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The role of *Escherichia coli* in the pathogenesis of coliform mastitis in sows

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Introduction

⇨ **today: larger litter sizes**

⇨ **increase in milk yield per day**

1970/1980ies ~ 5-7 kg (Elsley 1971, Noblet&Etienne 1986)

2012 ~ Ø 12 kg (Weber 2012)

milk amount and quality are essential for piglets‘ growth!

⇨ **any reduction leads to serious consequences**

Introduction

- ⇨ **milk yield can be negatively altered by coliform mastitis as part of the Postpartum Dysgalactia Syndrome (PDS)**
- ⇨ **multifactorial disease**
- ⇨ **clinical and subclinical cases**
- ⇨ **consequences for sow‘s and piglets‘ health**

Risk factor analysis

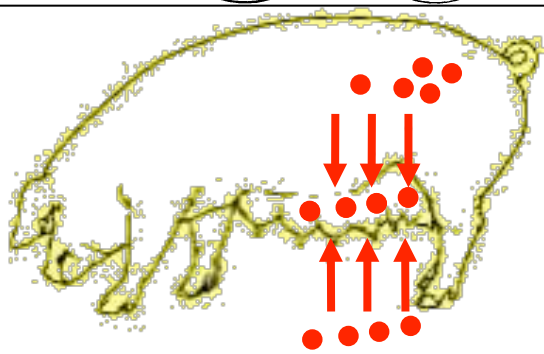
mastitis-risk⇧

Variable/Level	Odds ratio	P-value	
Piglets born alive			
<12	1.00		
12-13	1.07	0.0032	
>13	1.65		⇨ **>13 piglets born alive**
Piglets born dead			
0	1.00		
1	1.04	0.0595	
>1	1.45		⇨ **> 1 piglets born dead**
parity			
1	1.00		
2-3	0.59	0.0146	
4-5	0.51		⇨ **1. parity**
>5	0.67		
obstetrics			
yes	1.00	0.008	
no	1.72		⇨ **after birth assistance**

(n = 1337)

(Gerjets, Traulsen, Reiners & Kemper 2011)

Bacterial pathogens



- ⇨ endogen infection (guts, uterus, urinary tract)
- ⇨ galactogen infection: between 108. day of pregnancy and 2 days post partum (Bertschinger *et al*. 1990)
- ⇨ no significant differences in the bacterial spectrum of cranial and caudal teats (Kemper & Gerjets 2009)
- ⇨ bacteria of the skin flora are also present in milk (Kemper & Preißler 2011)

Material and methods

- ‚Structural and functional analysis of the genetic variation of the MMA-Syndrome‘

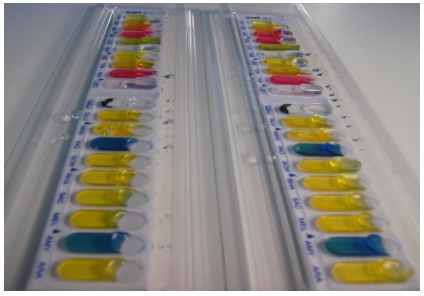
  (geMMA, funded by the German Ministry of Education and Research)

- data and samples from six farms
- high health status, free from PRRS, APP, Dysentery, Rhinitis, Salmonella
- mastitis-prevalence from 6.1 - 10.8%

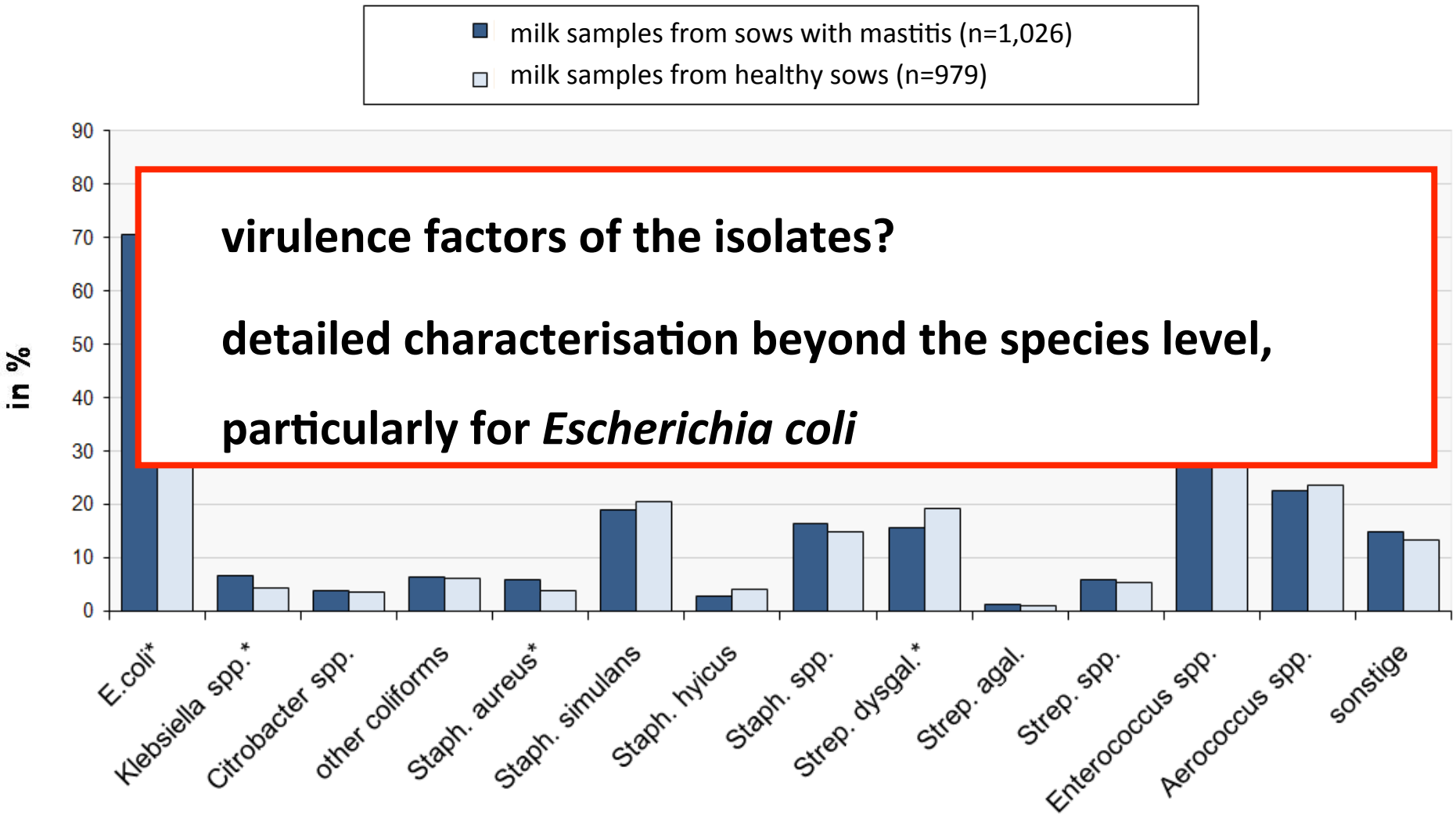
Material and methods

- ⇨ **trait ‚diseased‘: rectal temperature >39,5°C 24h post partum and inflammation of the mammary gland and/or altered piglet behaviour**

- ⇨ **bacteriological analysis of milk samples from healthy (n=979) and diseased (n=1,026) sows**



Results



virulence factors of the isolates?

detailed characterisation beyond the species level,

particularly for *Escherichia coli*

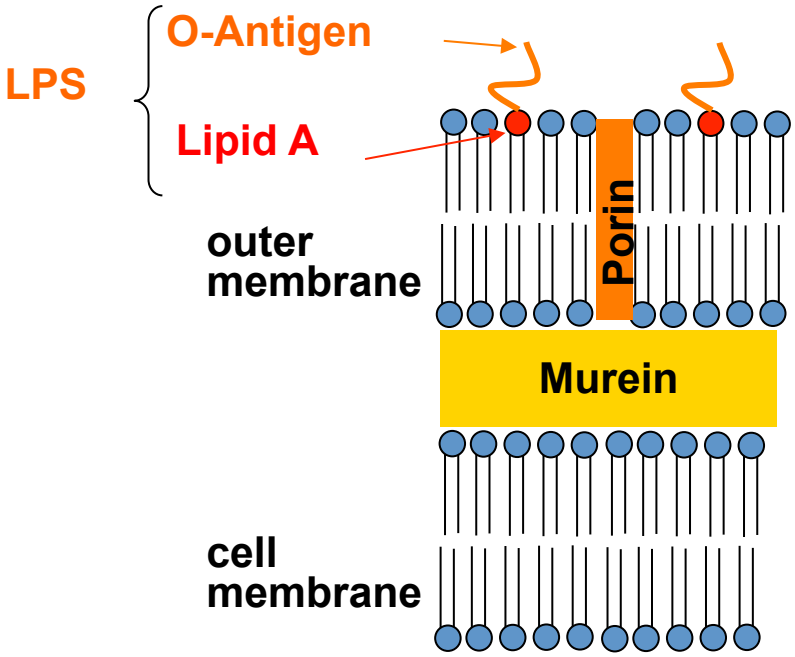
(Gerjets, Reiners & Kemper 2011)

Escherichia coli

Virulence factors

⇨ **endotoxins** (in each bacteria-cell)

Lipid A from the LPS-complex of the cell layer



essential for the pathophysiological processes in mastitis!

⇨ **enterotoxins**

heat labile (LT) and -stable (ST) enterotoxins

⇨ **cytotoxins**

hämolysins, Shigatoxins, necrotising toxins

⇨ **adhesion factors**

fimbrieae, proteins: Intimin, Invasin

Escherichia coli

Prevalence of virulence-associated genes in *E. coli*-isolates of healthy and diseased sows

⇨ **multiplex-PCR: detection of 27 virulence genes**

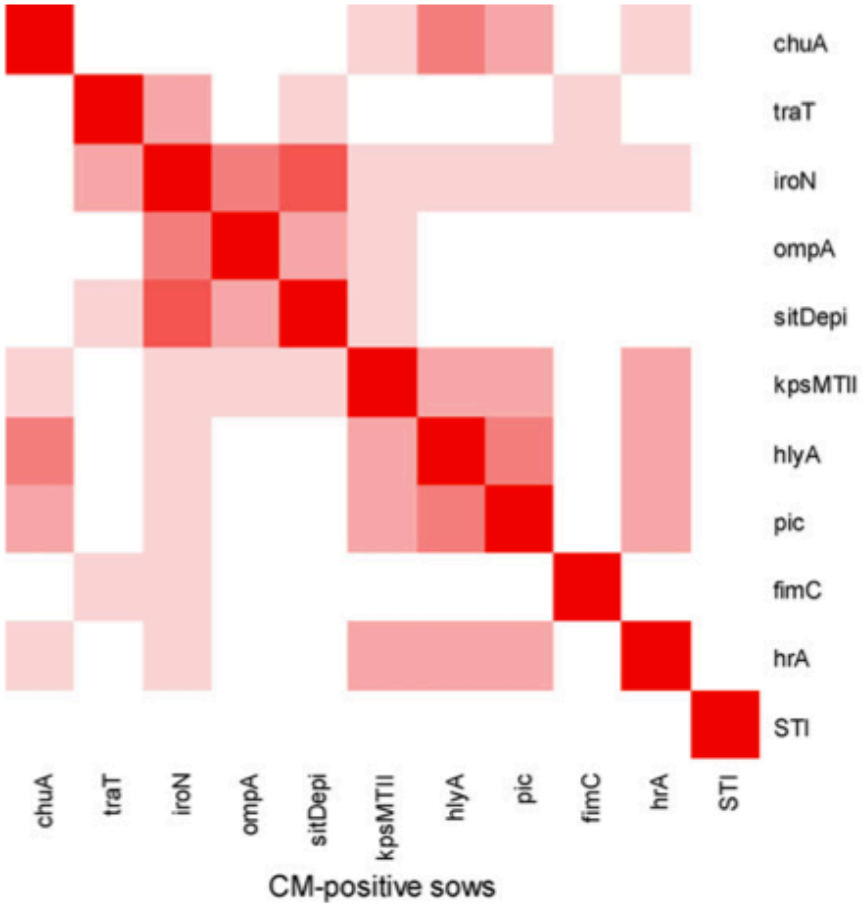
Gene(s)/categories		prevalence of virulence-associated genes (%)				*P*-value
		E. coli isolates (n = 1,271) of CM-negative sows	no. of farms with isolates with the respective gene	E. coli isolates (n = 1,132) of CM-positive sows	no. of farms with isolates with the respective gene	
Adhesins						
afa / dra	ExPEC	-	-	-	-	-
fimC	ExPEC	82.30	4	84.72	4	0.1112
*hra**	ExPEC	11.33	4	14.84	4	0.0106
iha	ExPEC	0.16	2	0.18	2	0.9077
sfa / foc	ExPEC	0.08	1	0.18	2	0.4971
K99 (fanA)	ETEC	-	-	-	-	-
K88 (faeG)	ETEC	0.08	1	0.09	1	0.9367
987P (fasA)	ETEC	0.08	1	-	-	0.3443
F18 (fedA)	ETEC	-	-	0.09	1	0.2892
F41 (fedA subunit)	ETEC	-	-	-	-	-
Iron acquisition						
Enterotoxins						
STII	ETEC	-	-	0.18	1	0.1338
STI	ETEC	2.28	2	1.94	1	0.5658
LT	ETEC	-	-	0.09	1	0.2892
Shiga Toxins						
Stx2e	STEC	-	-	-	-	-
Invasins						
gimB	ExPEC	0.08	1	0.00	-	0.3452
ibeA	ExPEC	0.63	3	0.97	2	0.3443
Miscellaneous						
pic	ExPEC	0.63	4	1.33	3	0.0804

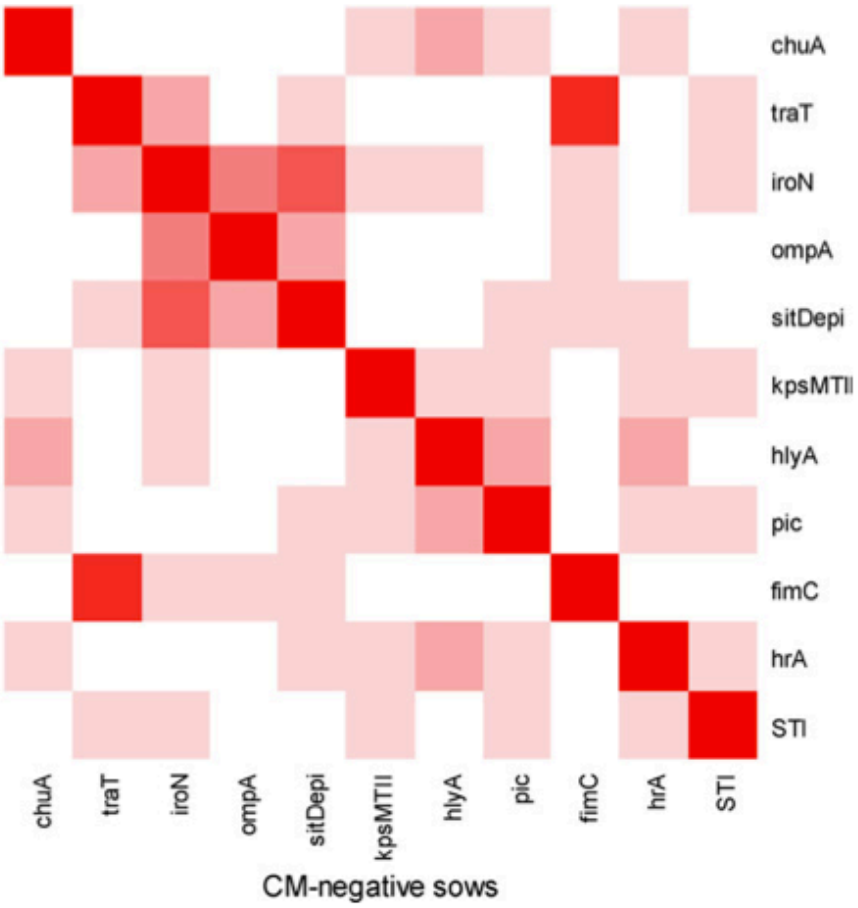
⇨ **significant differences in *hra*, *chua*, *iroN*, *kpsMTII***

⇨ **especially virulence genes of extra-intestinal pathogenic *E. coli*-strains**

Escherichia coli

Associations between 12 virulence-genes of *E. coli*-isolates of diseased and healthy sows, dark red: p<0.05





Discussion

- ⇨ **no characteristic virulence gene-pattern in *Escherichia coli***
- ⇨ **no specific ‘Mastitis-strain‘**
- ⇨ **farm-specific virulence gene-patterns**
- ⇨ **if adverse co-factors are present, nearly any strain is able to cause mastitis**

Discussion

Possible reasons for positive bacteriological results in clinically unaffected sows:

- ⇨ **bacterial colonisation**
- ⇨ **emerging subclinical mastitis in sows**
- ⇨ **contamination via teat canal (two to three milk cisterns)**
- ⇨ **resistance/tolerance due to genetic variation**
- ⇨ **resistance/tolerance due to unknown factors**

requires further clinical and experimental studies...

Conclusion

Pathogens (inflammation!)

⇨ *Escherichia coli*

⇨ and others...

Environmental factors

⇨ husbandry

⇨ hygiene

⇨ feeding

coliform mastitis = multifactorial disease

Sow factors

⇨ parity number

⇨ behaviour

strategic & integrated approaches for reduction on farm level!

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Thanks for your attention!

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