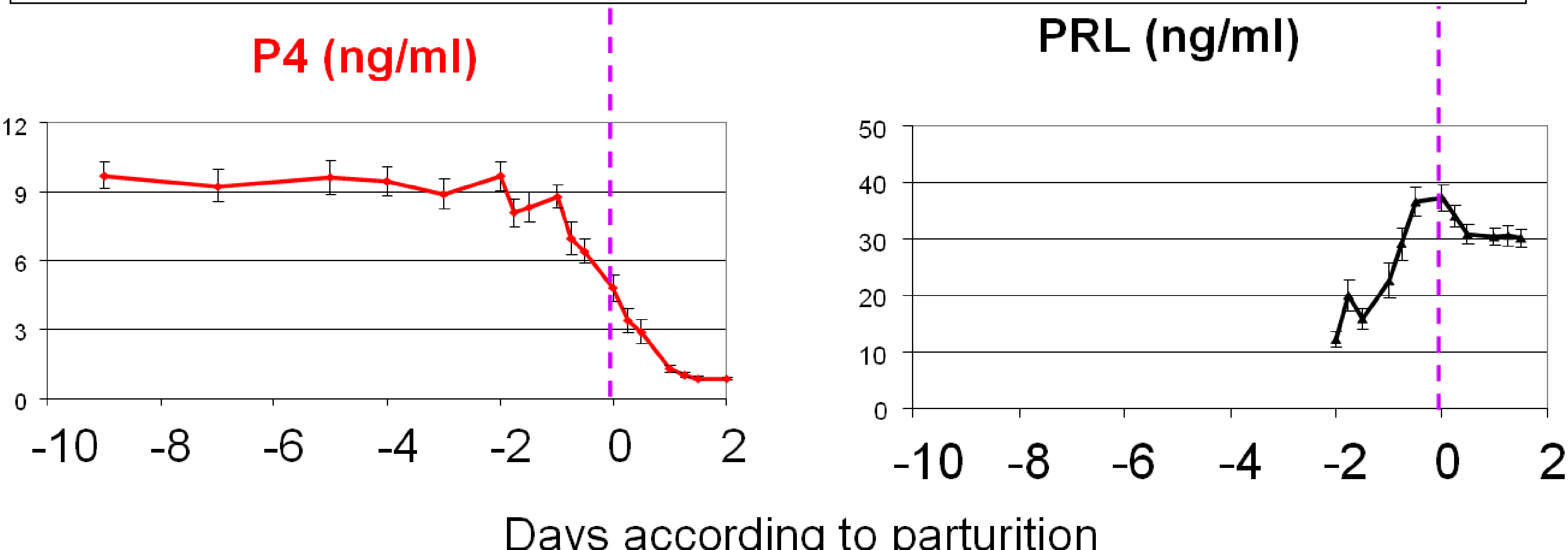




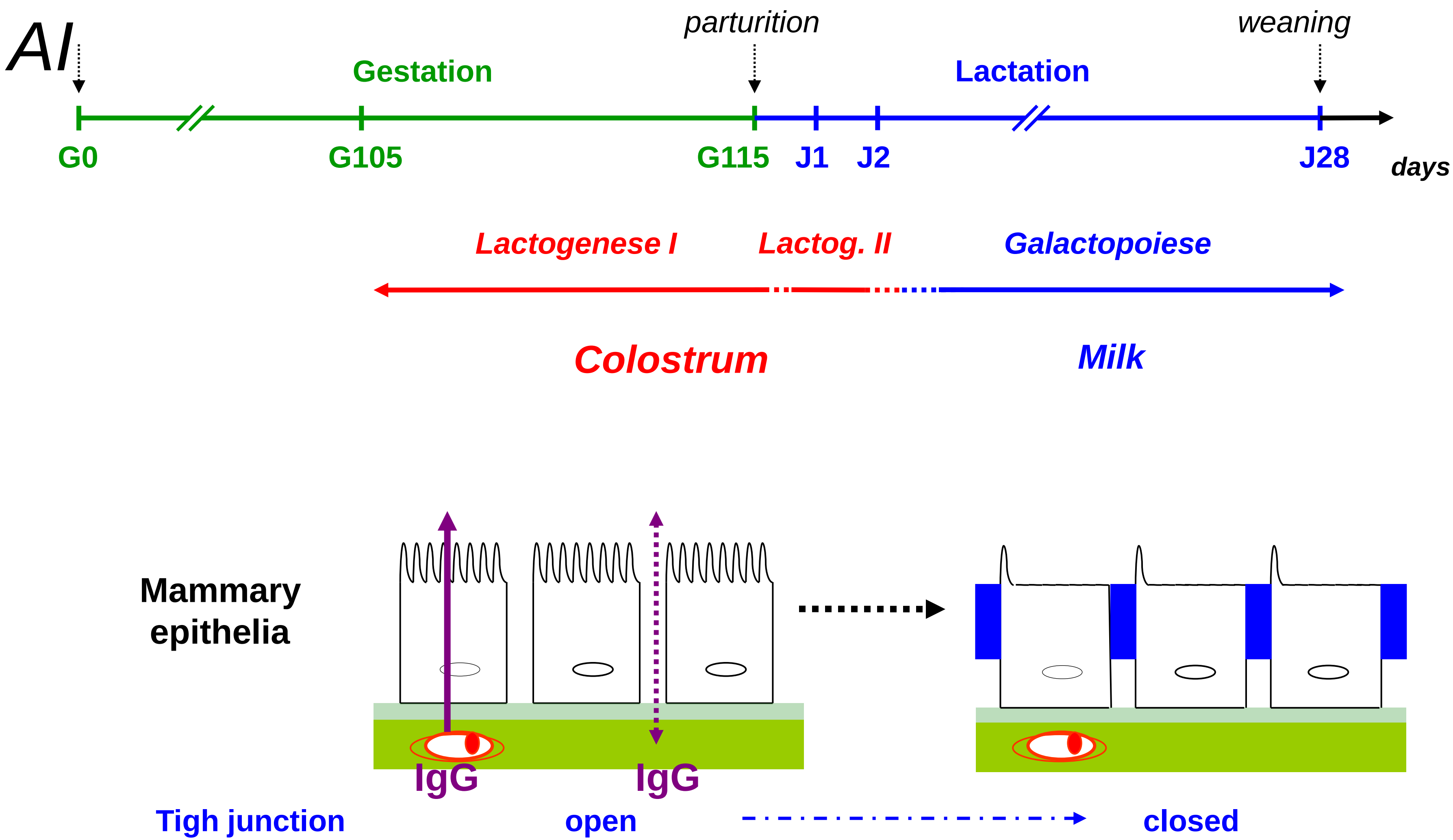
PDS

Postpartum Dysgalactia Syndrome

Hormonal changes involved in the farrowing process partly control the initiation of lactation. Indeed, the decline in circulating progesterone concentration before farrowing acts as a trigger for a succession of hormonal changes leading to farrowing and colostrum production

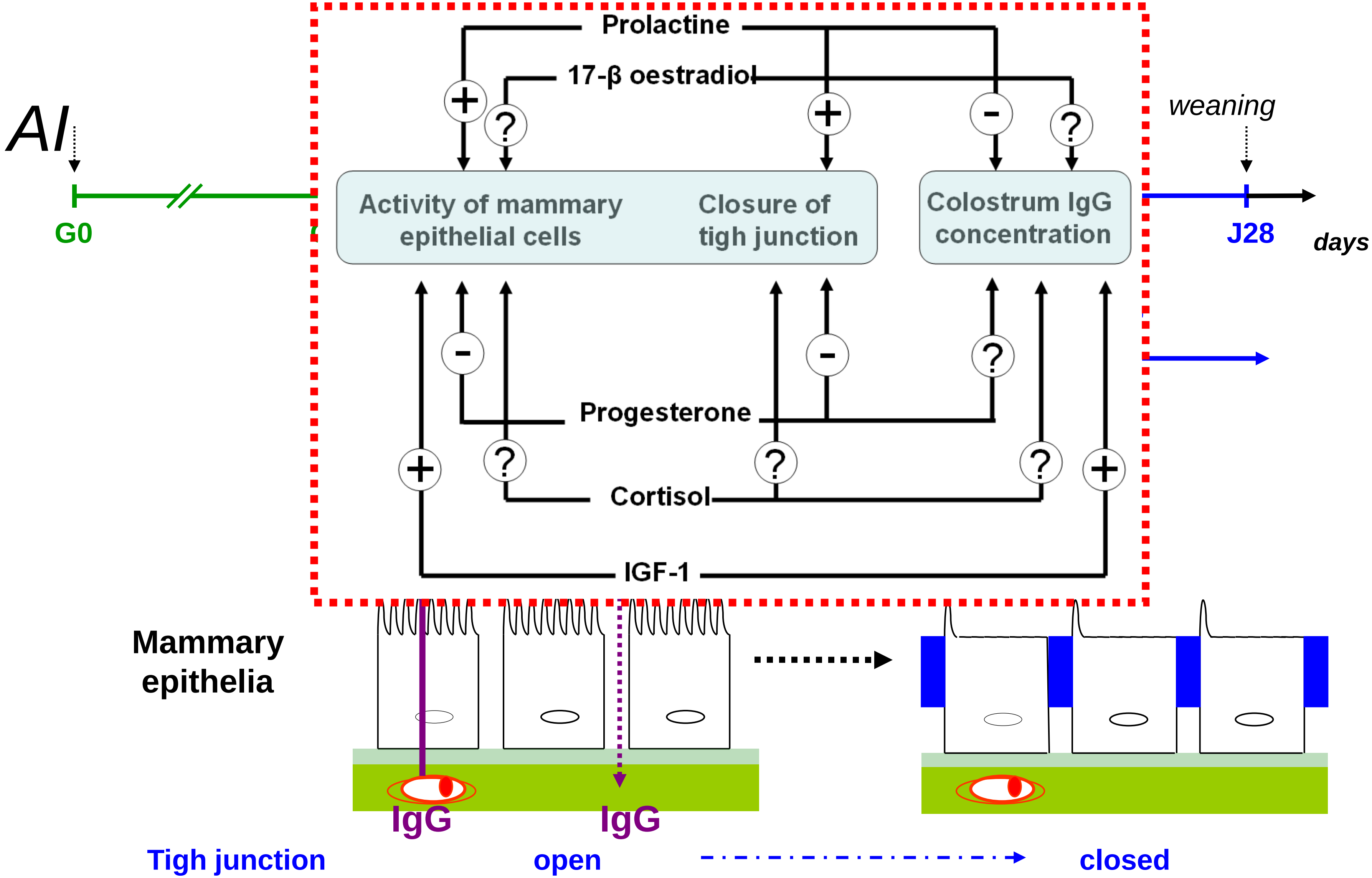


Lactogenesis

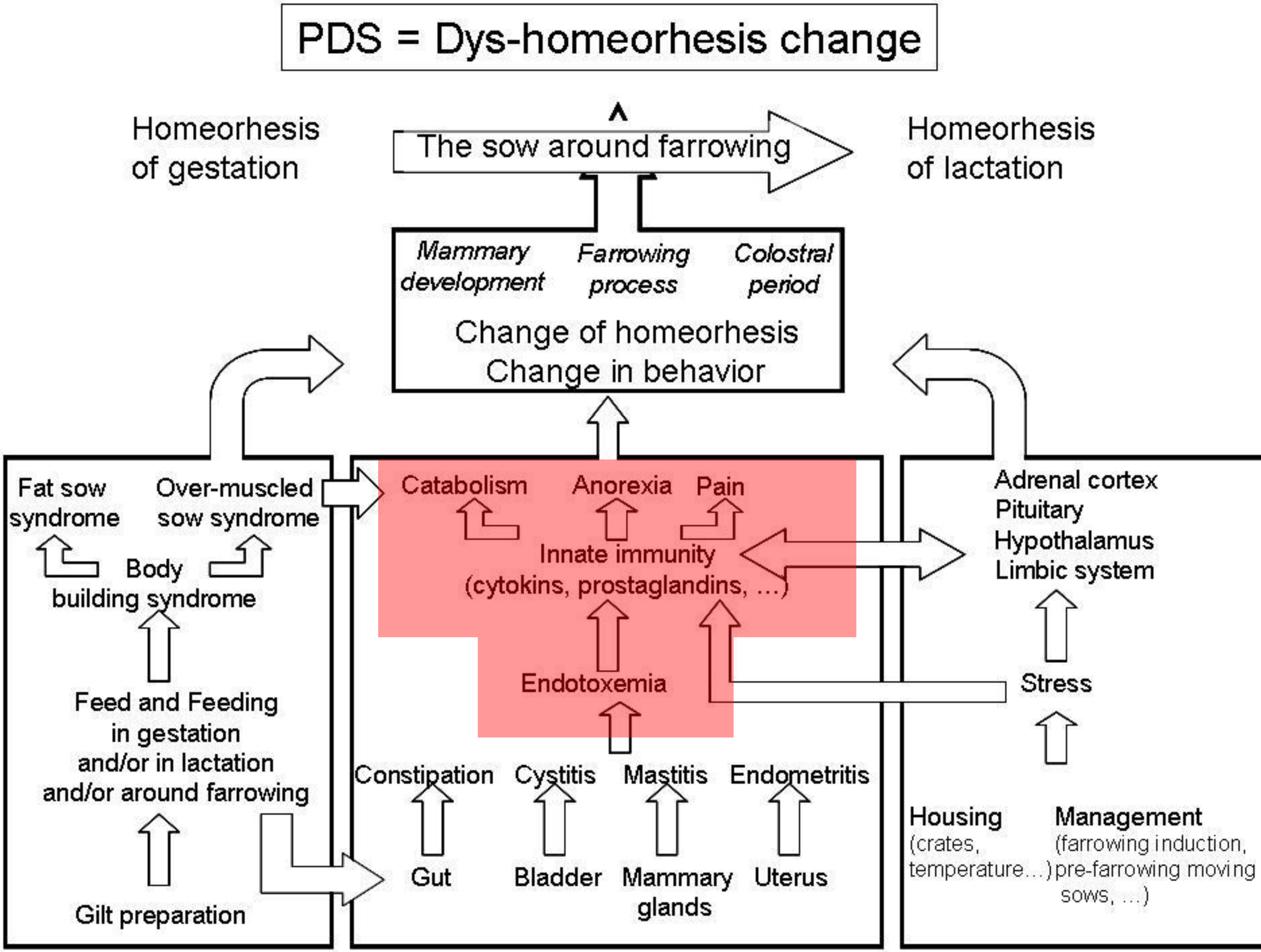


Adapted from Farmer et al., 2006 ; Barrington et al., 2001

Lactogenesis & homeorhesis



Adapted from Farmer et al., 2006 ; Barrington et al., 2001, Foisnet, 2010


PDS = Dys-homeorhesis change
Homeorhesis of gestation
The sow around farrowing
Homeorhesis of lactation
Mammary development
Farrowing process
Colostral period
Change of homeorhesis
Change in behavior
Fat sow syndrome
Over-muscled sow syndrome
Body building syndrome
Feed and Feeding in gestation and/or in lactation and/or around farrowing
Gilt preparation
Catabolism
Anorexia
Pain
Innate immunity (cytokins, prostaglandins, ...)
Endotoxemia
Constipation
Cystitis
Mastitis
Endometritis
Gut
Bladder
Mammary glands
Uterus
Adrenal cortex
Pituitary
Hypothalamus
Limbic system
Stress
Housing (crates, temperature...)
Management (farrowing induction, pre-farrowing moving sows, ...)

Postpartales Dysgalaktiesyndrom der Sau – eine Übersicht mit besonderer Berücksichtigung der Pathogenese

G. Reiner; B. Hertrampf; H. R. Richard
Professur für Schweinekrankheiten (Prof. Dr. Dr. habil. G. Reiner) der Justus-Liebig-Universität Gießen

Schlüsselwörter
Puerperium, Mastitis-Metritis-Agalaktie-Syndrom, Endotoxine, Faktorenkrankheit

Zusammenfassung
Erkrankungen der Sau im Puerperium verlaufen nicht unter einem einheitlichen klinischen Bild. Die Bezeichnung MMA (Mastitis-Metritis-Agalaktie-Syndrom) ist daher unzutreffend. Bakterielle Endotoxine induzieren die für das Krankheitsbild wesentlichen pathophysiologischen Abläufe. Die Bildung der zur Auslösung des Krankheitsbildes erforderlichen Endotoxinmenge wird in entscheidendem Maße von begünstigenden Management-, Haltungs- und Fütterungsbedingungen beeinflusst. Unabhängig von den an der Krankheitsgenese beteiligten Organsystemen stellt der Milchmangel das produktionsbeeinträchtigende Kardinalsymptom dar. Diagnostisch muss deshalb frühzeitig eine Risikoanalyse für die Sauen mit besonderer Berücksichtigung des Wurfes (Saugverhalten, Gewichtsentwicklung) erstellt werden. Bei der Diagnostik ist immer zwischen Fieber und Hyperthermie zu differenzieren. Die Arbeit gibt eine aktualisierte Übersicht zu den Pathogenesemechanismen und Risikofaktoren des Syndroms mit dem Ziel, das Verständnis der Entstehung und Bekämpfung zu vertiefen.

Key words
Puerperium, mastitis-metritis-agalactia syndrome, endotoxins, multifactorial disease

Summary
Puerperal diseases in sows do not involve consistent clinical outcomes. Thus, the term MMA (mastitis-metritis-agalactia syndrome), although well introduced, is deceptive. The major pathophysiological aspect of the disease is triggered by bacterial endotoxins. Their production depends on promoting management, housing and feeding conditions. Hypogalactia has the most important impact on production, independent of organ systems primarily involved. From a diagnostical point of view, early risk assessment for the sows to develop the disease, based on litter signs (e. g. growth, drinking behaviour), is thus of high importance. In this context it has to be distinguished between fever and hyperthermia. The present paper gives an update review on pathogenesis of the syndrome, with the special aim to increase the knowledge on pathogenesis and treatment of this disease.

Puerperal diseases in sows do not involve consistent clinical outcomes. Thus, the term MMA (mastitis-metritis-agalactia syndrome), although well introduced, is deceptive. The major pathophysiological aspect of the disease is triggered by bacterial endotoxins. Their production depends on promoting management, housing and feeding conditions. Hypogalactia has the most important impact on production, indepen-

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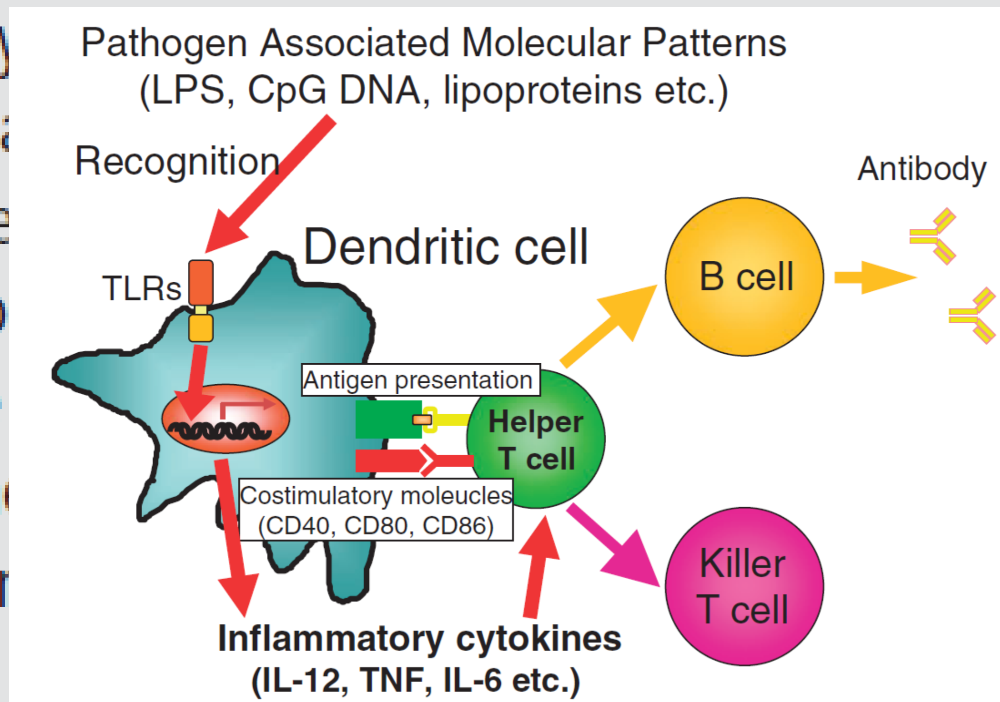
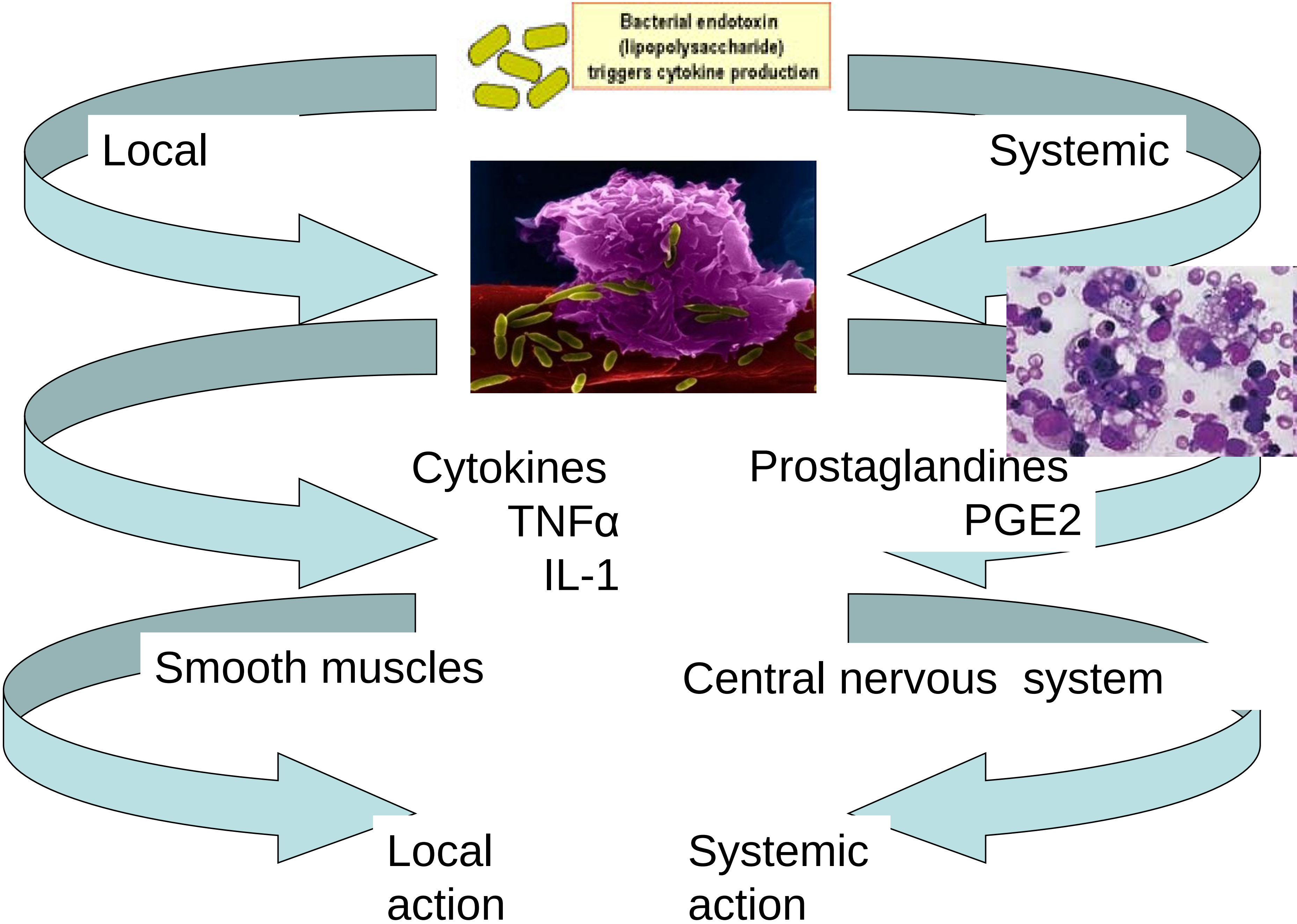
on litter signs (e … is of high impor-
tance. In this co … en fever and hy-
perthermia. The … on pathogenesis
of the syndrom … e knowledge on
pathogenesis ar



Reiner, 2009


Bacterial endotoxin
(lipopolysaccharide)
triggers cytokine production
Local
Systemic
Cytokines
TNFα
IL-1
Prostaglandines
PGE2
Smooth muscles
Central nervous system
Local
action
Systemic
action

Reiner, 2009

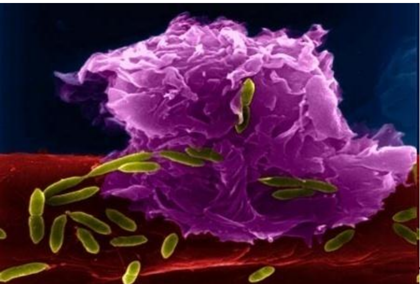
Painful

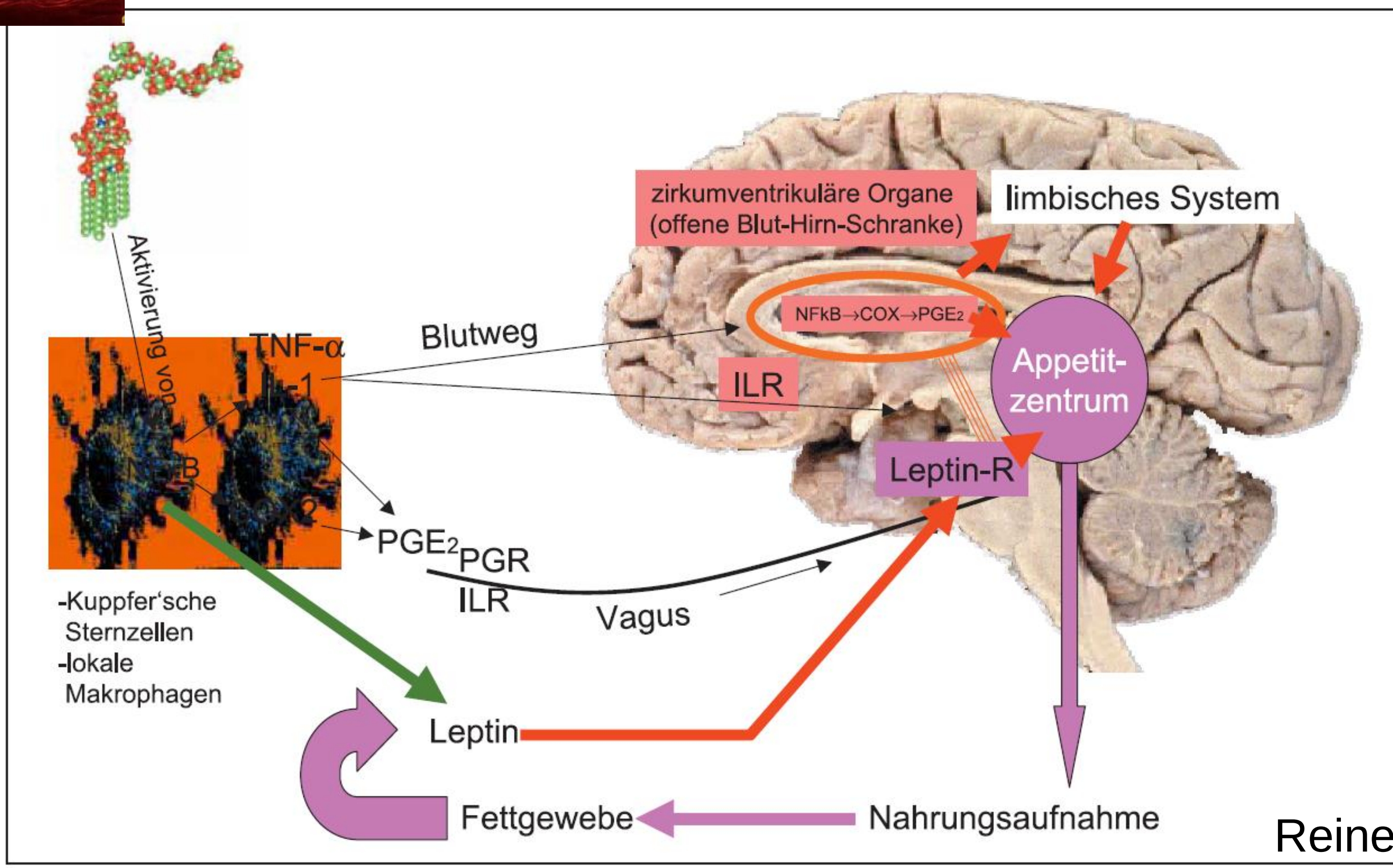
Anorexia

Catabolism

Hormonal balance (i.e. leptin, prolactin)

Dysgalactia





Reiner, 2009

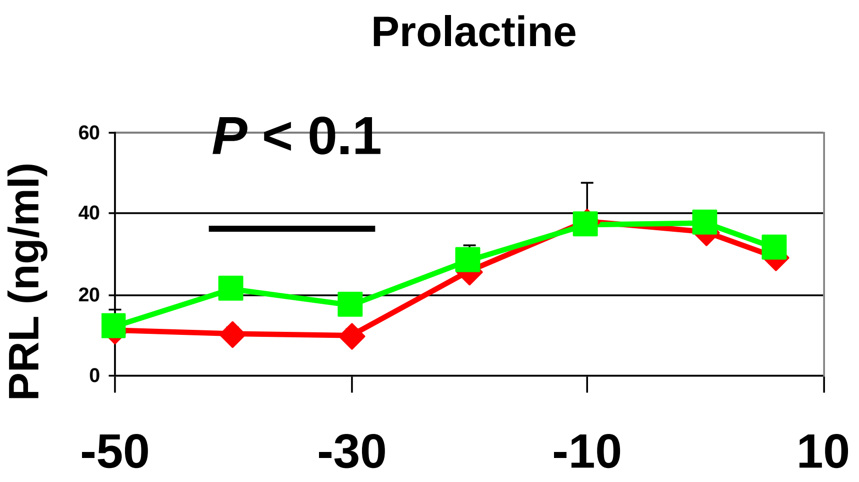
Dyshomeorhesis and production of colostrum

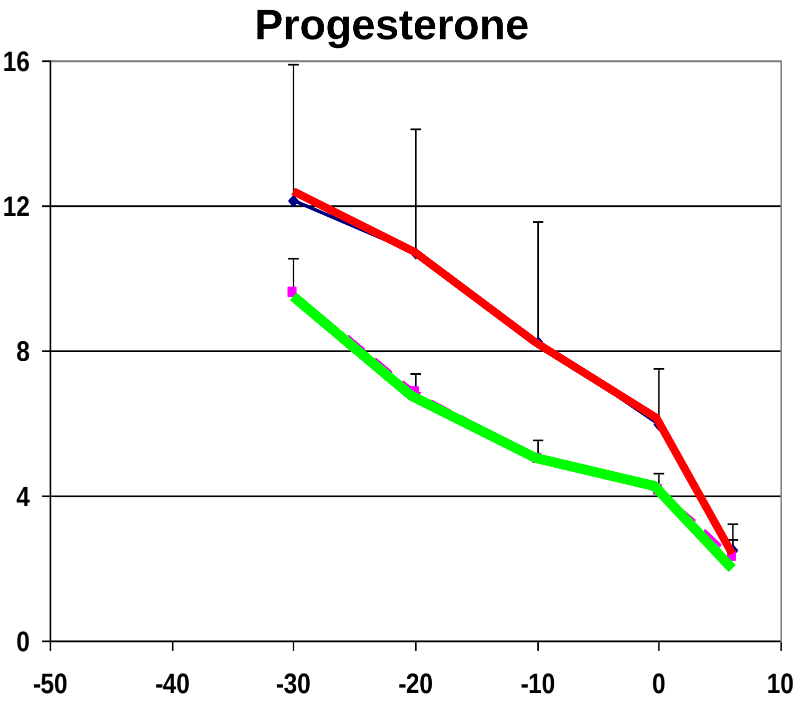
- Weak production of colostrum

  Less synthesis of lactose and higher permeability of lactocyte epithelium

  Link with hormonal changes within 48 hours **before** farrowing

PDS: pathophysiology



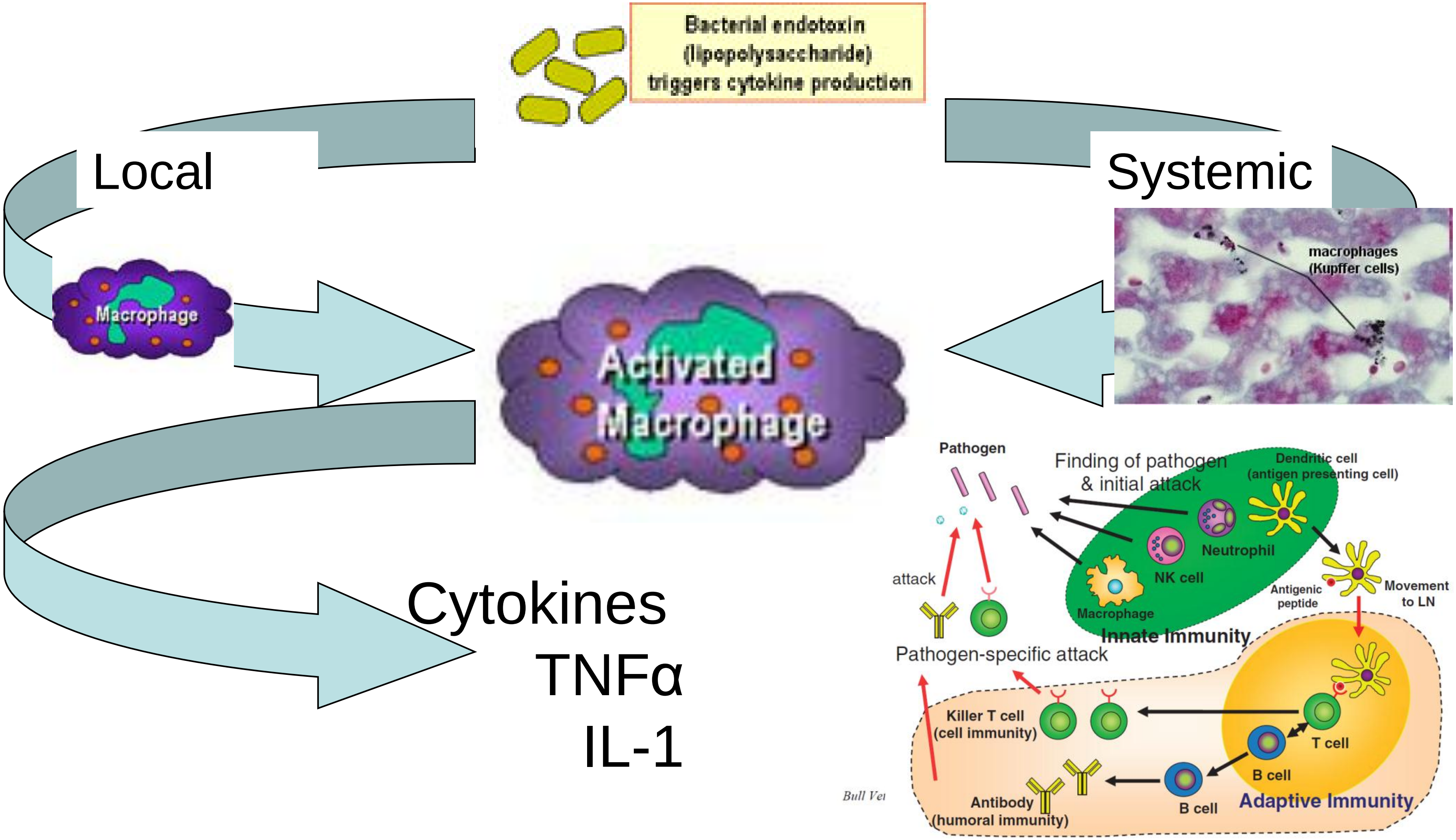


Hours according to farrowing

Weak production n=4

Good production n=12

Foisnet, 2009



The Influence of Intramammary Lipopolysaccharide Infusion on Serum Ca, P, Vitamin D, Cytokines and Cortisol Concentrations in Lactating Sows

J. F. Wang[1,4], M. Wang[1], J. L. Ma[1], L. G. Jiao[1], X. Y. Zhou[2] and J. E. Lindberg[3]

Addresses of authors: [1]College of Veterinary Medicine, China Agricultural University, Beijing, China; [2]Laboratory of Endocrinology, Peking Union Medical College Hospital, Beijing, China; [3]Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, Uppsala, Sweden; [4]Corresponding author: Tel.: +86 10 6273 1094; fax: +86 10 6273 1274; E-mail: jiufeng_wang@hotmail.com

J. Vet. Med. A 53, 113–118 (2006)

TUMOUR NECROSIS FACTOR-α AND INTERLEUKIN-6 CONCENTRATION IN THE SERUM OF SOWS WITH THE MMA SYNDROME

MAREK SZCZUBIAŁ AND RENATA URBAN-CHMIEL[1]

Department and Clinic of Animal Reproduction, [1]Sub-Department of Veterinary Prevention, Faculty of Veterinary Medicine, University of Life Sciences in Lublin, 20-612 Lublin, Poland
marek.szczubial@ar.lublin.pl

Received for publication January 24, 2008

Serum TNFα

Bull Vet Inst Pulawy 52, 267-270, 2008

10 « MMA sows »

Serum TNFα concentration (pg/mL)

Group	48-72 h before parturition a	12-24 h before parturition b	12-24 h after parturition c	48-72 h after parturition d	statistically significant differences
Experimental	87.51 ±49.0	94.65** ±32.10	316.39 ±45.80	336.34* ±196.98	ac***, ad**, bc***, bd**
Control	69.60 ±29.75	45.38 ±25.03	234.19 ±165.40	186.76 ±52.46	ac**, ad***, bc**, bd***

ab…cd – statistically significant intergroup differences at individual measurement points; * P<0.05, ** P<0.01, *** P<0.001.

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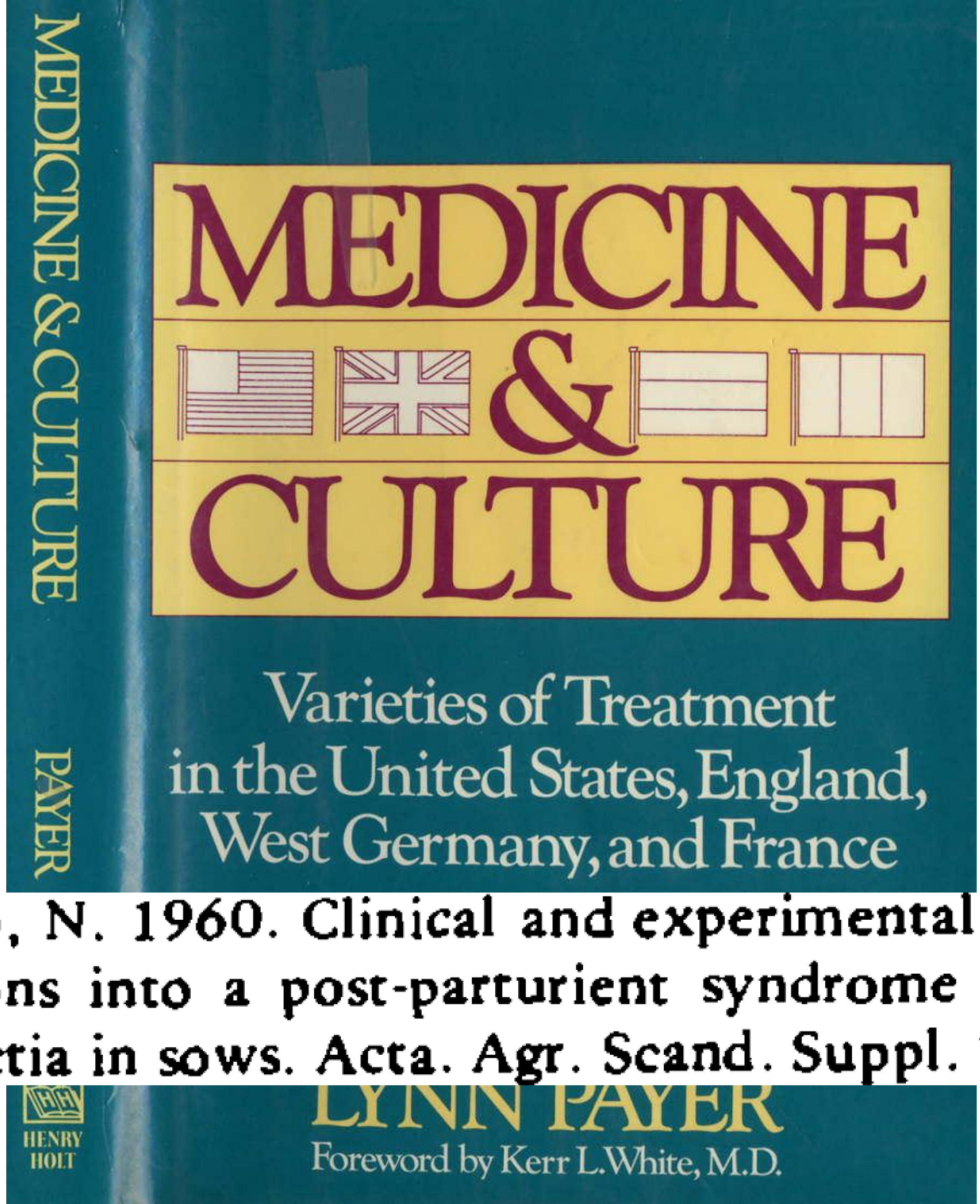
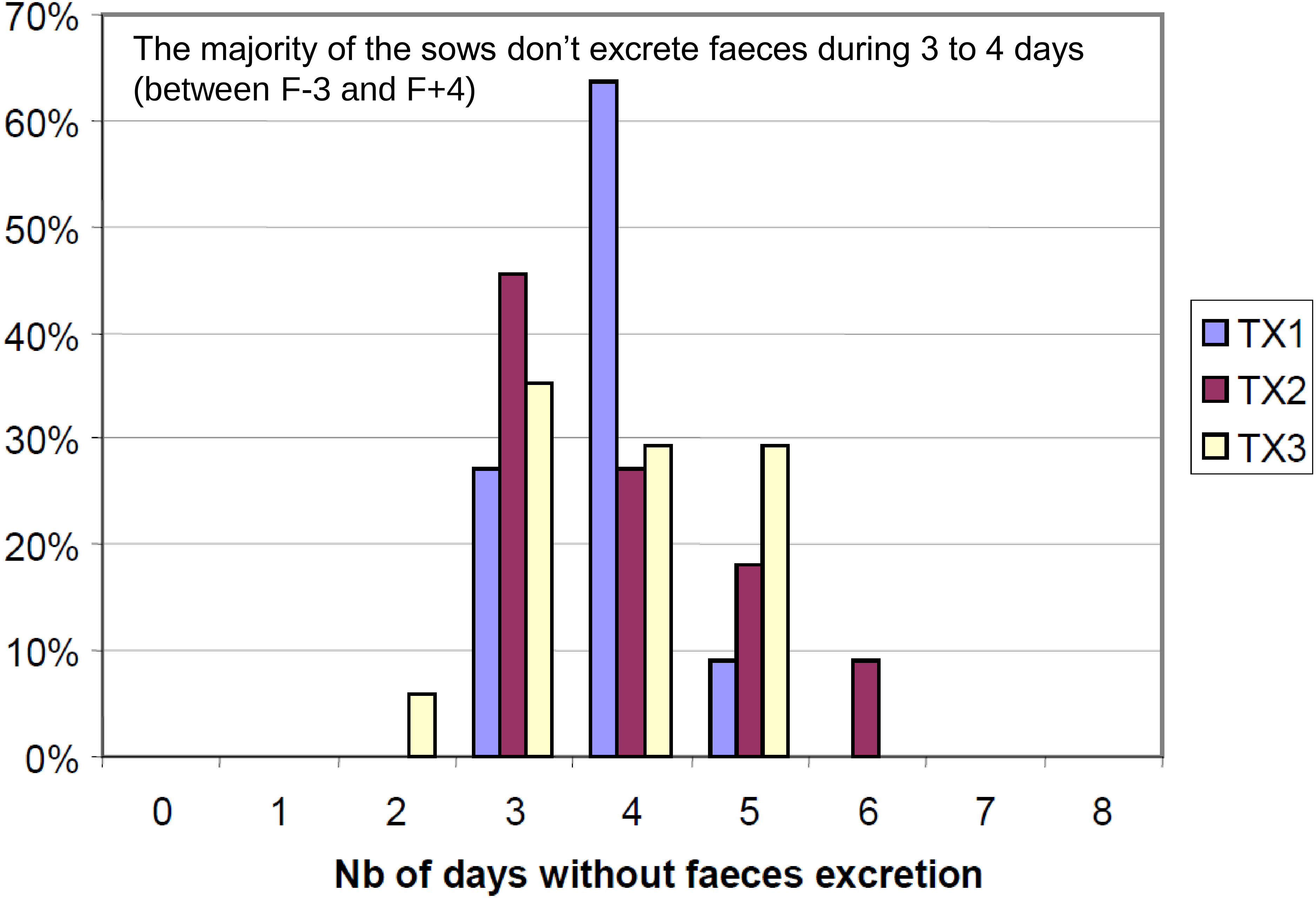


Ringarp, N. 1960. Clinical and experimental investigations into a post-parturient syndrome with agalactia in sows. Acta. Agr. Scand. Suppl. 7:1.

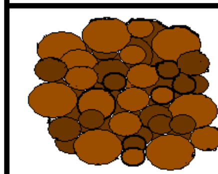
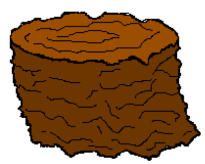
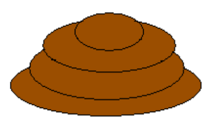
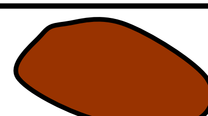
- Constipation is common around farrowing
  - Hard faeces may create a physical obstacle pressing the birth canal (Cowart, 2007)
  - Discomfort/pain may influence hormonal pattern
    - Opioids inhibit release of oxytocin (Bicknell and Leng, 1982; Douglas et al., 1995; Brown et al., 1999)
  - Prolonged constipation and endotoxins may break the gut barrier (Smith, 1985; Martineau et al., 1992)
    - Effect on the endocrine regulation???



Grannec 2007

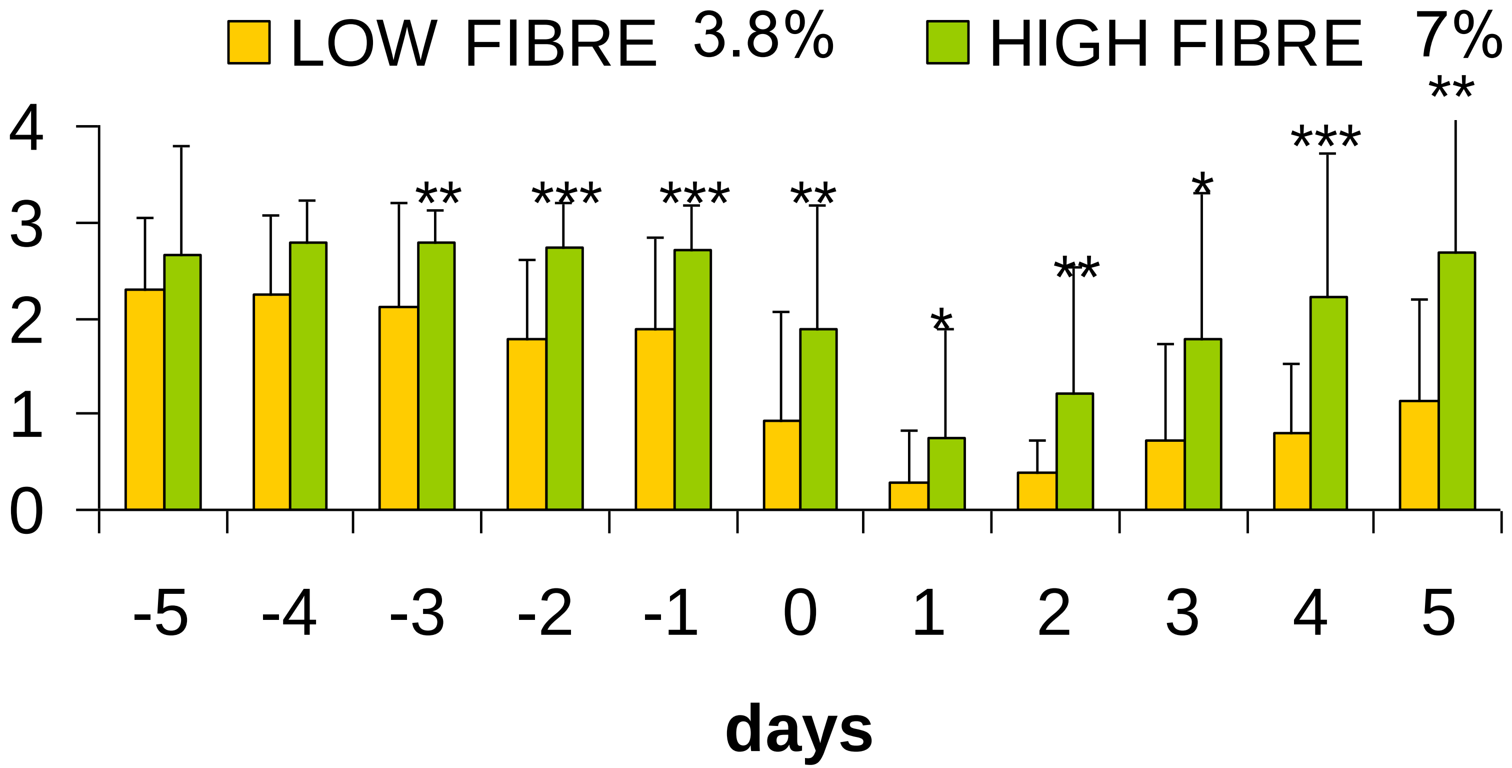
We monitored the intestinal activity of all of the sows in the four replicates ($n = 81$), from five days before to five days after farrowing, making a daily qualitative evaluation of the faeces. Every morning before the daily cleaning, we ranked the faeces of each sow by visual qualitative evaluation. We assigned a score value ranging from 0 to 5, with 0 (absence of faeces), 1 (dry and pellet-shaped), 2 (between dry and normal), 3 (normal and soft, but firm and well formed), 4 (between normal and wet, still formed but not firm) and 5 (very wet faeces, unformed and liquid).

Faecal qualitative score

	0	absence of faeces
	**1**	dry and pellet-shaped (unformed)
	**2**	between dry and normal (pellet-shaped and formed)
	**3**	normal and soft, but firm and well formed
	**4**	between normal and wet; still formed, but not firm
	**5**	very wet faeces, unformed and liquid

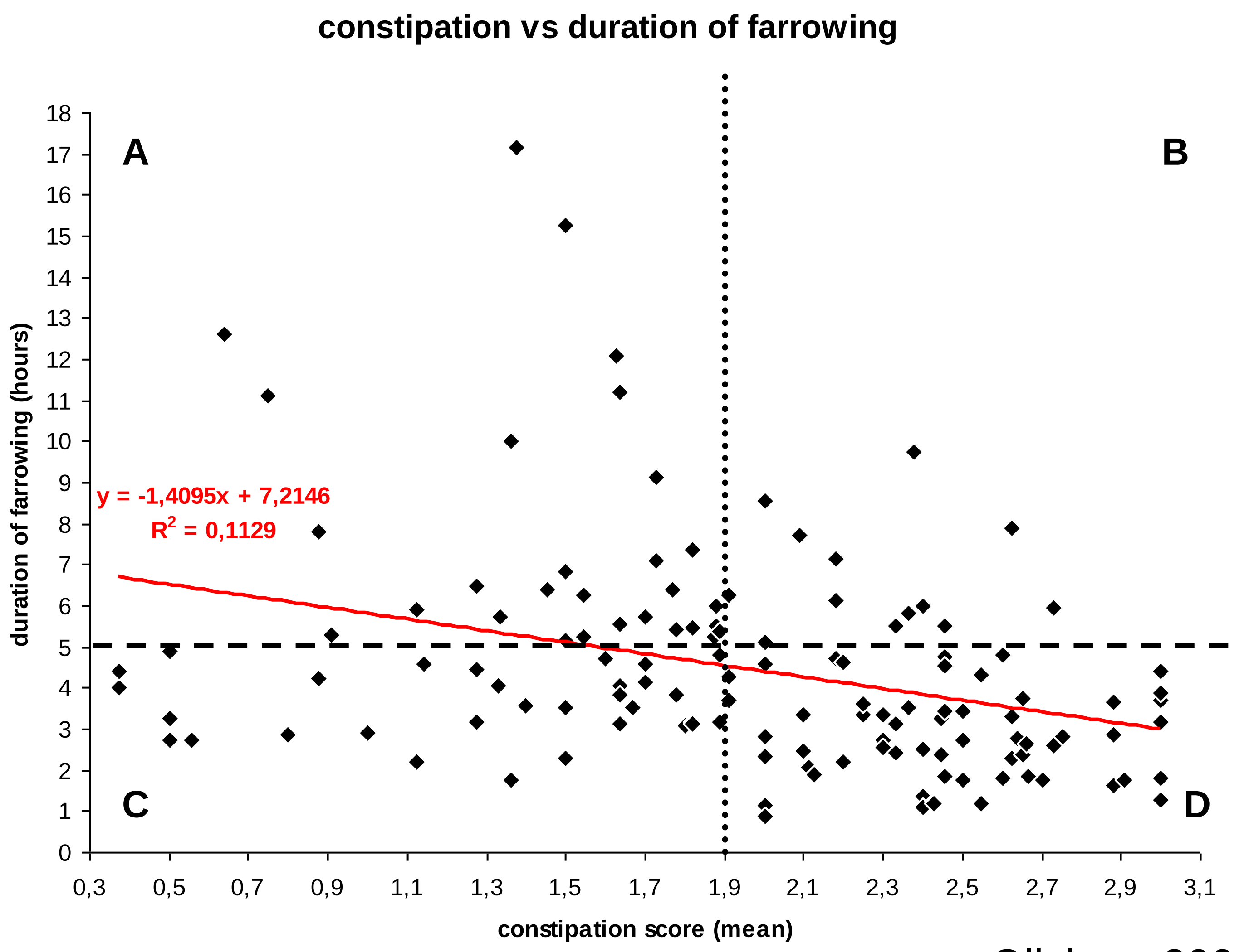
Oliviero, 2008

Evolution of the constipation index around farrowing (n=250 sows)
Effect of fiber



Oliviero, 2008

Constipation index at farrowing and quality of farrowing

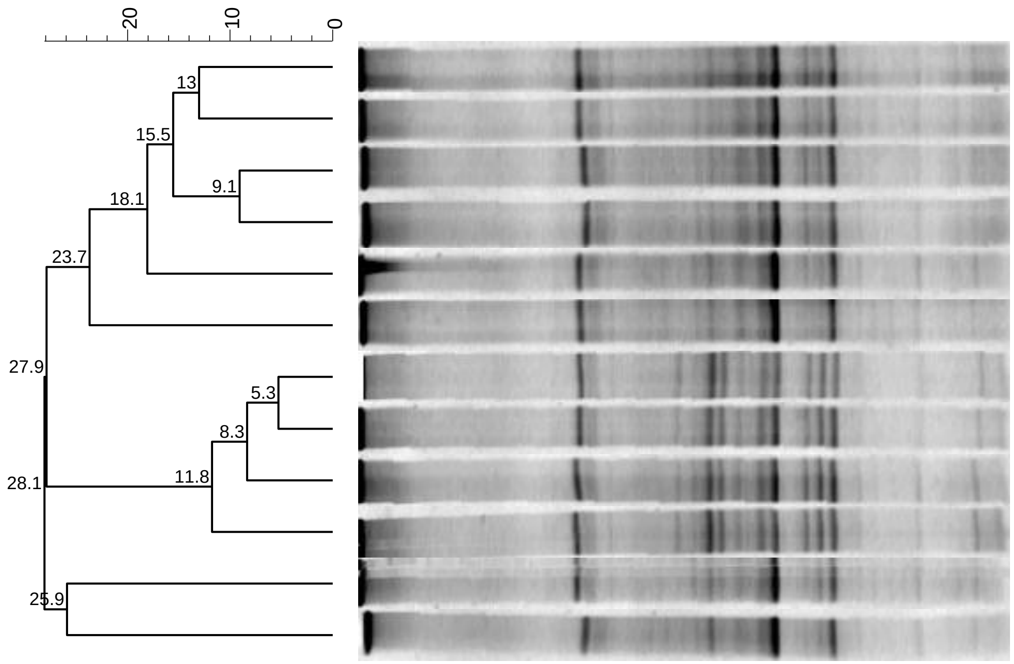


Oliviero, 2008

Effect on gut flora

Dendogram cluster analysis

% of similarity



T3, day -21
T3, day-3
T4, day -21
T4, day-3
T4, day +7
T3, day +7
T1, day -21
T1, day -3
T2, day -3
T2, day, -21
T1, day +7
T2, day +7

High Fibre

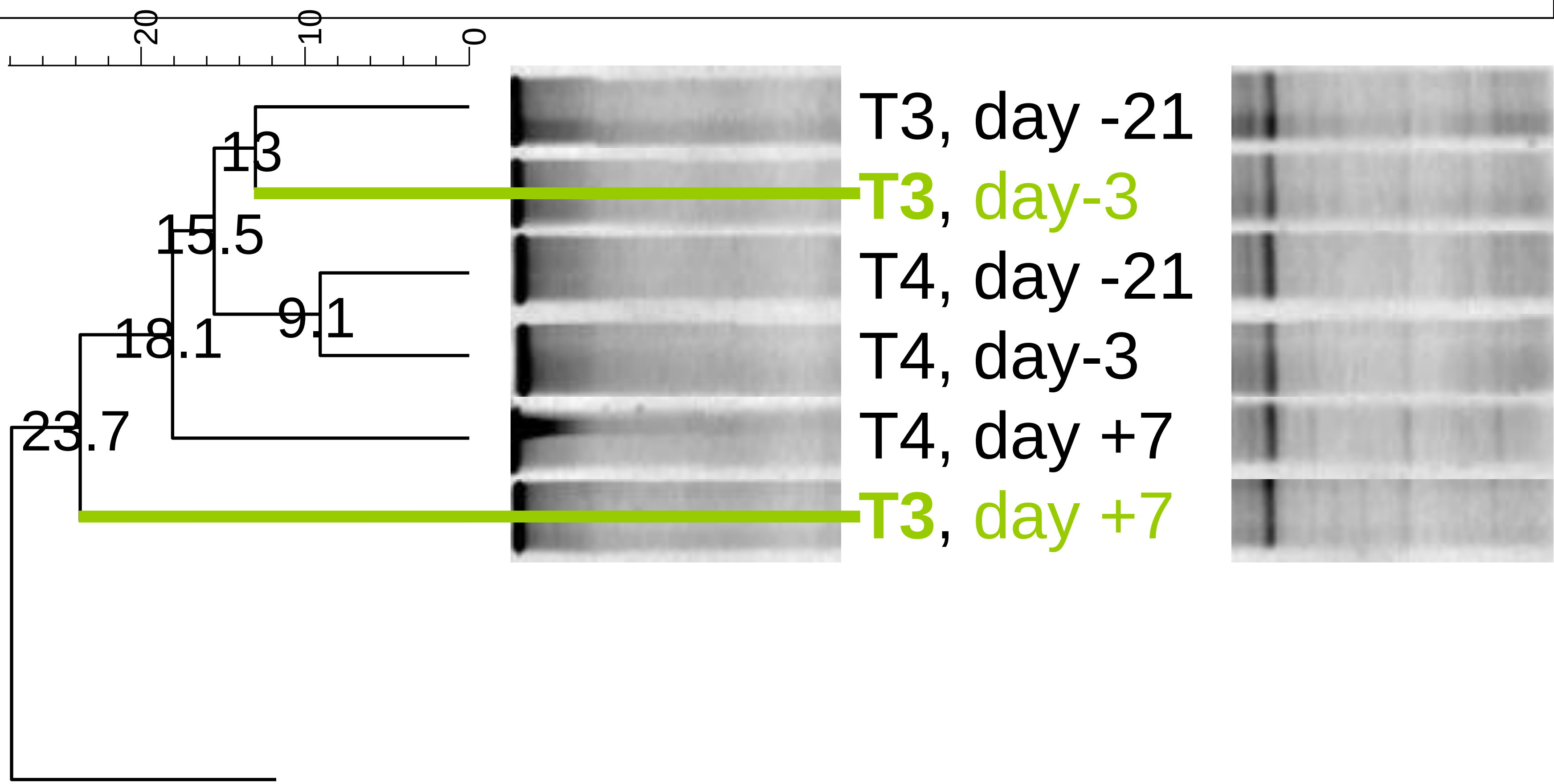
Corn soy

T1 = Corn Soy
T3 = High fibre
T2 = Corn soy + Sb
T4 = High fibre + Sb

Huge changes around farrowing even with the same feed

Letreut, 2009

Dendogram cluster analysis (% of difference)



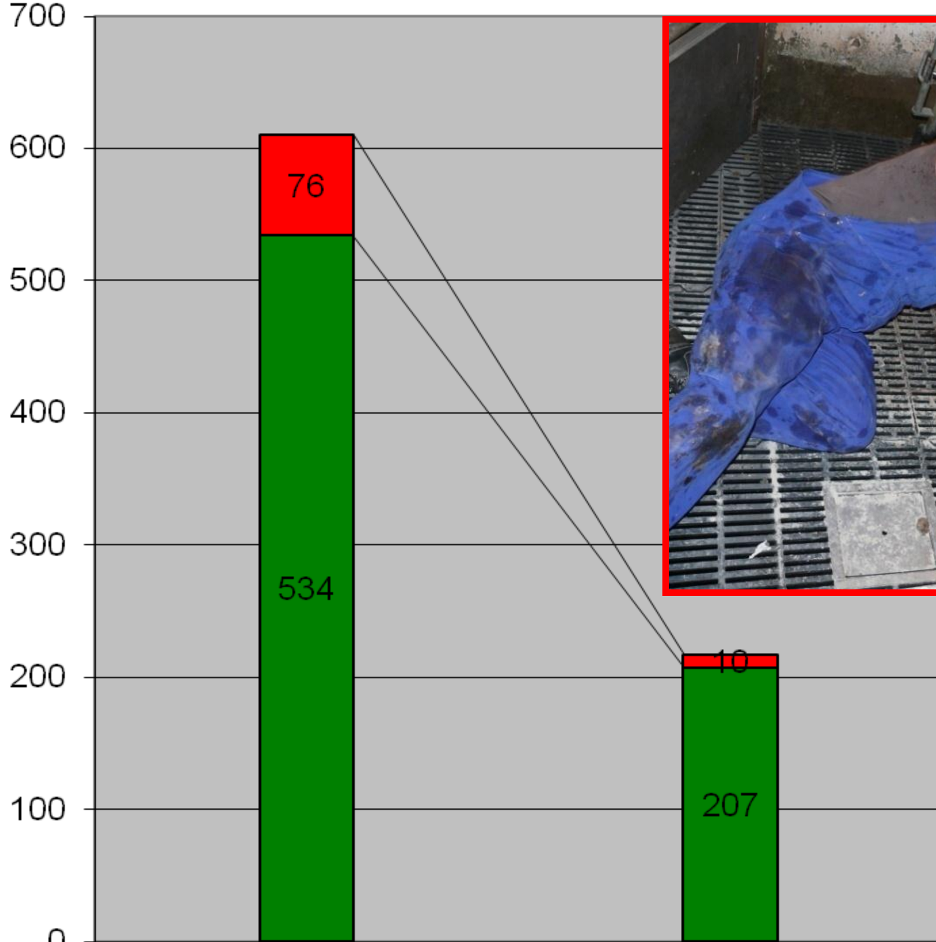
% of different cluster of bacteria

Letreut, 2009

Evaluation of the quality of farrowing

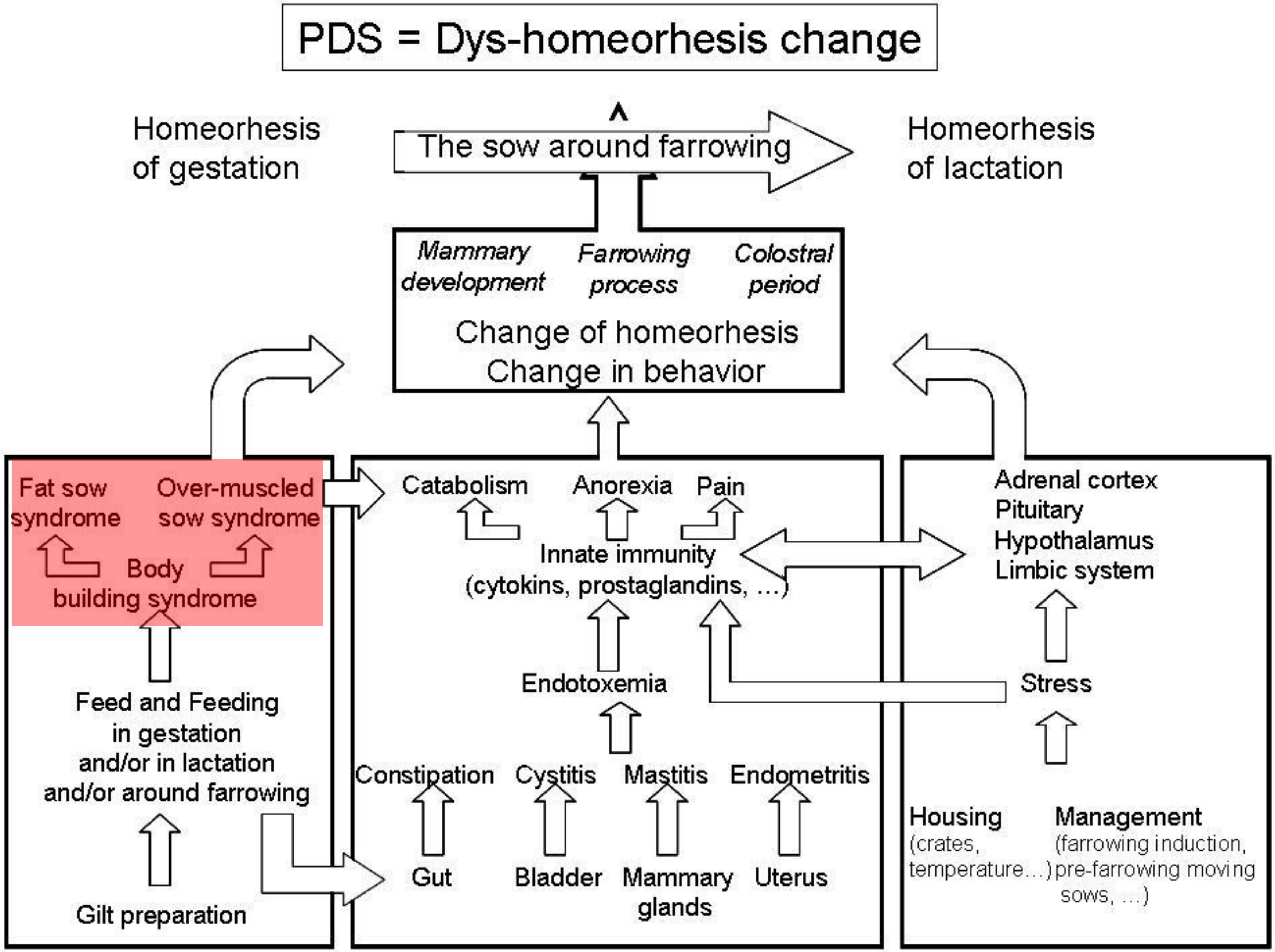
Manual (help) versus natural farrowing

12.5%
vs
4.6%



	Control	Effect on gut flora
fouillés	76	10
non fouillés	534	207

Martineau, 2010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Fat sow syndrome
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Body building syndrome
Feed and Feeding in gestation and/or in lactation and/or around farrowing
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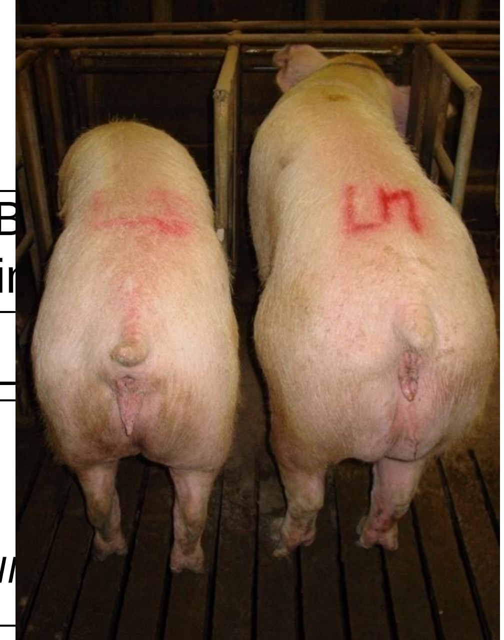
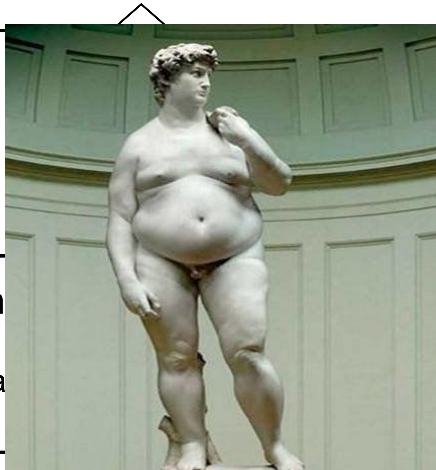
Endotoxemia
Constipation
Cystitis
Mastitis
Endometritis
Gut
Bladder
Mammary glands
Uterus
Adrenal cortex
Pituitary
Hypothalamus
Limbic system
Stress
Housing (crates, temperature…)
Management (farrowing induction, pre-farrowing moving sows, …)



Fat sow syndrome

Over-muscled sow syndrome

Body building syndrome



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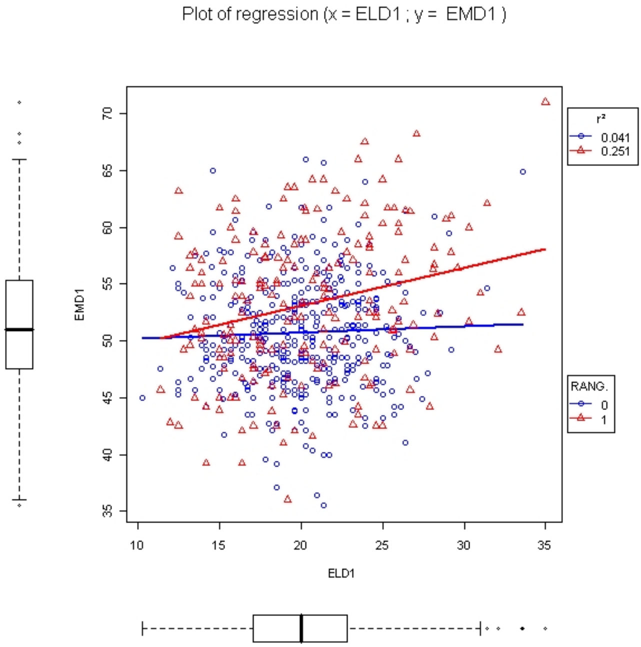
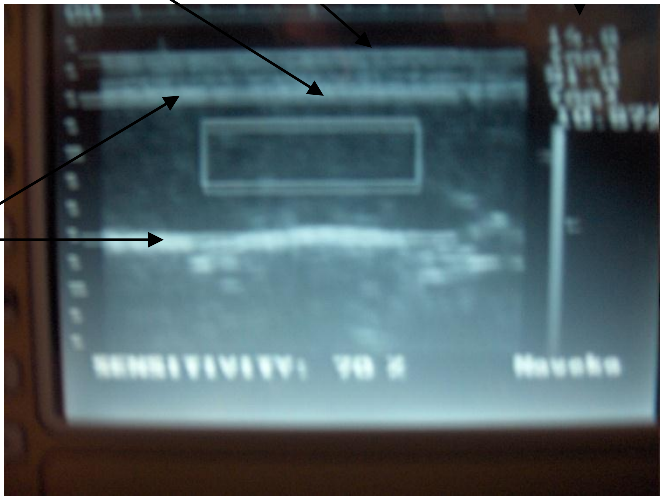
BF & BL

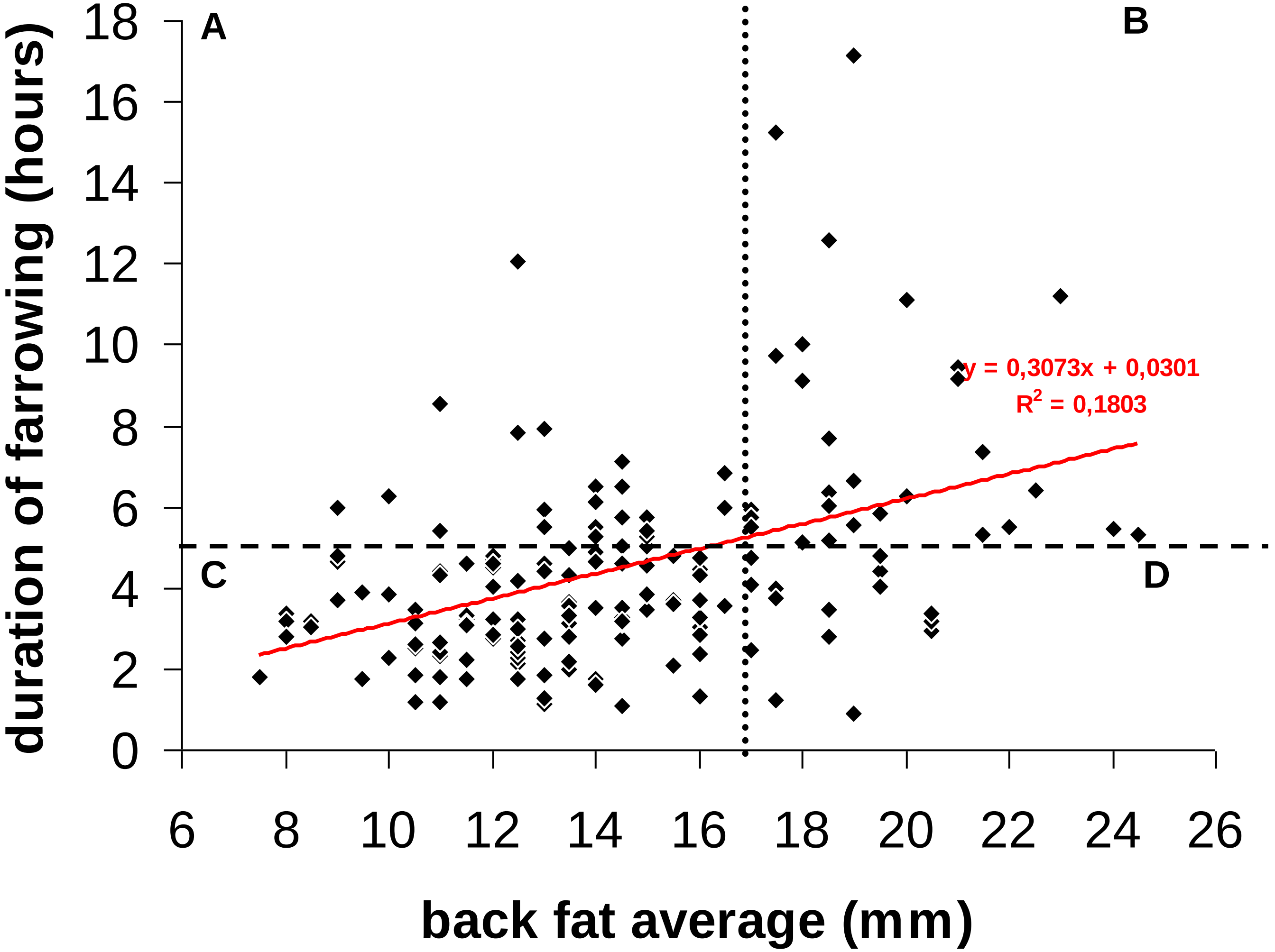


Back Fat = 14,0 mm

Back Lean = 51,0 mm



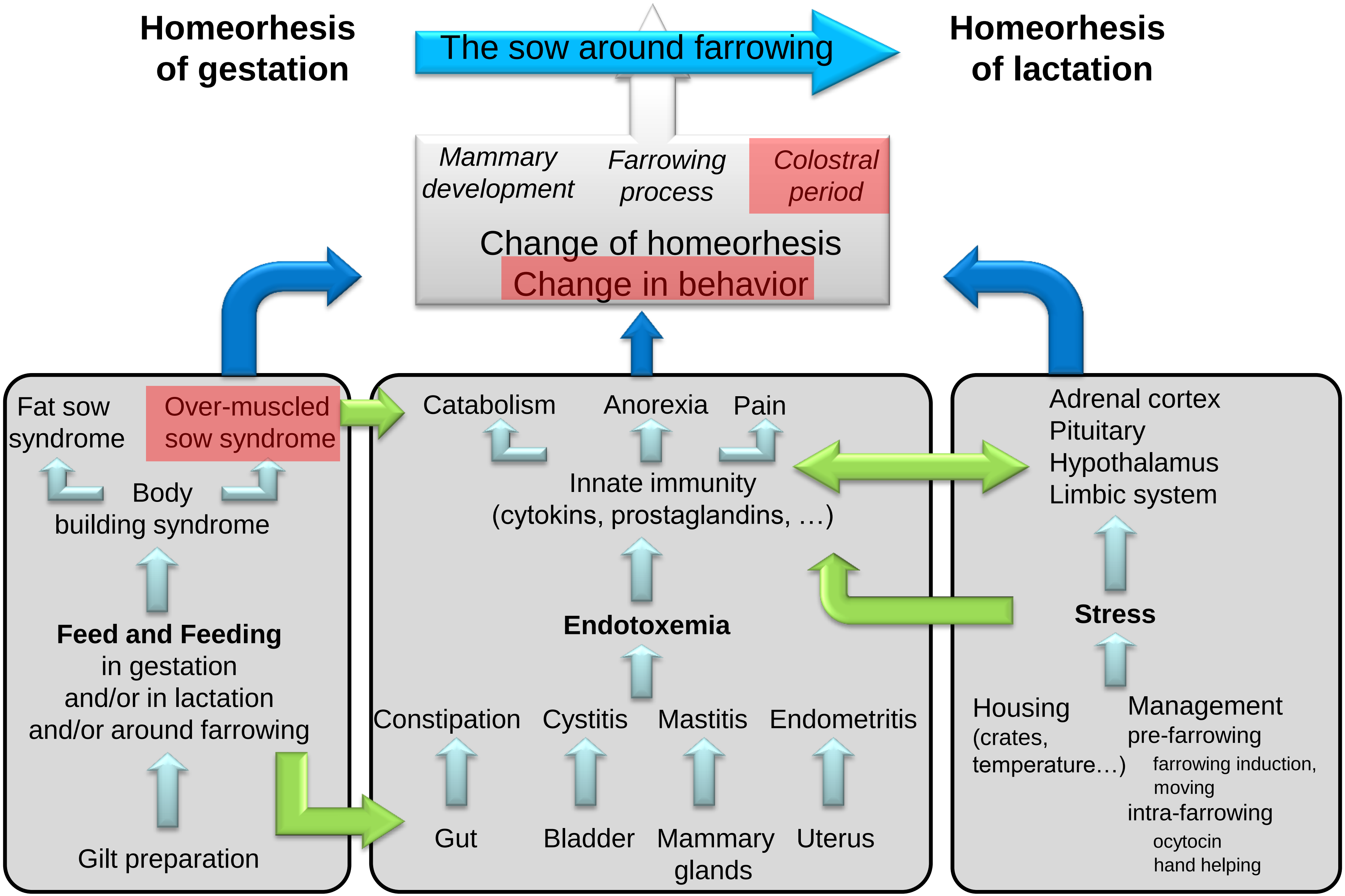
Quality of farrowing



Oliviero, 2008

- Higher layer of back-fat associated with longer duration of farrowing
  - High level of fat may interfere with the lipid-soluble steroids
    - Progesterone:estrogens ratio >>> oxytocin receptors activation (McCracken et al., 1999; Russell et al., 2003)
  - Fat sows may have more fat layers around the birth canal
    - Reduction of the diameter / physical obstacle during the delivering (Cowart, 2007)

PDS : Dys-homeorhesis change



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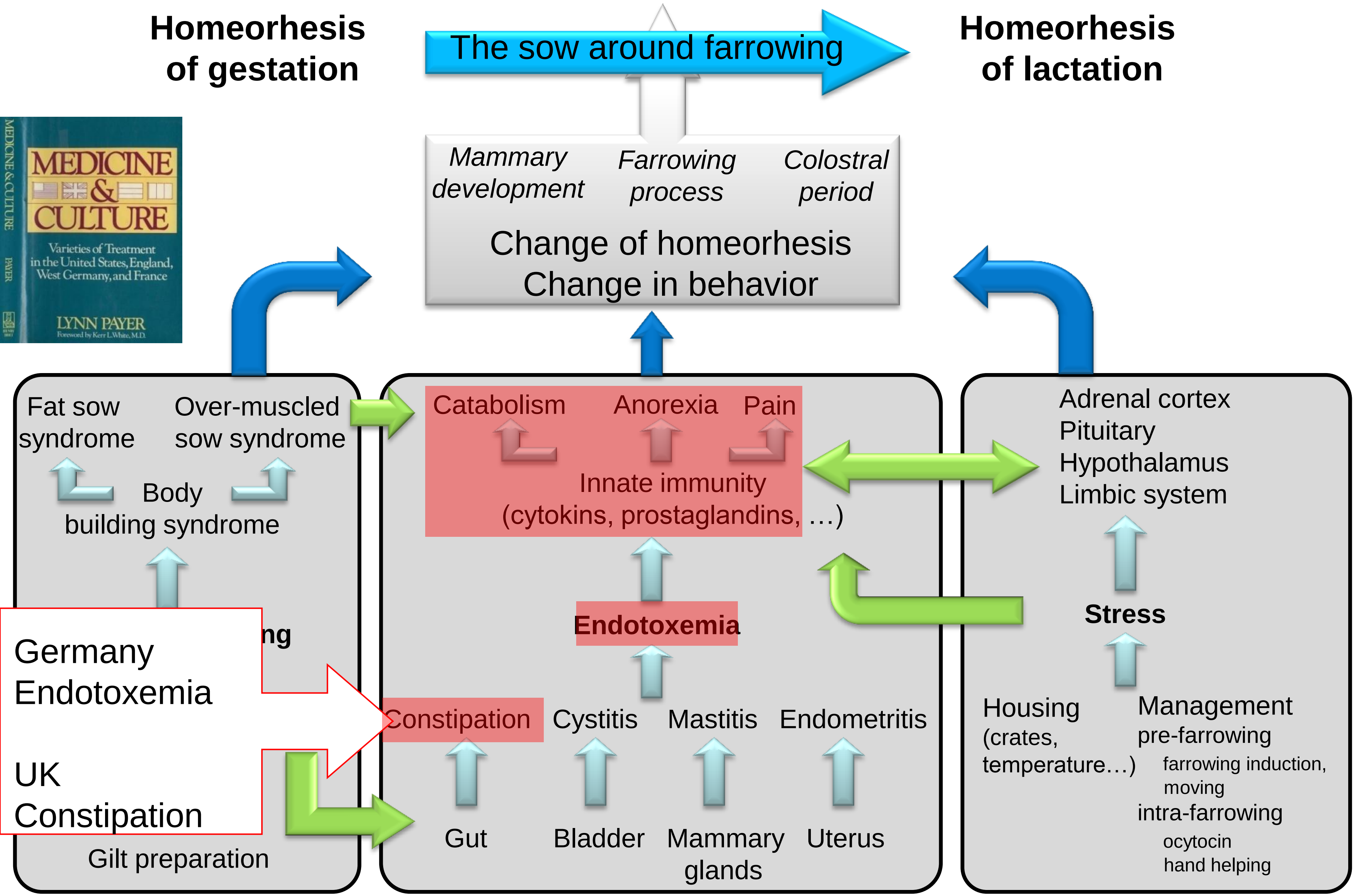

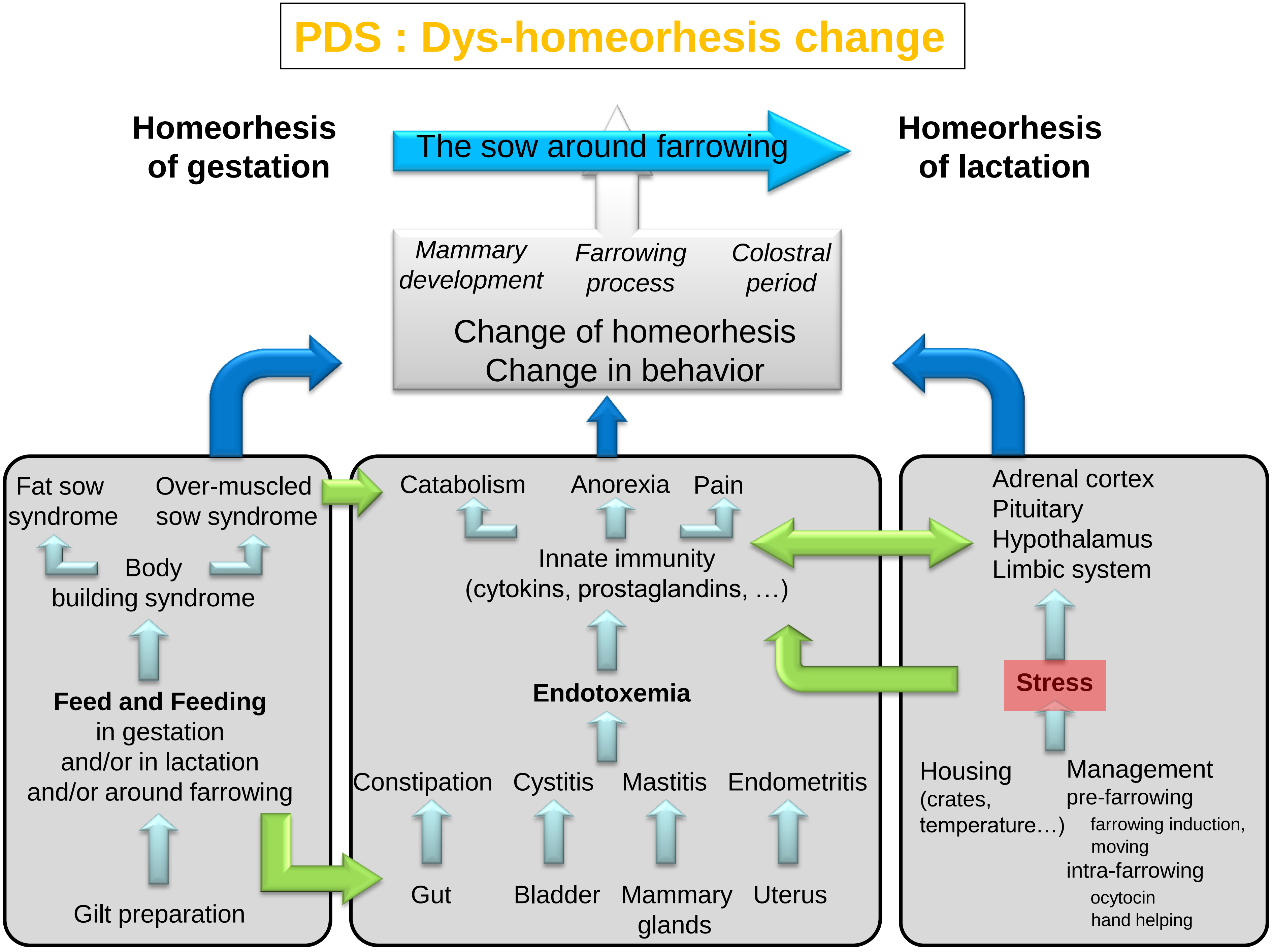
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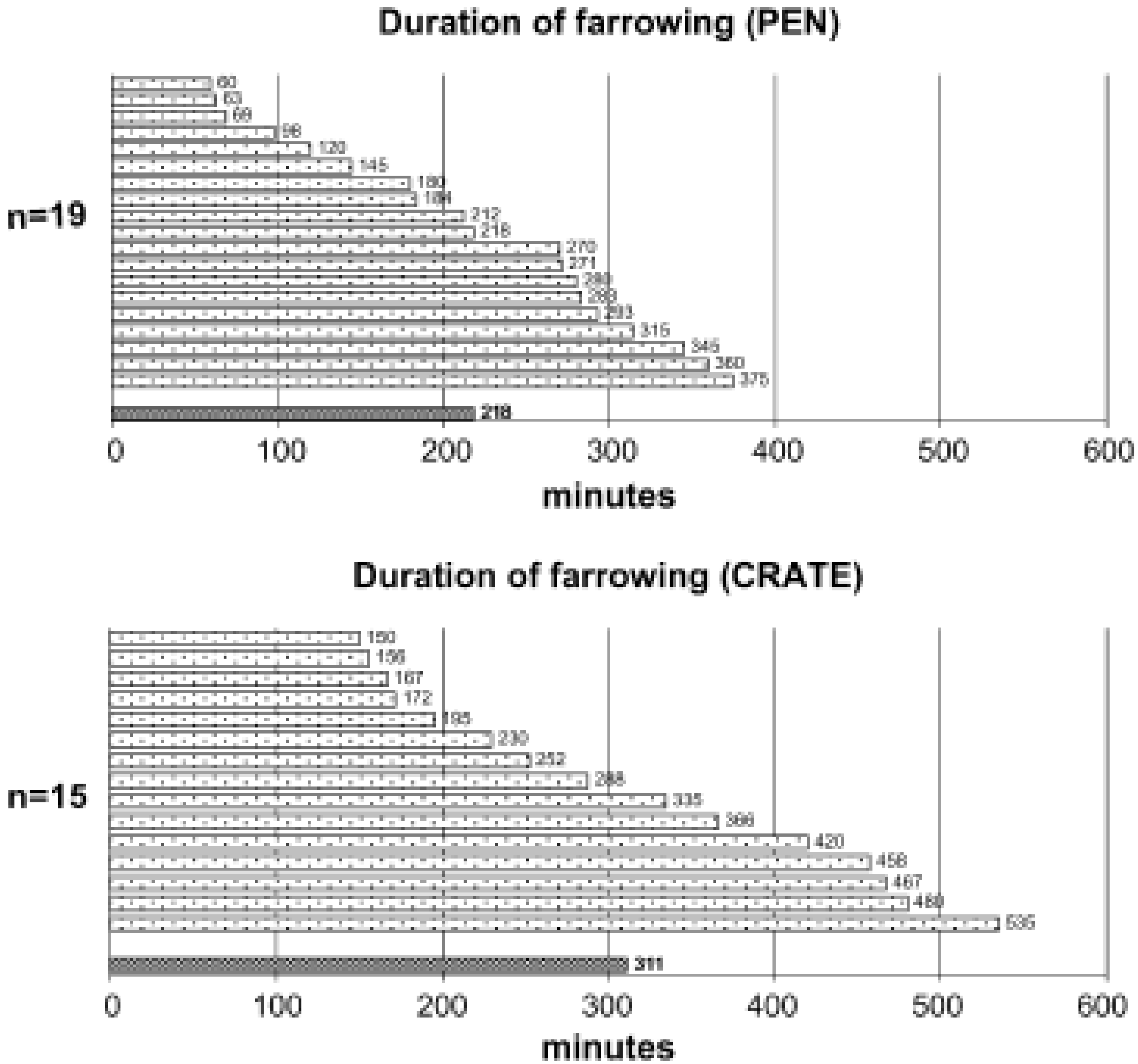
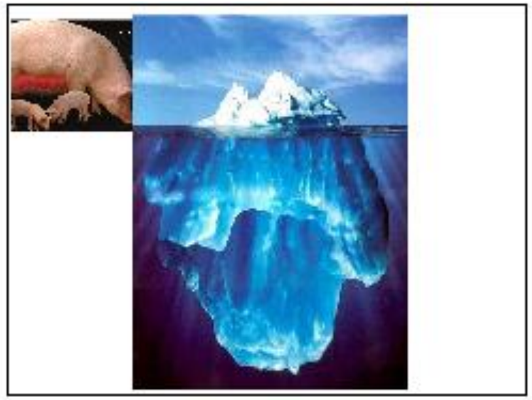
Endometritis
Gut
Bladder
Mammary glands
Uterus
Adrenal cortex
Pituitary
Hypothalamus
Limbic system
Stress
Housing (crates, temperature…)
Management
pre-farrowing
farrowing induction, moving
intra-farrowing
ocytocin
hand helping

I


Duration of farrowing (PEN)
n=19
60
63
98
120
145
180
212
218
270
271
315
345
360
375
218
0
100
200
300
400
500
600
minutes
Duration of farrowing (CRATE)
n=15
150
167
172
195
230
252
288
335
366
420
458
467
535
311
0
100
200
300
400
500
600
minutes

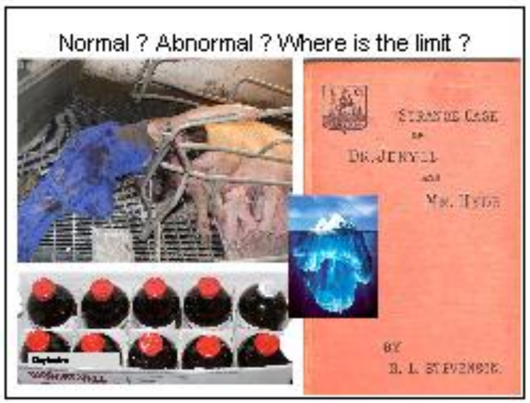
Flash back

00:07 1

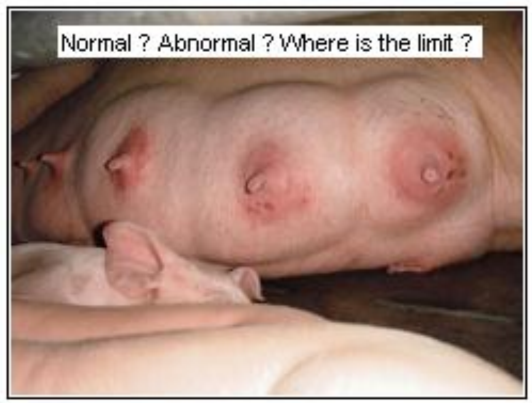


2

3

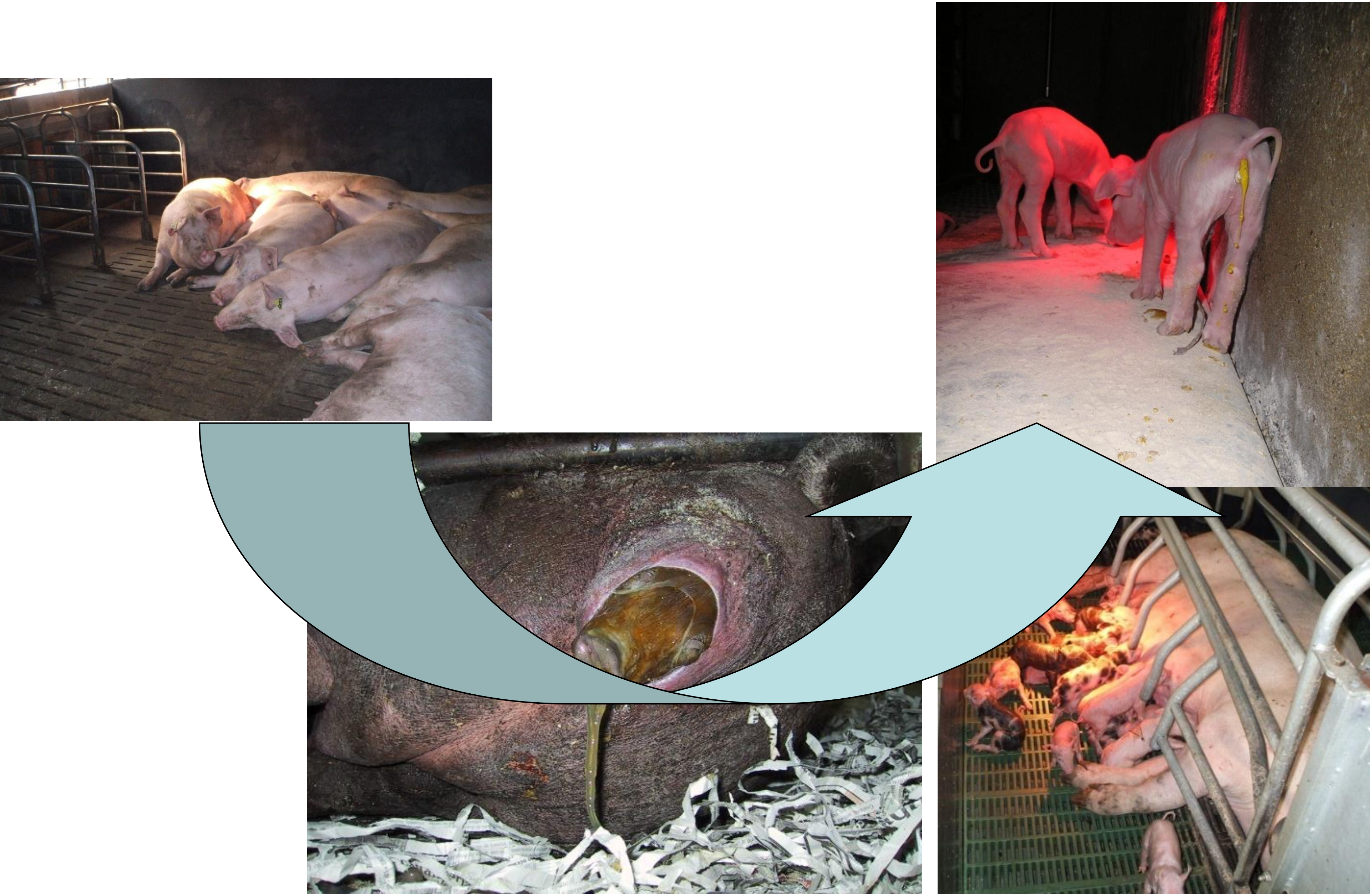


4



5

6



PDS : Dys-homeorhesis change

Homeorhesis of gestation

The sow around farrowing

Homeorhesis of lactation

Mammary development | *Farrowing process* | *Colostral period*

Change of homeorhesis
Change in behavior