



# Intramammary administration of lipopolysaccharides at parturition affects colostrum quality

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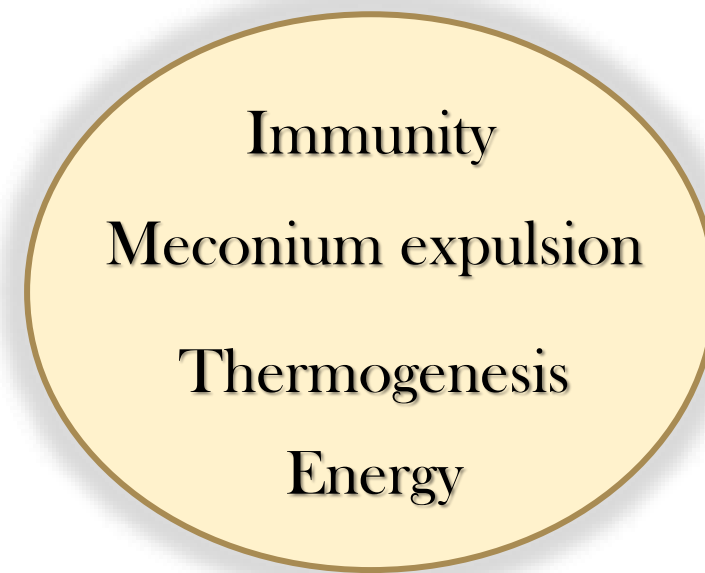


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# Background

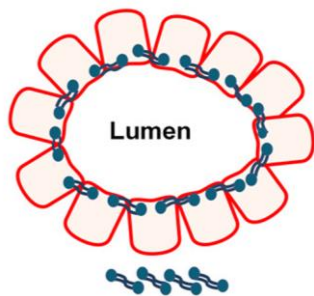
## Passive Immune Transfer



# Background

## Blood-milk barrier

Mammary alveolus epithelium with integrated tight junction



Zhang et al. 2015

## Colostrogenesis



## Mastitis



↓ Integrity

↑ Permeability



Different chronological patterns of appearance of blood derived milk components during mastitis indicate different mechanisms of transfer from blood into milk.  
Wellnitz et al. (2015)



Pathogen-specific immune response and changes in the blood-milk barrier of the bovine mammary gland.  
R. Bruckmaier and O. Wellnitz (2017)

# Background

VM

Dose dependent changes in inflammatory parameters in the milk of dairy cows after intramammary infusion of lipopolysaccharide. Werner-Misof et al. (2007)



Concomitant lipopolysaccharide-induced transfer of blood-derived components including immunoglobulins into milk. Lehmann et al. (2013)

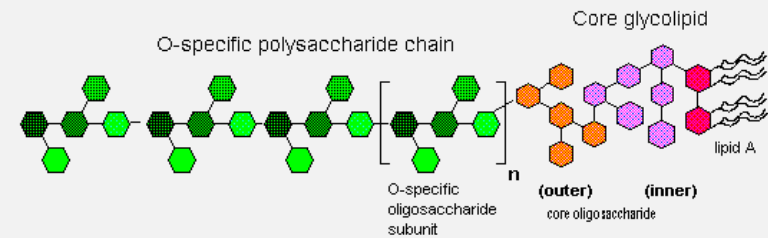
SCIENTIFIC  
REPORTS  
nature

Milk yield, milk composition, and milk metabolomics of dairy goats intramammary-challenged with lipopolysaccharide under heat stress conditions. Salama et al. (2020)



## Lipopolysaccharides

Gram-negative bacterial endotoxin (lipopolysaccharide, LPS)







## Hypothesis

The intramammary administration of bacterial lipopolysaccharides (LPS; *Escherichia coli* serotype O26:B6) at parturition in dairy goats increases the permeability of the blood-milk barrier resulting in increased concentration of colostrum and milk immune components.

## Objectives

Evaluate the effect of intramammary administration of LPS on:

- Colostrum and milk yields and composition.
- Goat immune system during the first 4 weeks of lactation.

# Material and Methods



Animal experiment procedure: OEBA-ULPGC 27/2021

## Intramammary administration

### LPS group

n = 10

50  $\mu$ g de LPS in 2 mL  
saline solution 0.9%

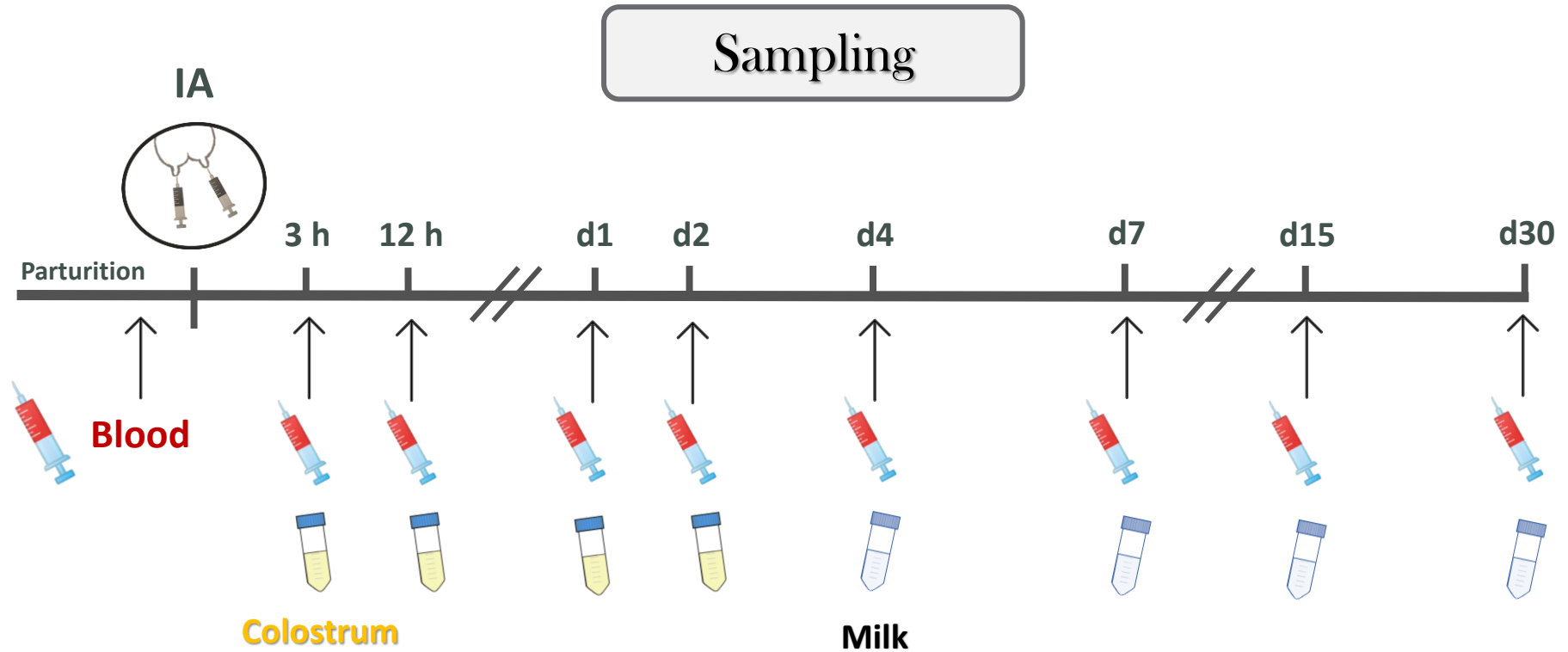
### CONTROL group

n = 10

2 mL of saline  
solution 0.9%



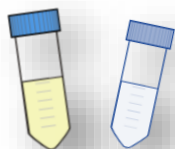
# Material and Methods



Animal experiment procedure: OEBA-ULPGC 27/2021

# Material and Methods

## Variables



Colostrum/milk

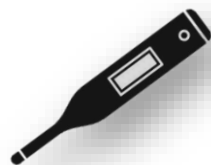
- Yield
- Chemical composition
- Somatic cell count (SCC)
- Immunoglobulin (Ig) G and M



Blood

- Serum  
β-hydroxybutyrate, glucose, calcium, free fatty acids, lactate dehydrogenase and total proteins.

- Plasma IgG and IgM
- Rectal temperature



## Statistical analysis



### Mixed procedure

Repeated measure: Time  
Subject: Animal ID

Tukey's test,  $p\text{-value} \leq 0.05$





# Results & Discussion

## Colostrum

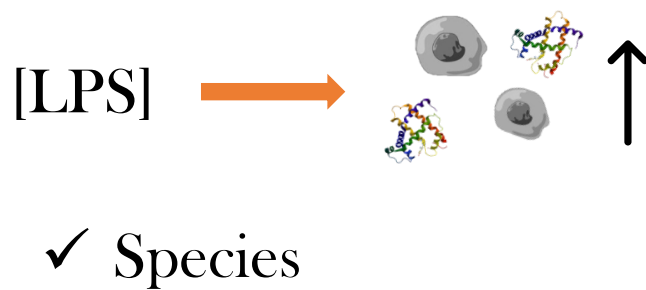
Variables	Groups			Fixed effects		
	LPS	CON	SEM	IA	Time	IA×T
Yield, kg	1.9	1.8	0.22	0.792	0.002	0.462
Lactose, %	3.2	3.5	0.15	0.111	0.002	0.204
Fat, %	7.5	8.6	0.42	0.065	<0.001	0.862
Protein, %	8.8	8.2	0.60	0.393	<0.001	0.641
Total solids, %	24.1	24.4	0.72	0.637	<0.001	0.378
SCC, log <sub>10</sub> cells/mL	3.5	3.1	0.09	0.011	0.161	0.169
IgG, mg/mL	31.9	19.0	4.80	0.044	<0.001	0.515
IgM, mg/mL	0.8	0.5	0.08	0.037	<0.001	0.798

# Results & Discussion

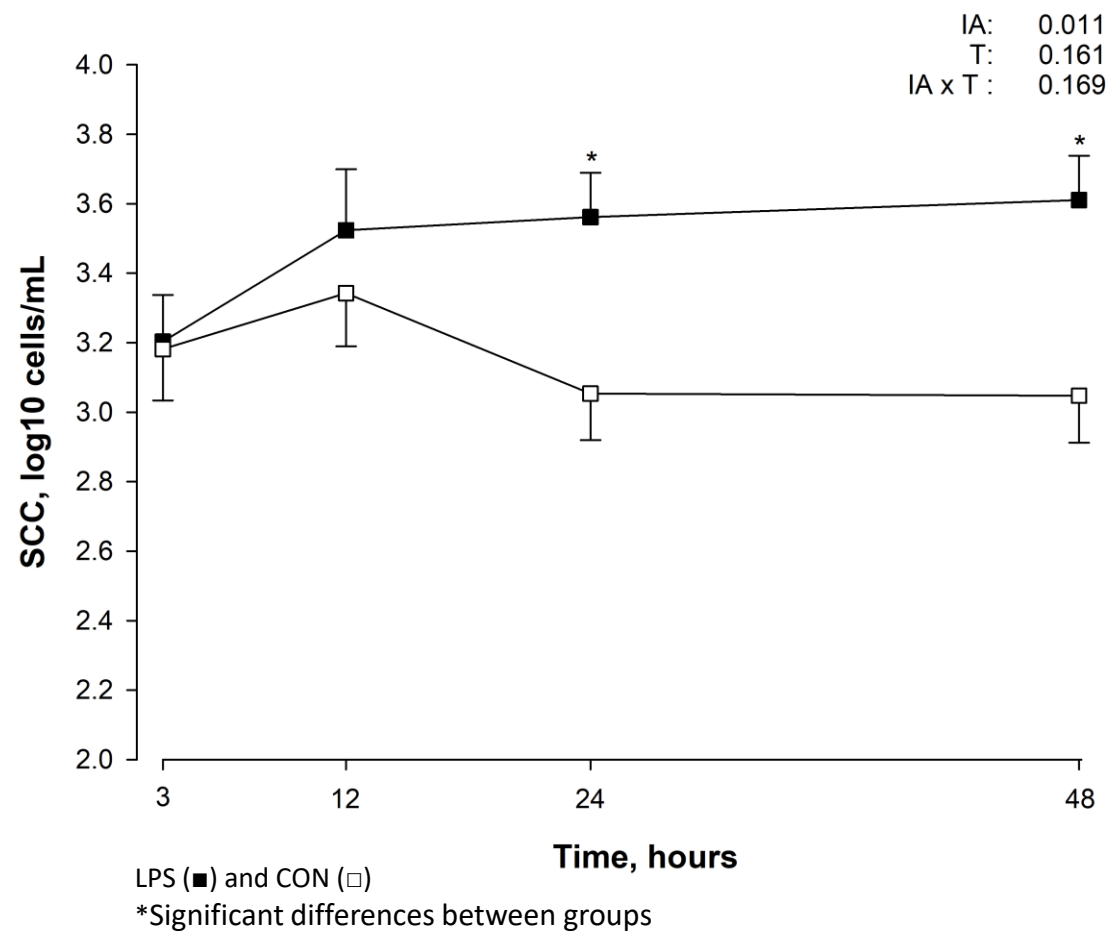
## ■ Immune response

van Oostveldt et al. (2002)

Werner-Misof et al. (2007)



## Somatic cell count (SCC)



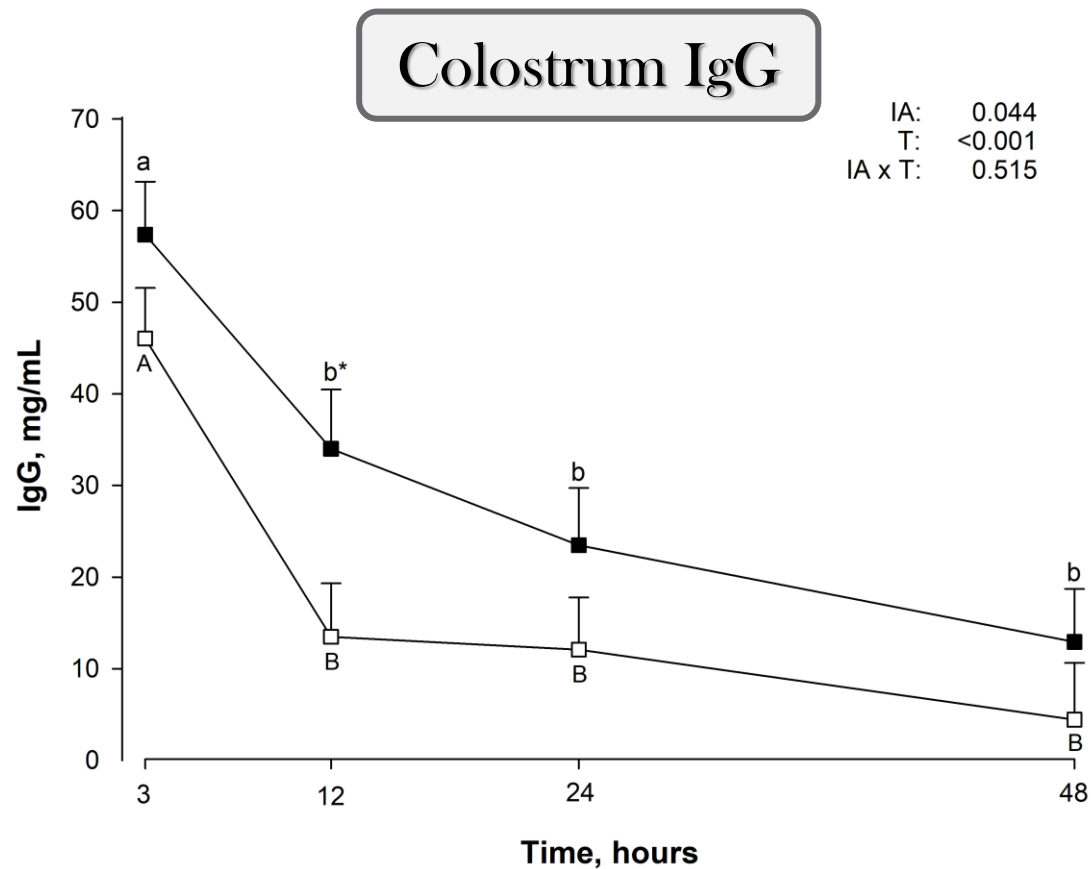


# Results & Discussion

## Colostrum

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# Results & Discussion



LPS (■) and CON (□)

\*Significant differences between groups

a-b / A-B Significant differences throughout time within group

## ■ BMB permeability

Wellnitz et al. (2013), Lehmann et al. (2013)

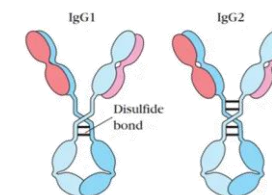
## ✓ Transmembrane proteins

Kobayashi et al. (2013)



## ■ Active transport

## ✓ Receptors



Wall et al. (2015)



# Results & Discussion

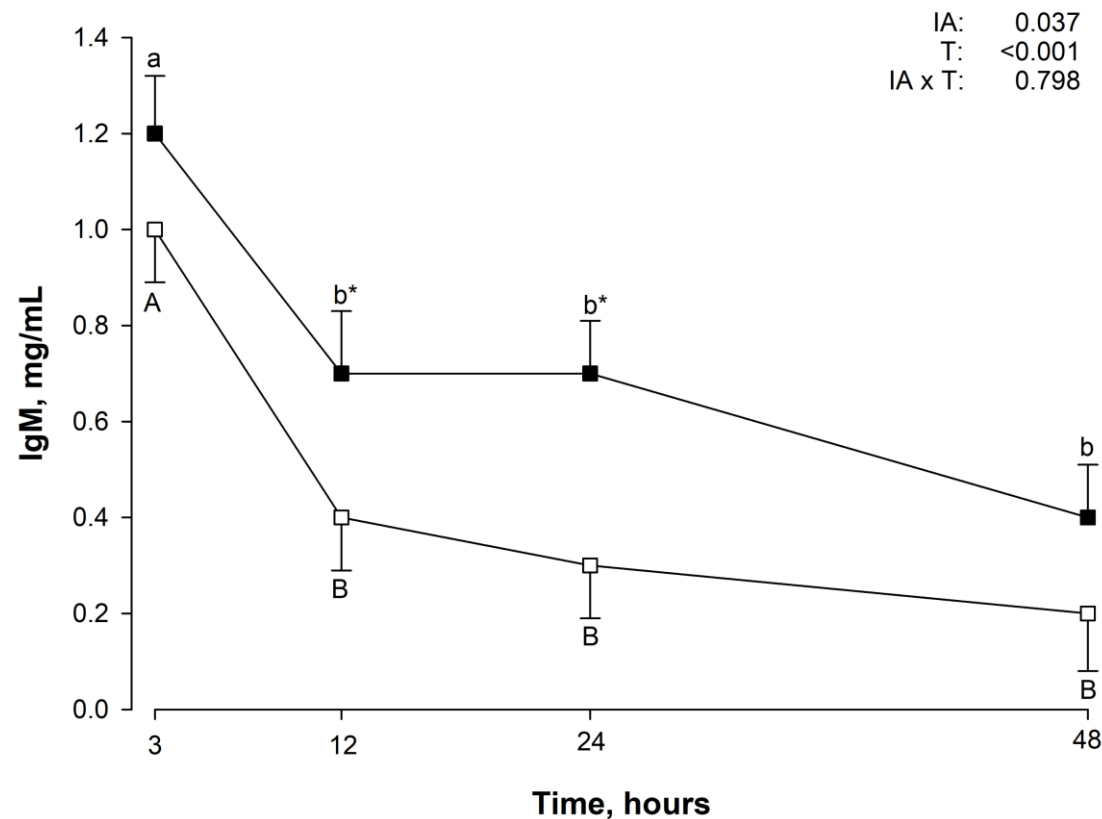
## ■ Dose and timing

Werner-Misof et al. (2007)



Full vs. Empty

## Colostrum IgM



IA: 0.037  
T: <0.001  
IA x T: 0.798

LPS (■) and CON (□)

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# Results & Discussion

## Milk

Variables	Groups			Fixed effects		
	LPS	CON	SEM	IA	Time	IA×T
Yield, kg	2.5	2.4	0.18	0.733	0.513	0.842
Lactose, %	4.3	4.6	0.08	0.026	<0.001	0.927
Fat, %	4.3	4.5	0.15	0.309	<0.001	0.065
Protein, %	4.4	4.3	0.16	0.676	<0.001	0.161
Total solids, %	14.1	14.4	0.22	0.450	<0.001	0.602
SCC, log <sub>10</sub> cells/mL	2.9	2.6	0.11	0.004	0.045	0.350
IgG, mg/mL	0.8	0.9	0.10	0.468	0.035	0.159
IgM, mg/mL	0.1	0.1	0.09	0.458	<0.001	0.258



# Results & Discussion

## ■ Udder inflammation

↓ [ Lactose ]

Castro-Costa et al. (2014); Salama et al. (2020); Shangraw et al. (2020)

### ✓ Increased SCC

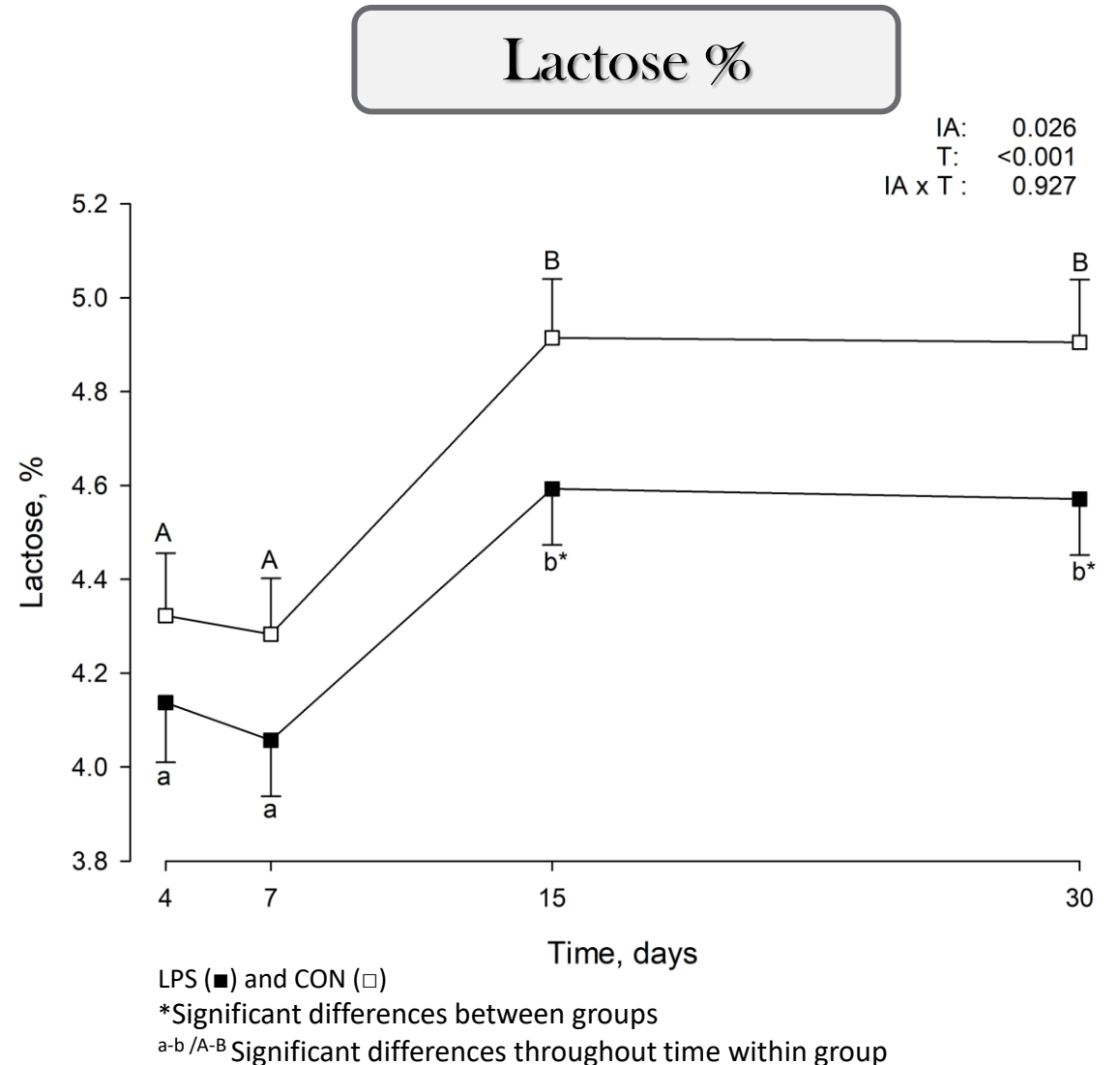
Antanaitis et al. (2021)

### ✓ Transfer to bloodstream

Chedly et al. (2010)

### ✓ Energy source

Silanikove et al. (2014)





# Results & Discussion

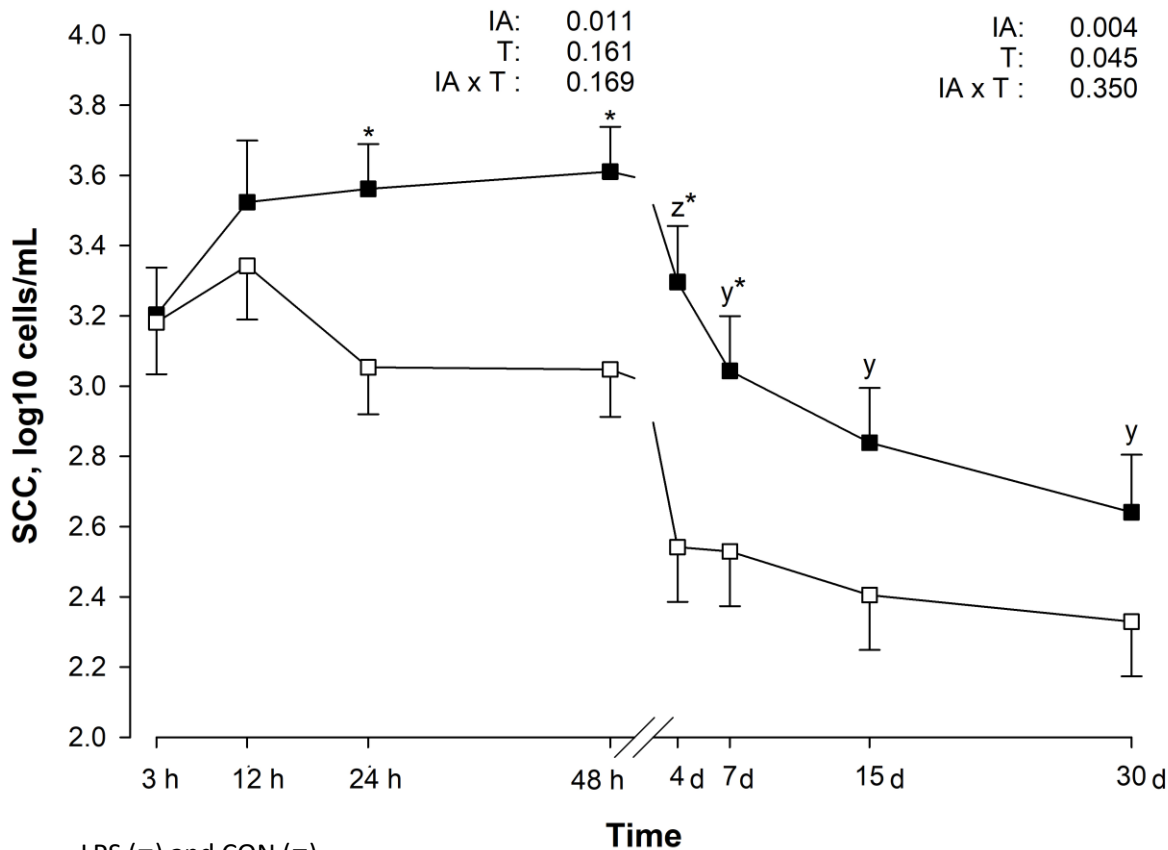
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# Results & Discussion

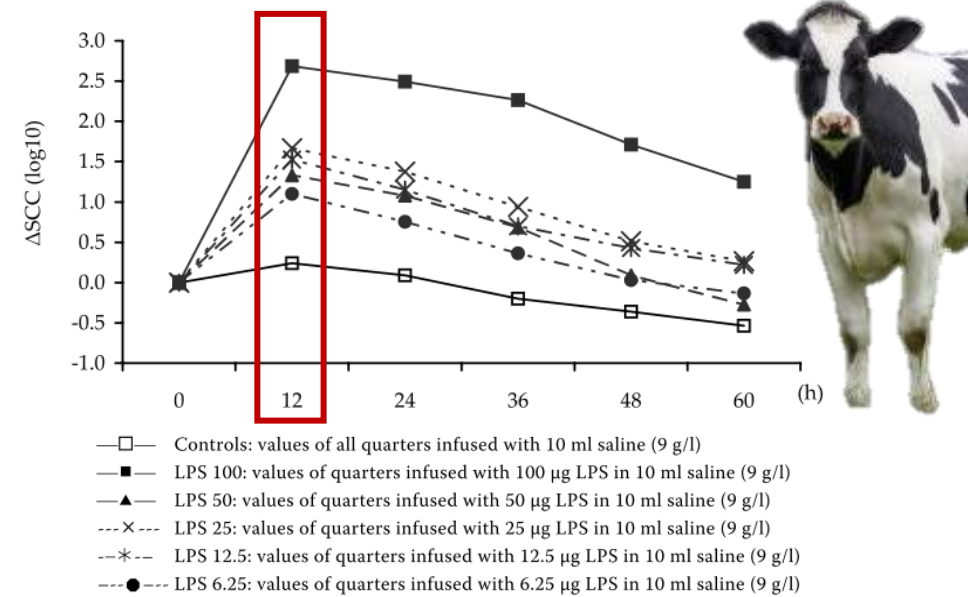
## Somatic cell count (SCC)



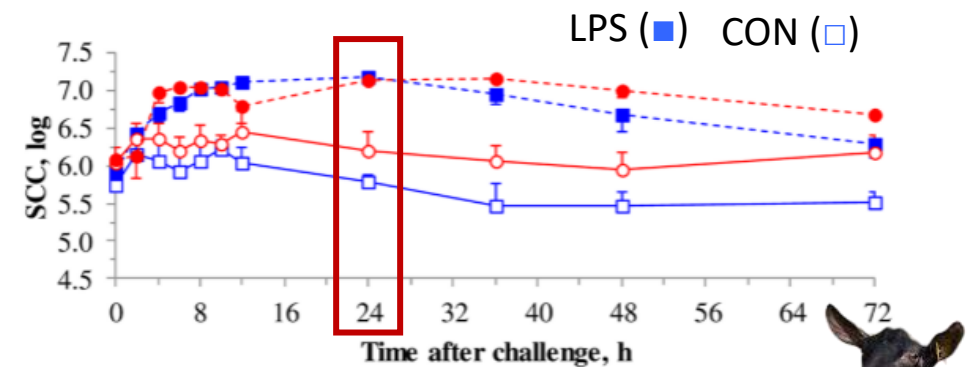
LPS (■) and CON (□)

\*Significant differences between groups

<sup>z-y</sup> Significant differences throughout time within group



Werner-Misof et al. (2007)



Salama et al. (2020)



# Results & Discussion

Variables	Groups		SEM	Fixed effects		
	LPS	CON		IA	Time	IA×T
IgG, mg/mL	8.4 [7.2-9.7]	7.7 [6.7-9.0]	-	0.446	<0.001	0.744
IgM, mg/mL	1.6	1.8	0.11	0.243	<0.001	0.775
BHB, mmol/L	0.8 [0.6-1.1]	1.0 [0.7-1.3]	-	0.611	0.002	0.729
Glucose, mg/dL	48.2 [40.2-54.3]	48.4 [45.3-51.8]	-	0.883	<0.001	0.430
Calcium, mg/dL	8.6	8.5	0.13	0.347	<0.001	0.699
LDH, U/L	490.1	456.6	23.1	0.313	0.004	0.302
FFA, mmol/L	0.9	0.9	0.05	0.782	<0.001	0.667
Total protein, g/dL	6.5	6.2	0.14	0.087	<0.001	0.976
Rectal temperature, °C	39.0	38.7	0.07	0.002	<0.001	0.007

# Results & Discussion

## ■ Systemic response

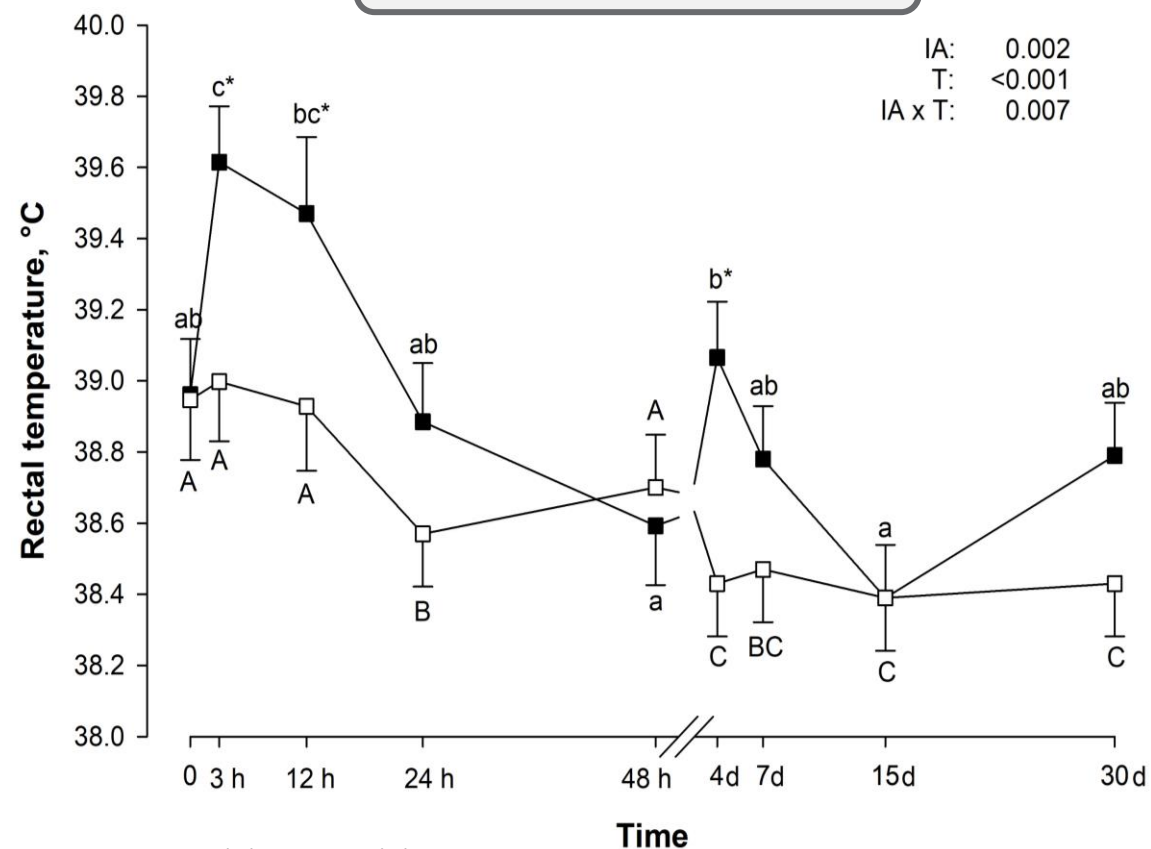
↑ Rectal temperature

Salama et al. (2020)  
Gross et al. (2020)

✗ Plasma immunoglobulins

✗ Serum metabolites

### Rectal temperature



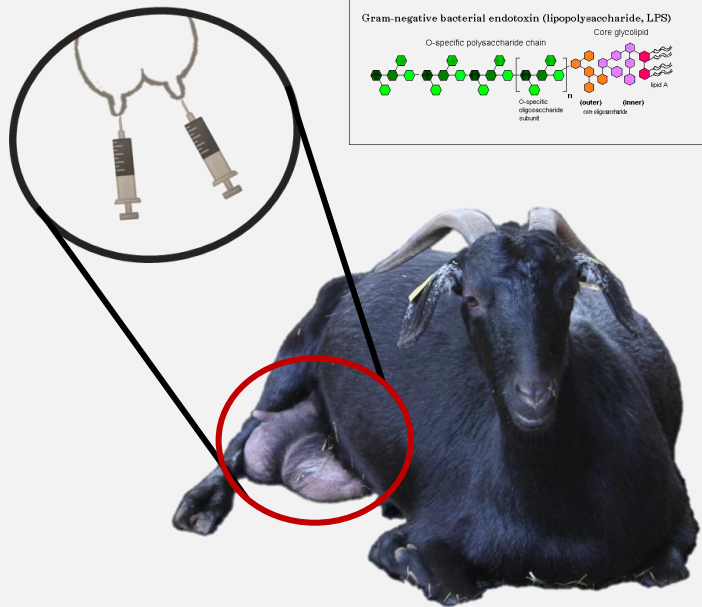
LPS (■) and CON (□)

\*Significant differences between groups

a-c/A-C Significant differences throughout time within group

# Conclusions

## Intramammary administration of LPS



## Colostrum composition

↑ IgG and IgM  
↑ SCC







# Thank you for your attention

## Funding



**UNIÓN EUROPEA**

Fondo Europeo de Desarrollo Regional  
*"Una manera de hacer Europa"*



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