Understanding Ruminant Microbiomes to Improve Animal Health, Productivity, and Sustainability

Early life microbiome development

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Re-Livestock
RESILIENT FARMING SYSTEMS

master

HoloRuminant
Understanding microbiomes of the ruminant holobiont

Global Methane Hub

BEZOS EARTH FUND

CSIC
Consejo Superior de Investigaciones Científicas

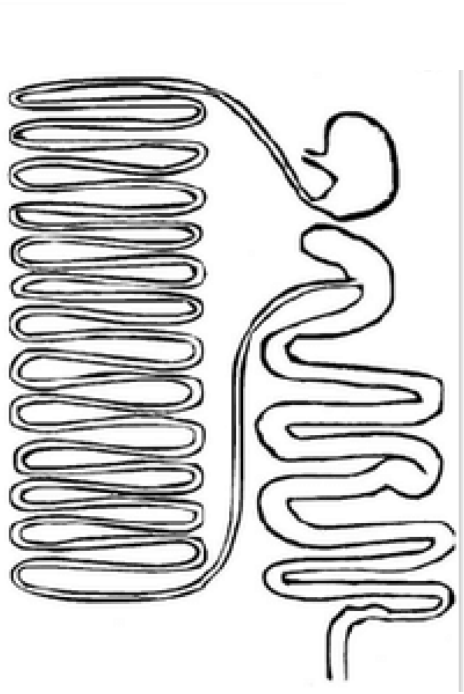
Outline

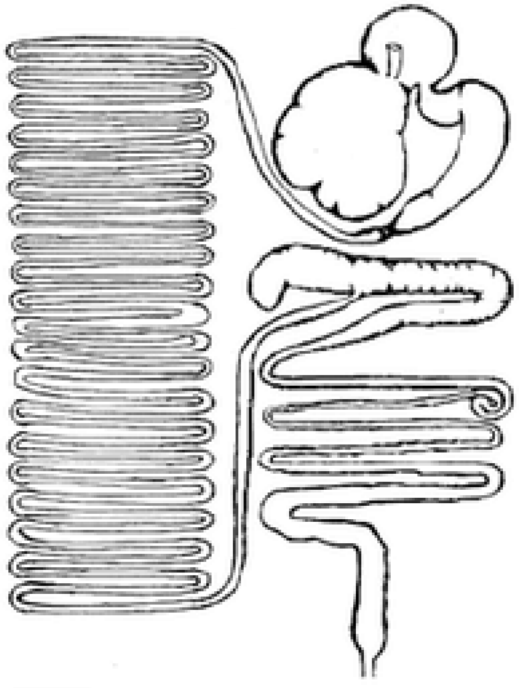
1. What is the rumen
2. Development of the rumen

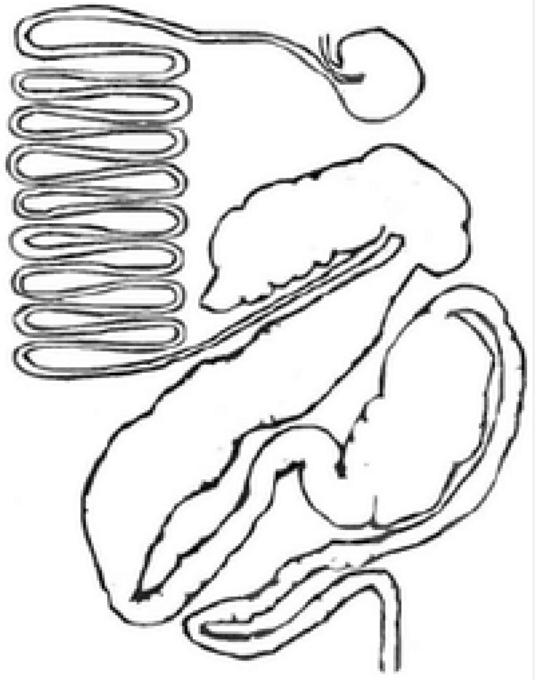
    - Anatomical
    - Microbial

    - Nutritional interventions for health and sustainability

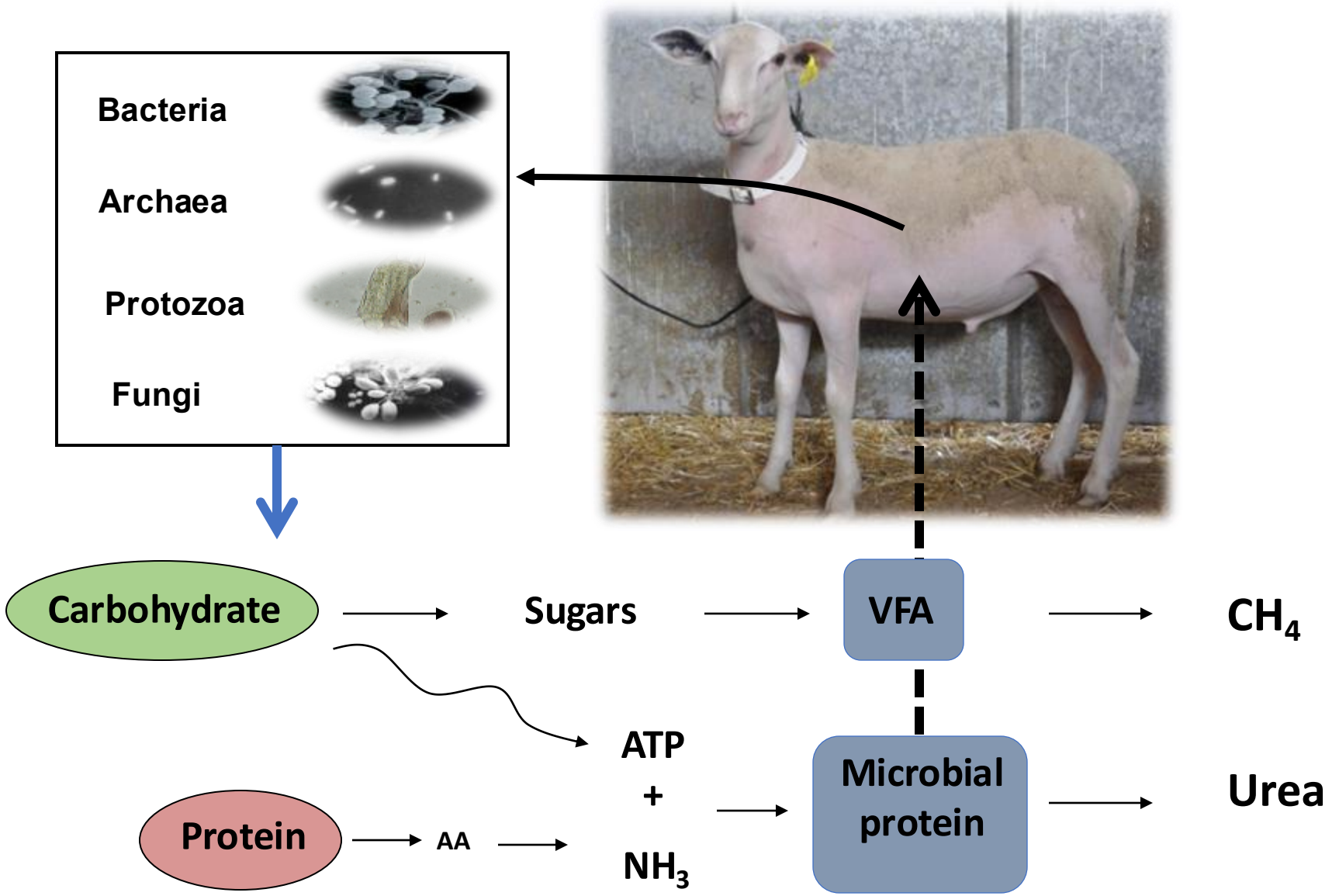
1. What is the rumen







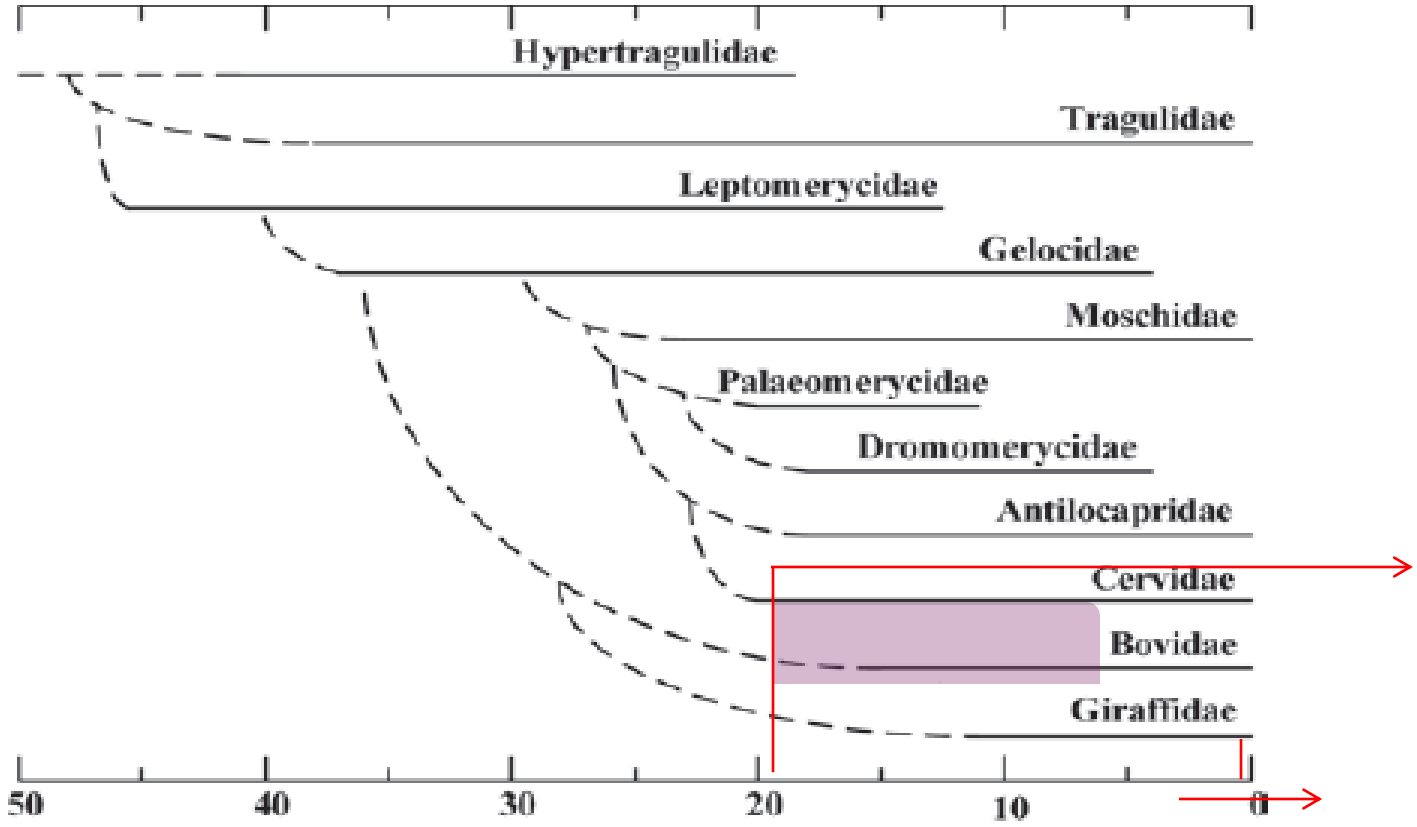
1. What is the rumen



1. What is the rumen

- **Redundant**
- **Resilient**
- **Host-specific**

1. What is the rumen

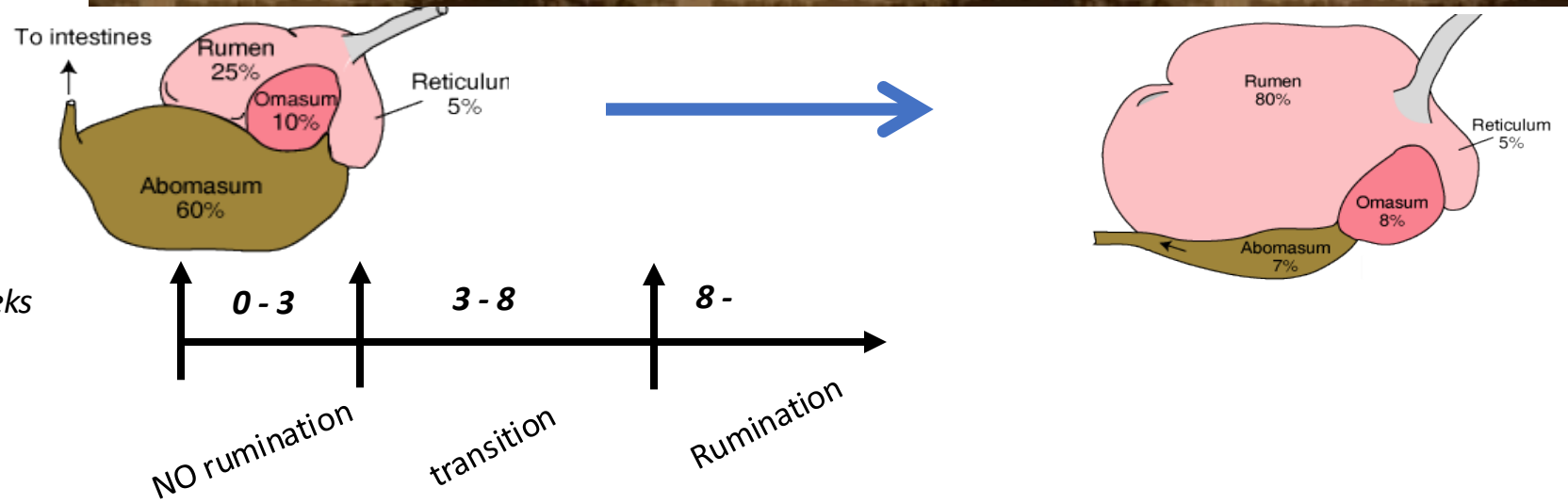


- **First populations**
- 10-15 mill years

Outline

1. What is the rumen
2. Development of the rumen
    - Anatomical
    - Microbial
    - Nutritional interventions for health and sustainability

Development of the rumen



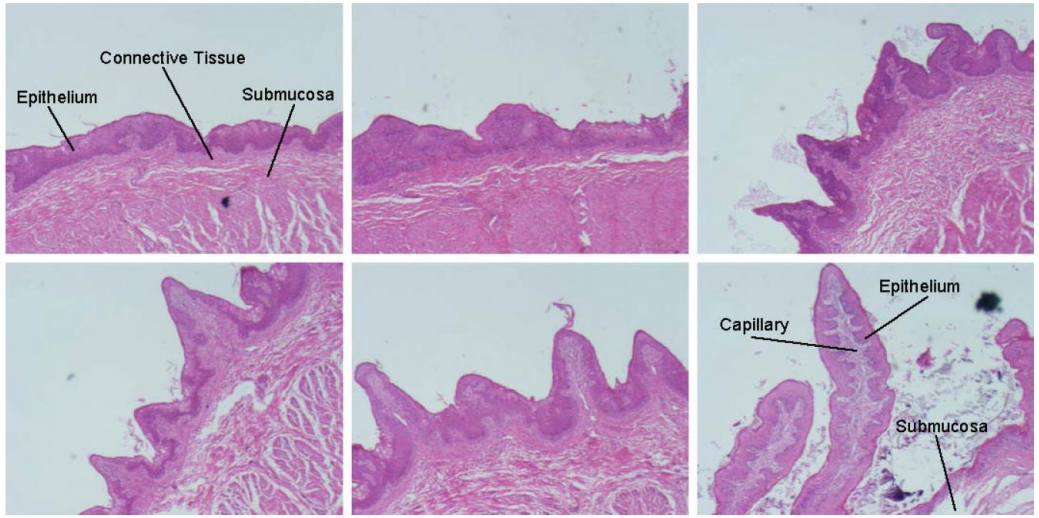
Anatomical ----------→

Functional ----------→

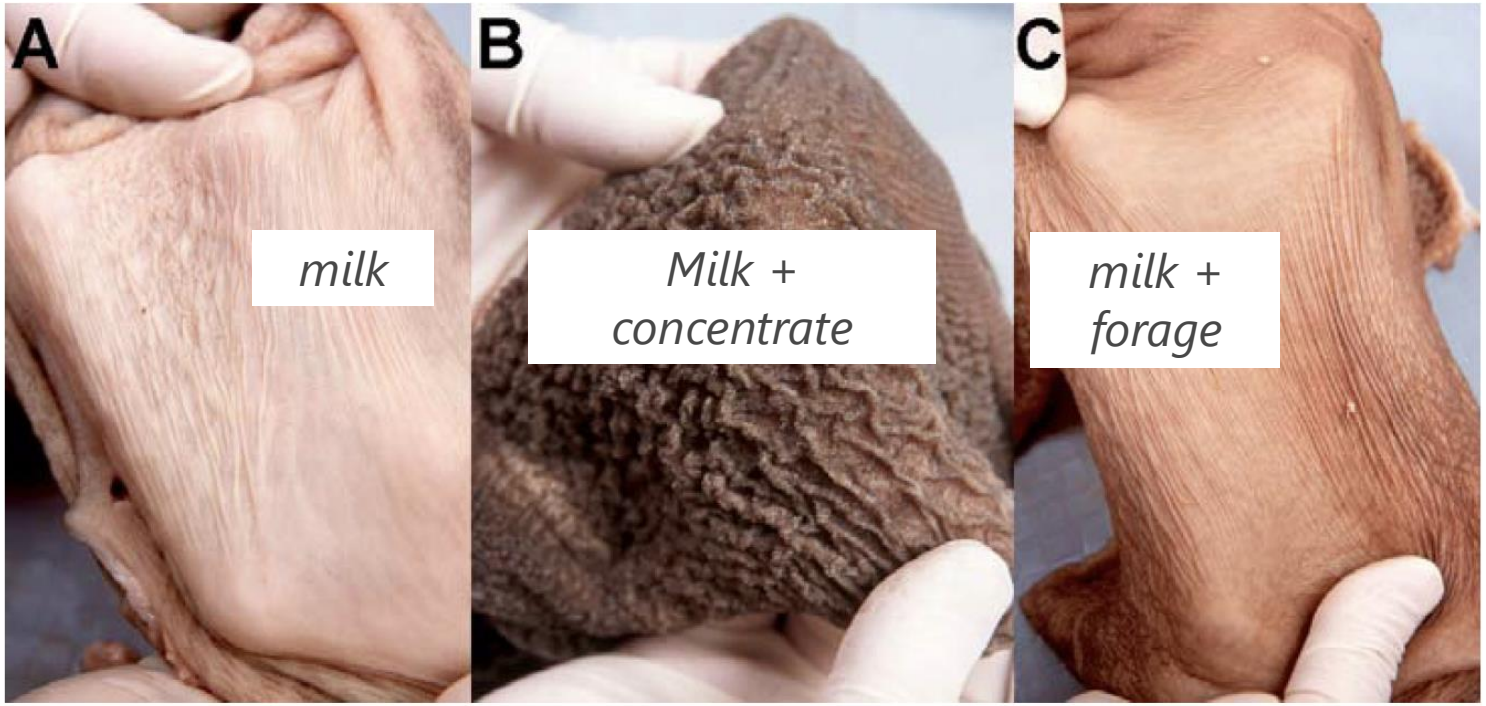
Microbial ----------→

Development of the rumen: anatomical

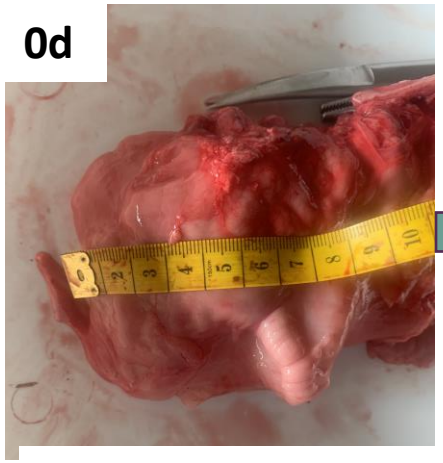
Rumen papillae



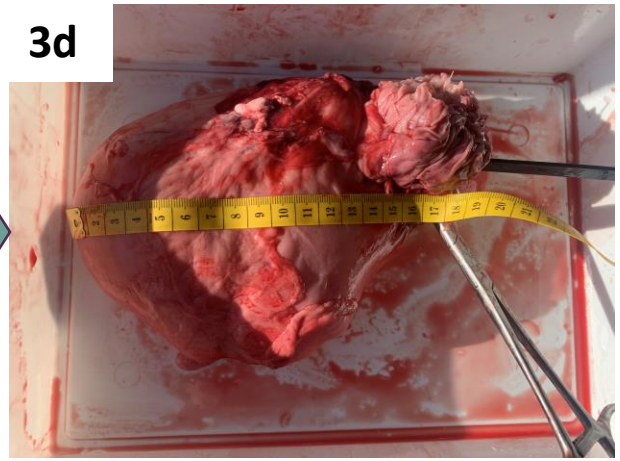
6 weeks



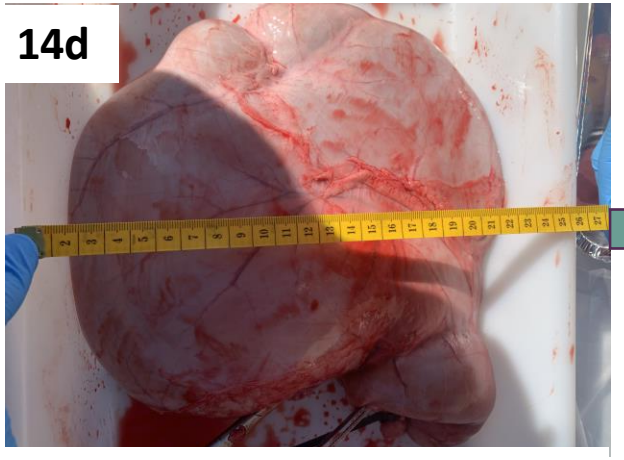
Development of the rumen: anatomical



10 x 7 cm – 0.31 kg

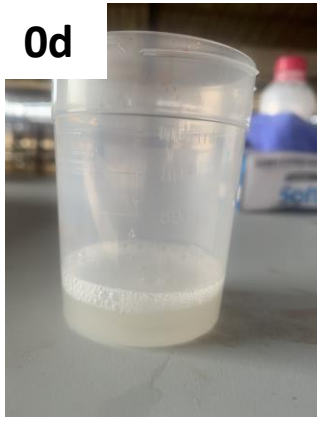


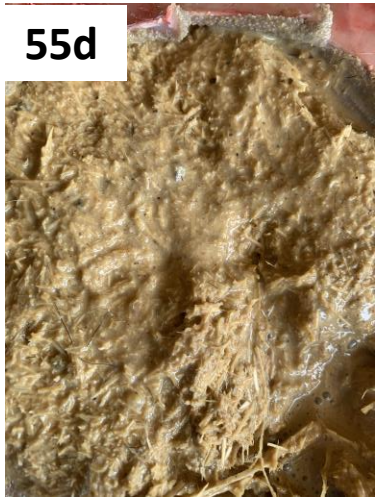
16 x 14 cm – 0.50 kg



19 x 22 cm – 1.84 kg

42 x cm 30 – 5.5 kg





Development of the rumen: anatomical

ZARA HOME

TOALLA ALGODÓN HILO TINTADO

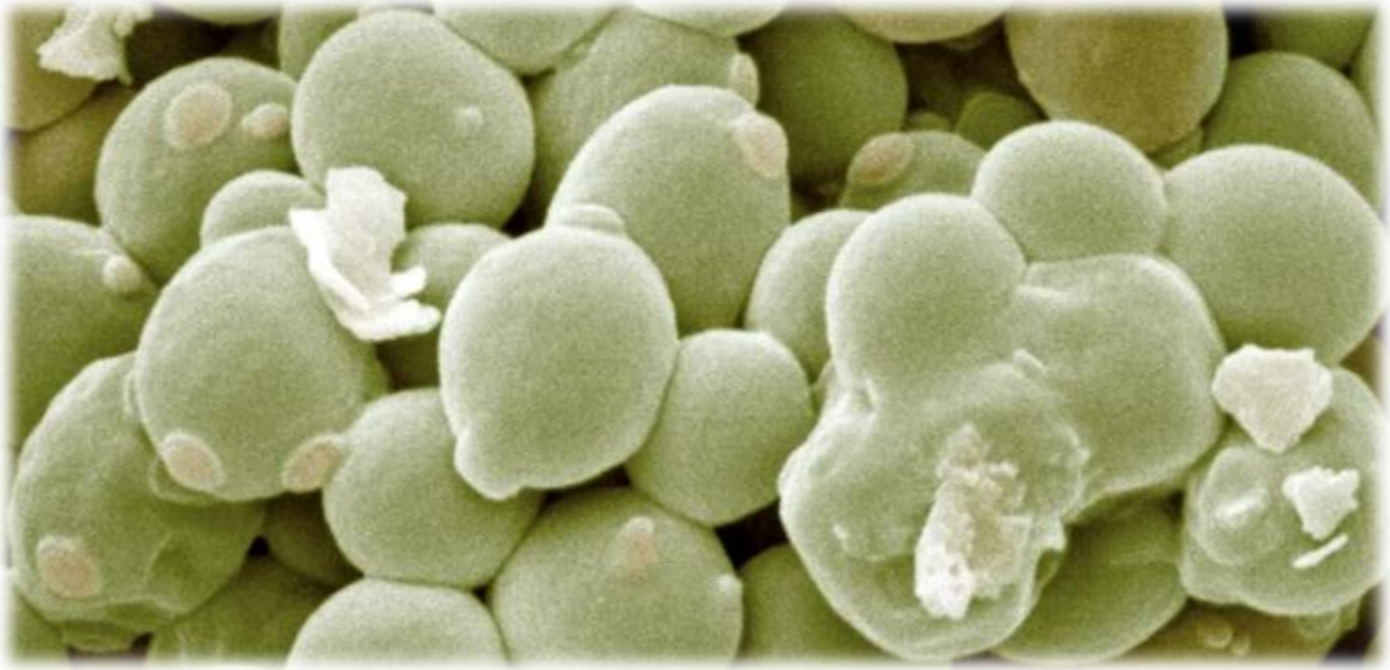
25,99 €

TOALLA ALGODÓN CENEFA PLIEGUES

17,99 €

Development of the rumen: anatomical

Yeast

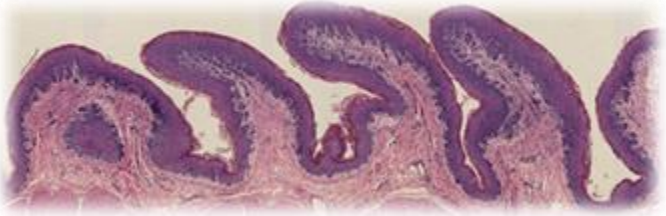


Saccharomyces cerevisiae

Bread, beer…

- Probiotics
- No symbiotic in the rumen

- Consume **O_2**
- Promote other **bacteria**
  - Control pH (lactate)
  - Producee butyrate

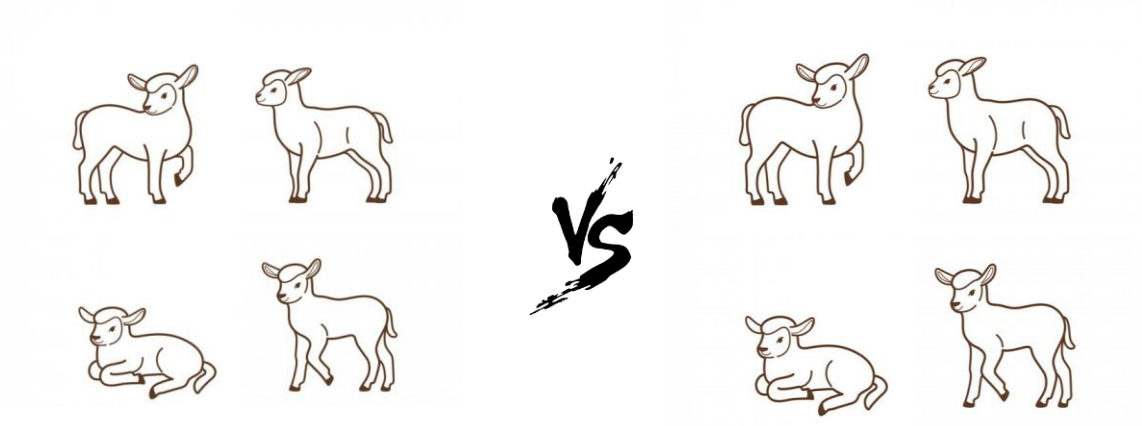


Development of the rumen: anatomical

Experimental design

Puebla de Don Fadrique

Asociación Nacional De Criadores De Ovino Segureño (ANCOS), Huéscar, Granada



Control

-n=23
-Maternal milk
-Starter feed

Yeast

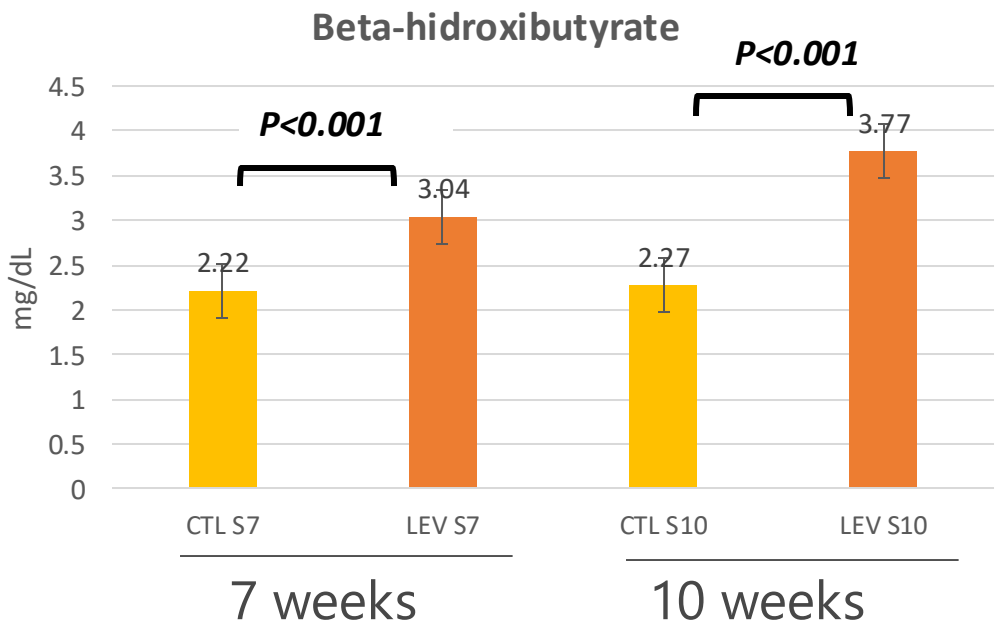
***S. Cerevisiae* CNCM I-1077**

-n=23
-Maternal milk
- Starter feed + LSC

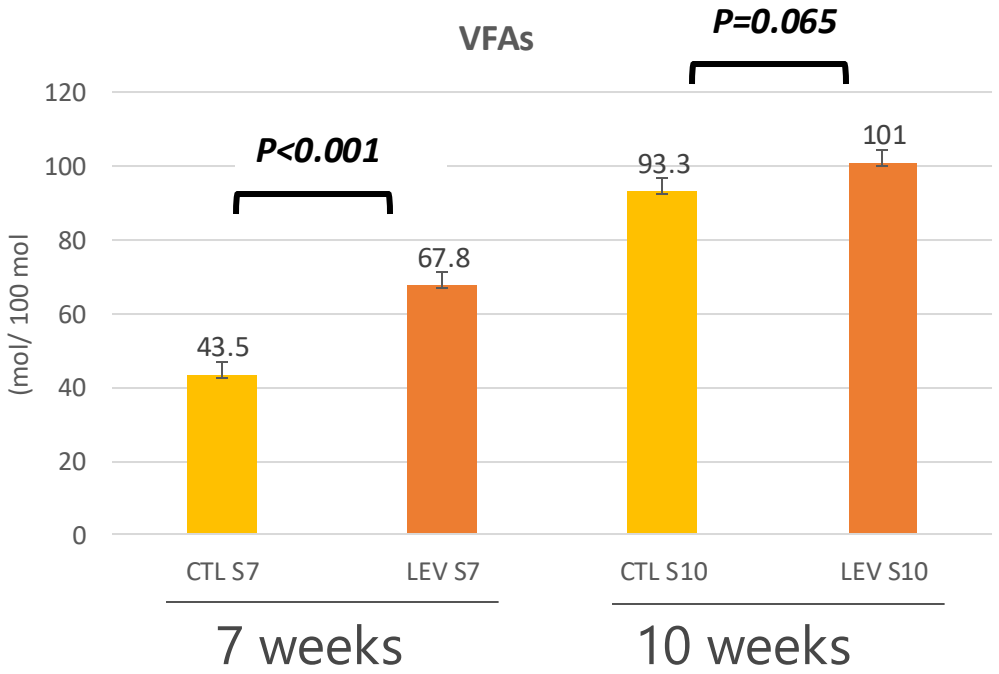
Sampling at **7** and **10** weeks (weaning at 9 weeks)

Development of the rumen: anatomical

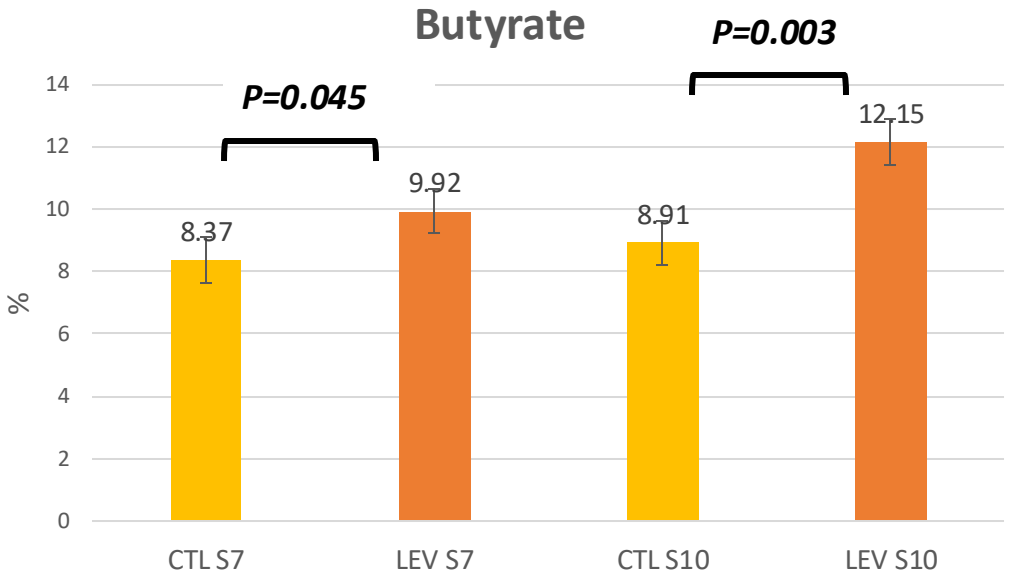
Blood

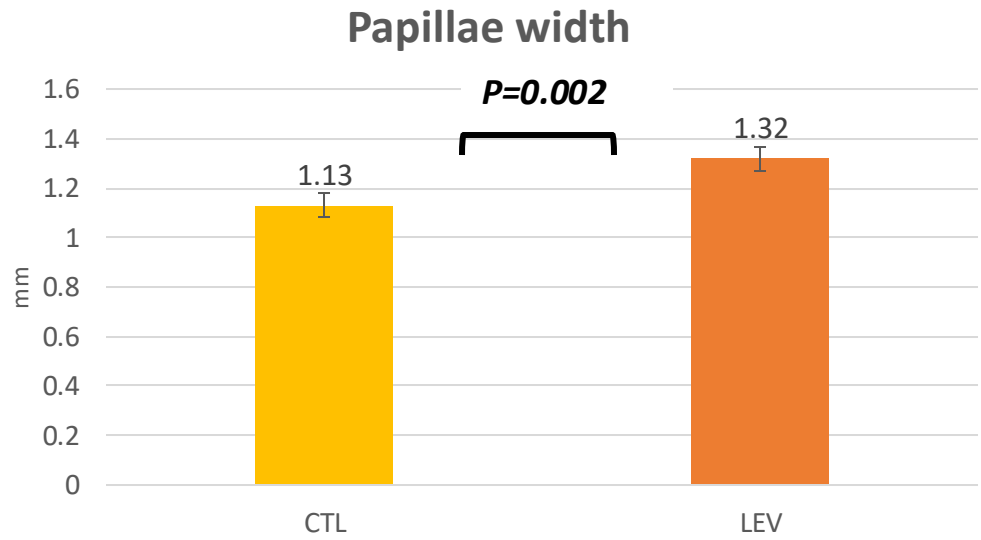


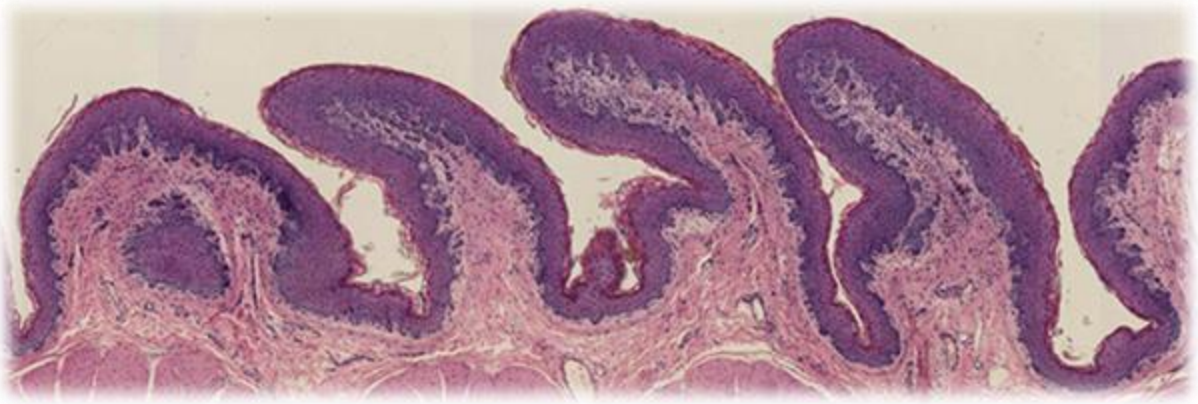
Rumen



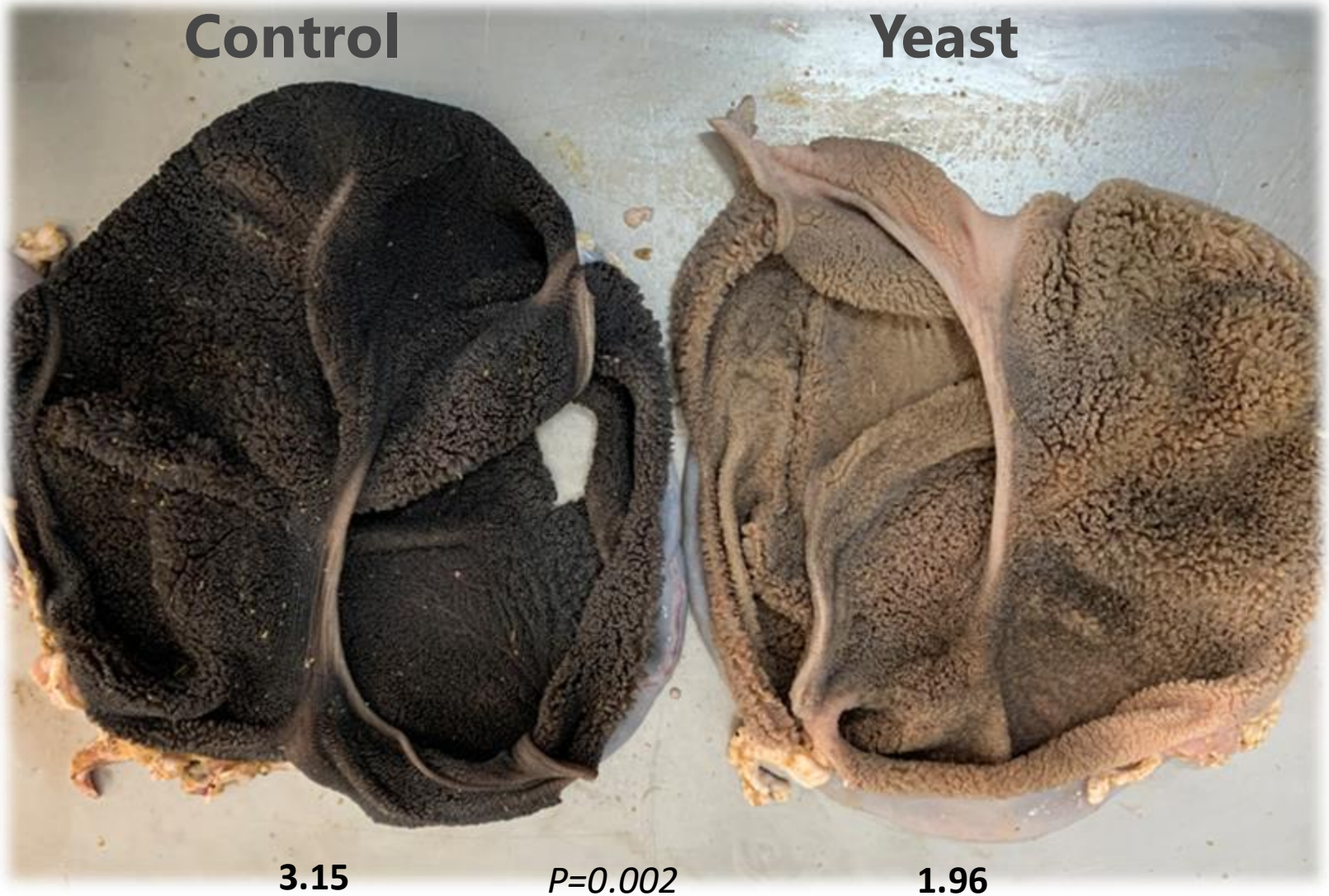
Development of the rumen: anatomical



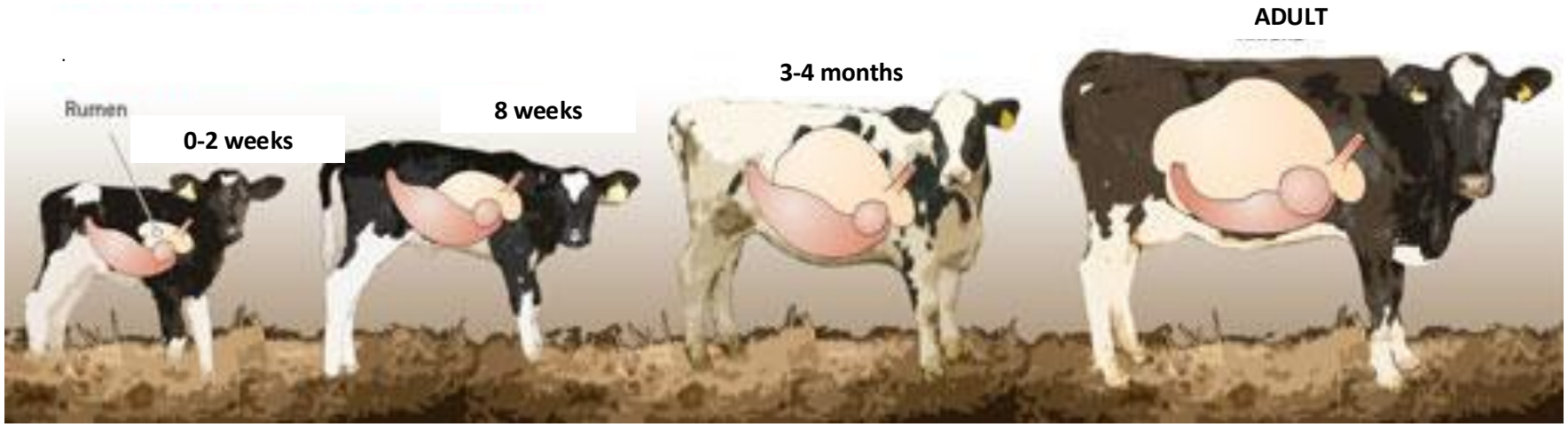


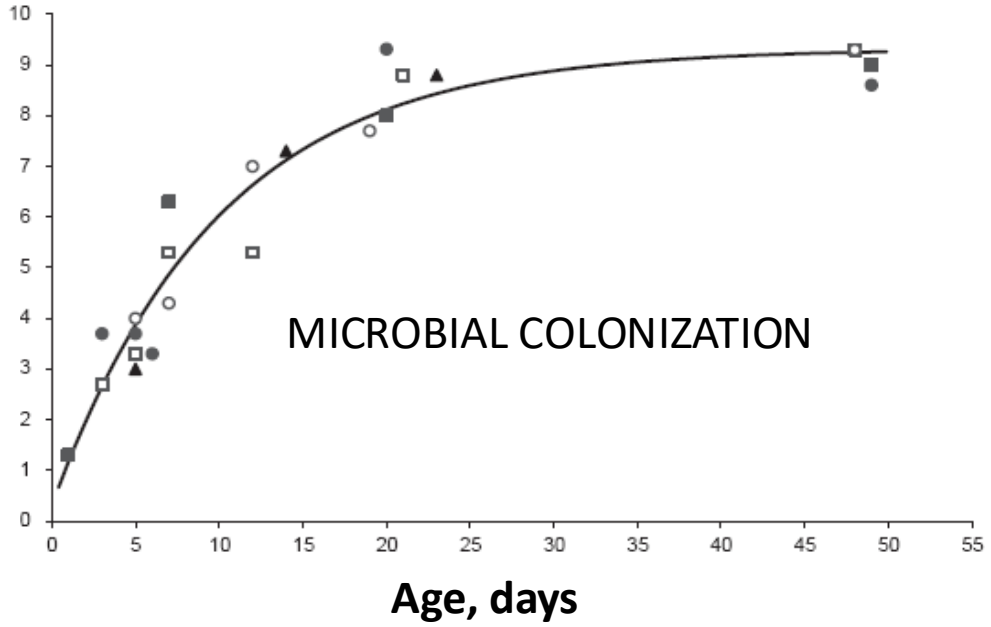


Development of the rumen: anatomical



Development of the rumen: microbial

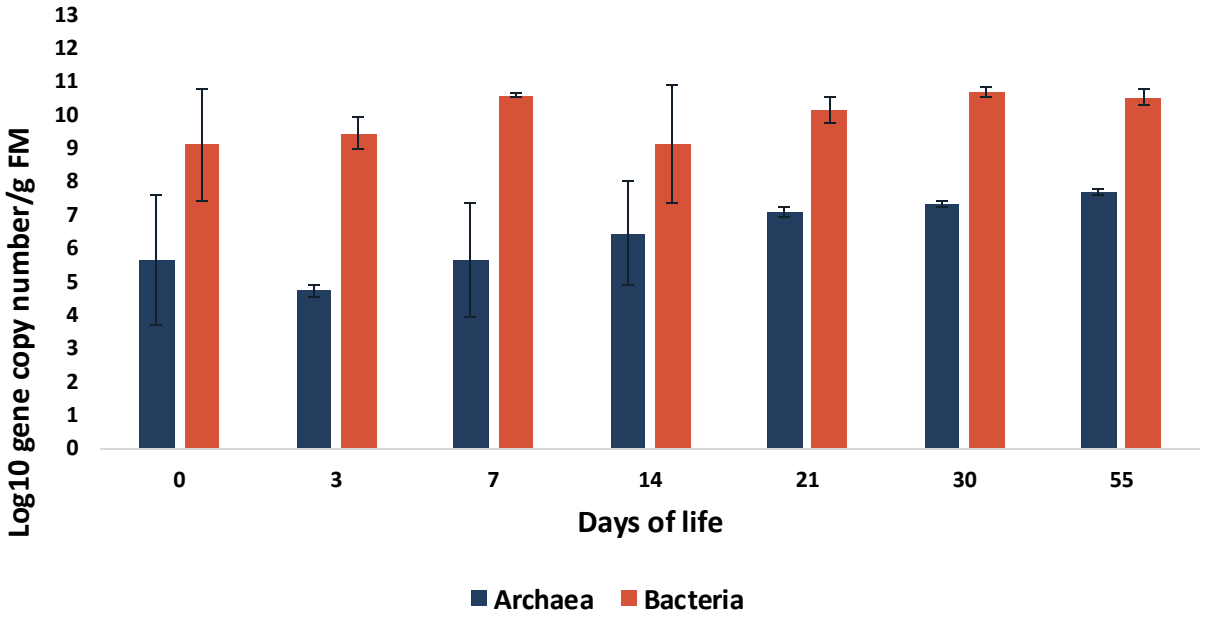




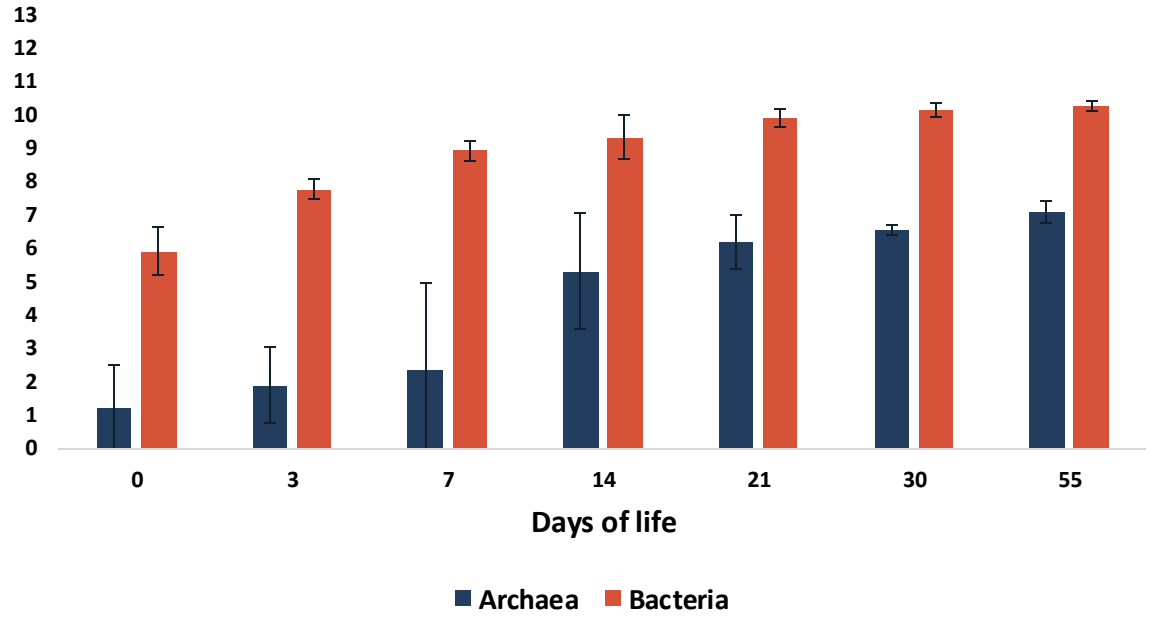
Rapid colonization

Development of the rumen: microbial

qPCR rumen: pregastric fermentation



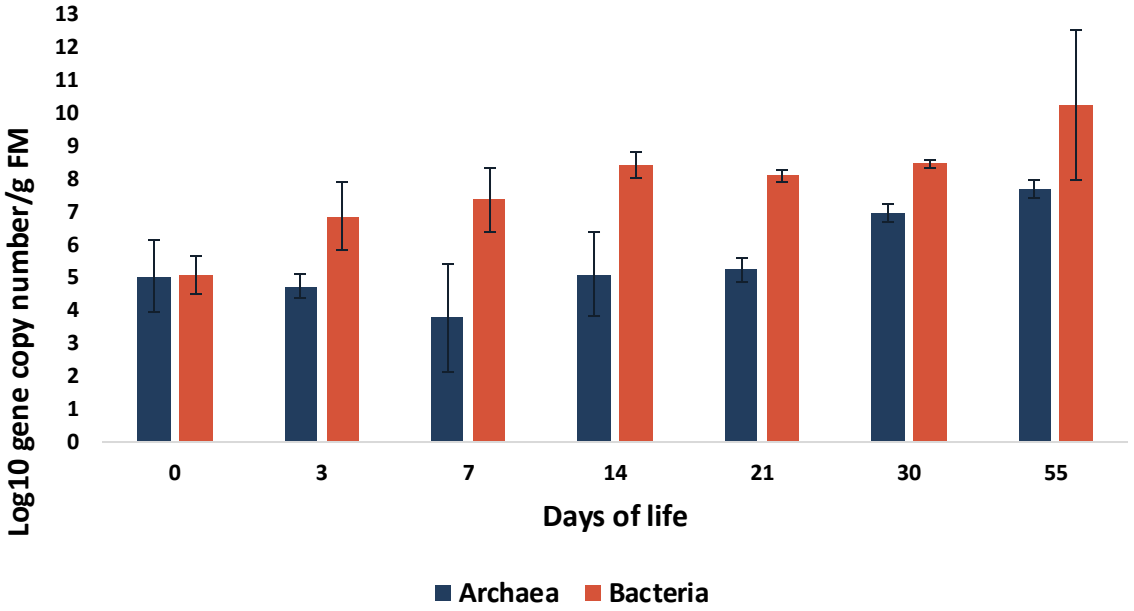
Digesta



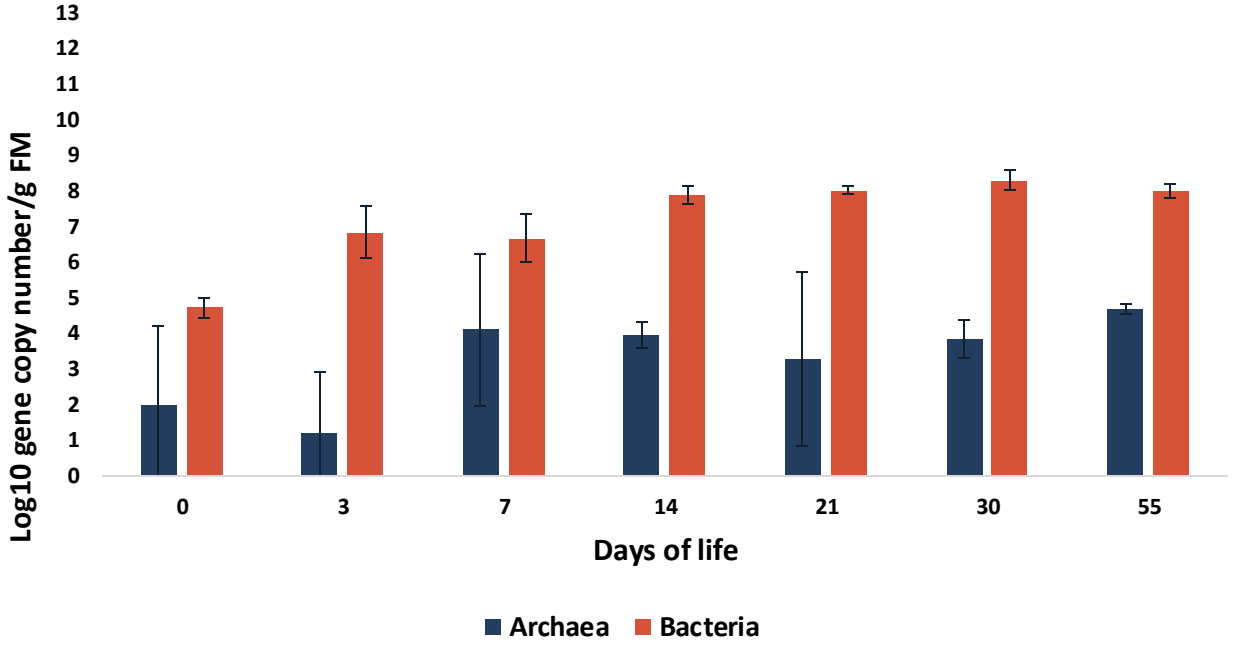
Epithelium

Development of the rumen: microbial

qPCR caecum: postgastric fermentation



Digesta

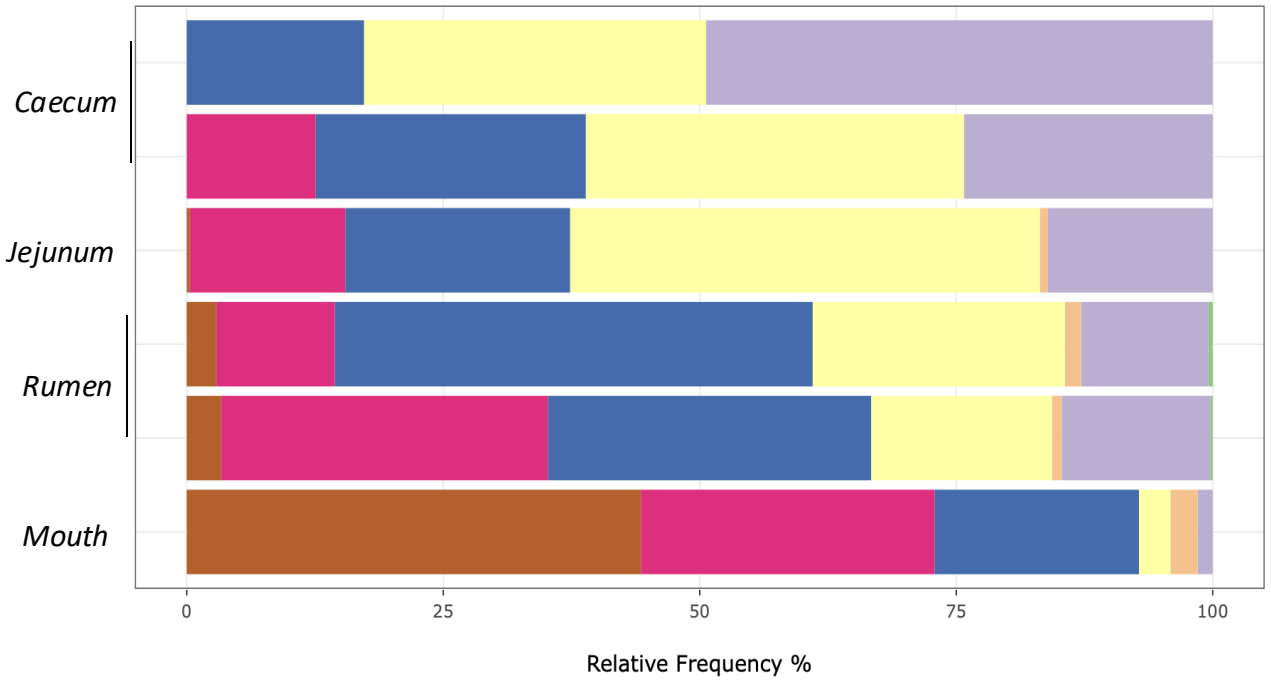


Epithelium

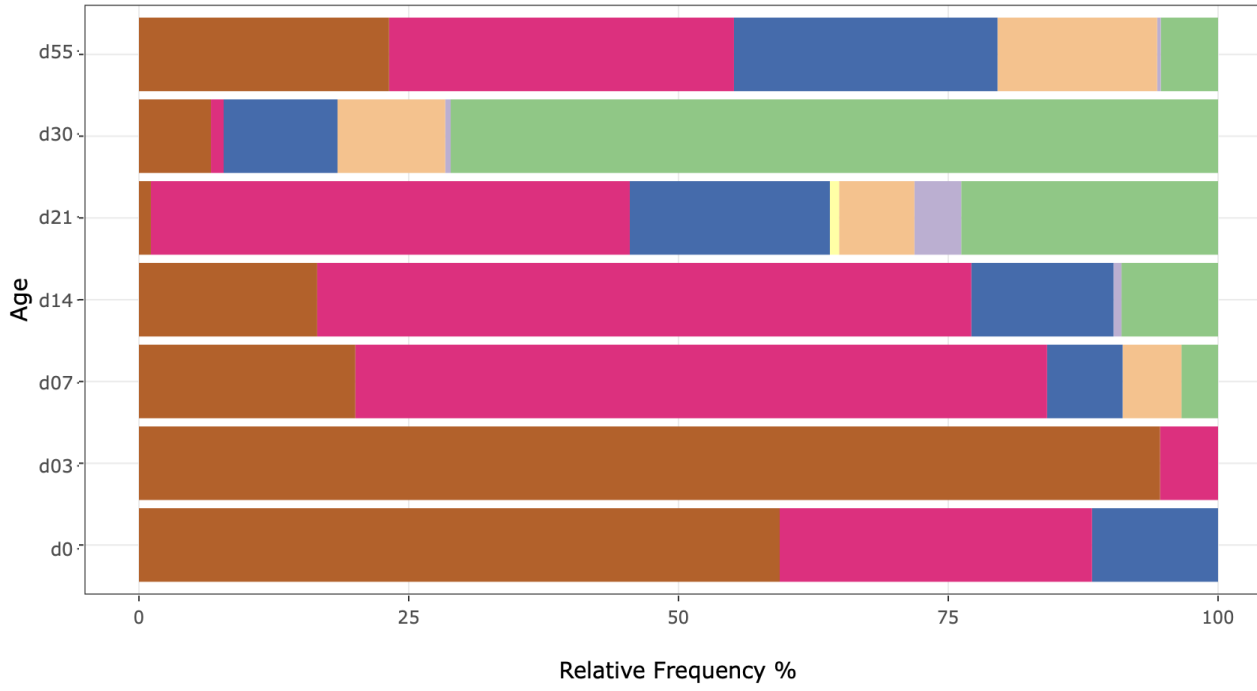
Development of the rumen: microbial

Relative abundances

By Location



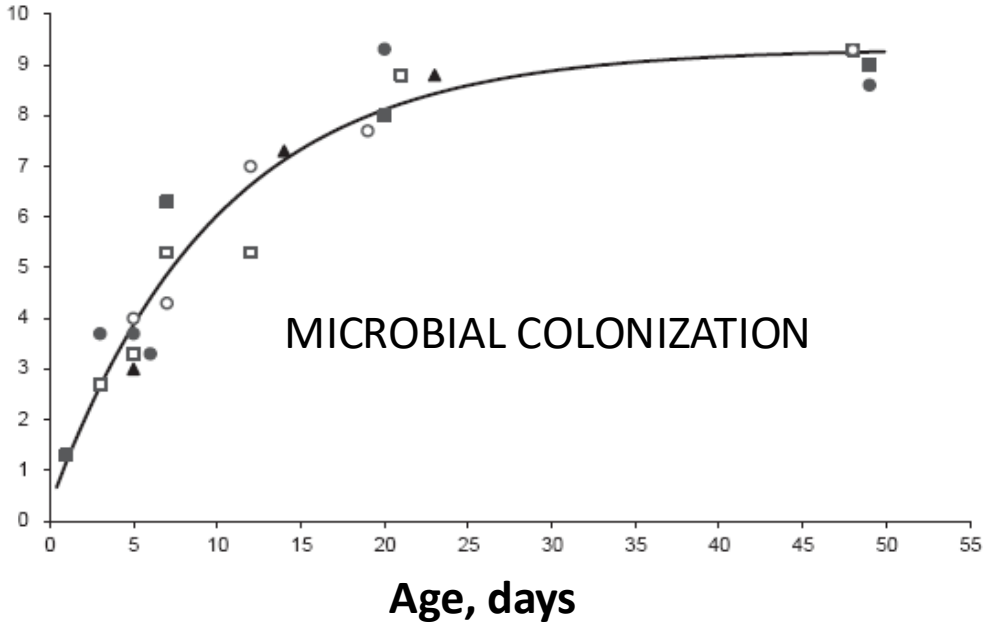
By Age



* *Methanoprimaticola*
Methanosphaera
* *Methanarcanum*
Methanarmilla
Methanocatella
Methanobrevibacter
* *Methanomethylophilus*

Methanarmilla
* *Methanarcanum*
* *Methanomethylophilus*
* *Methanoprimaticola*
Methanosphaera
Methanocatella
Methanobrevibacter

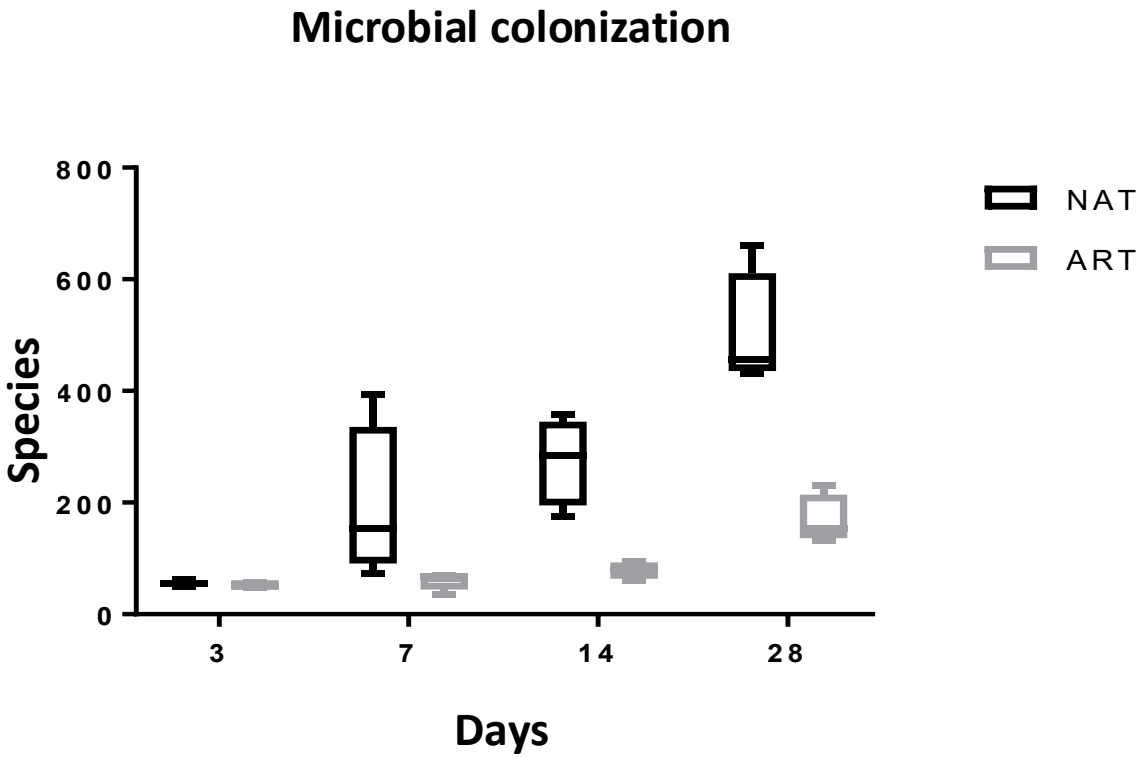
Development of the rumen: microbial

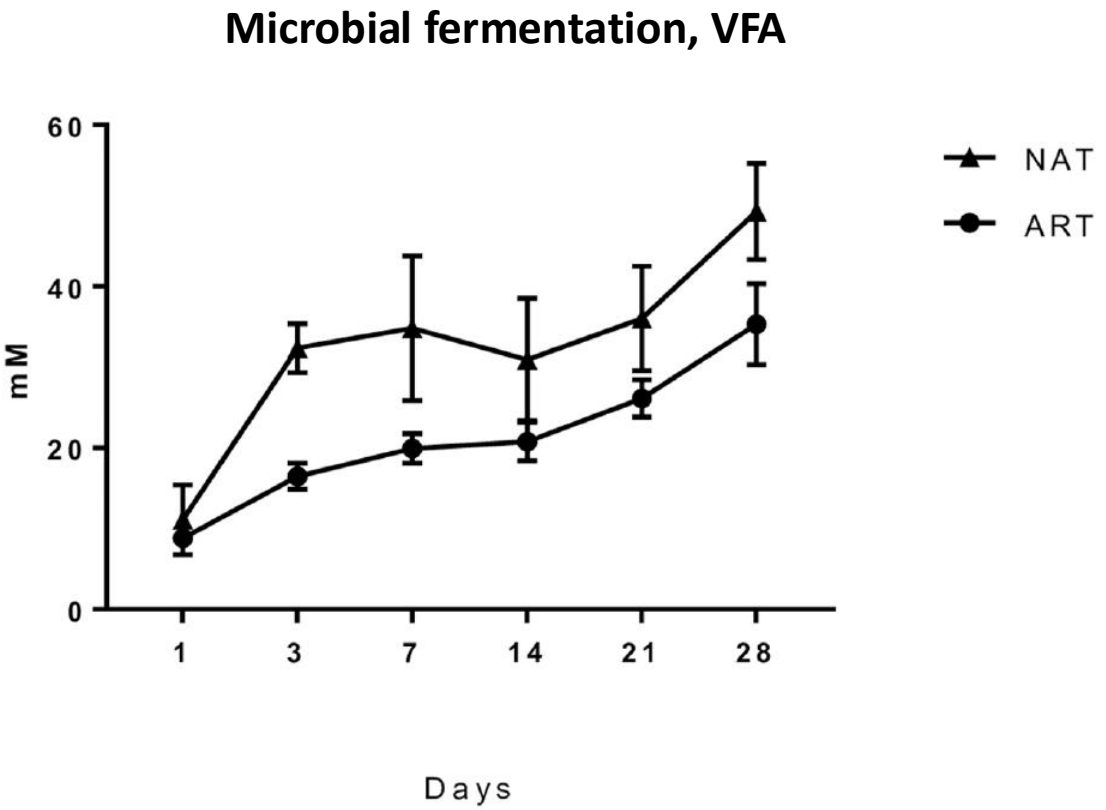


NATURAL

ARTIFICIAL

Development of the rumen: microbial

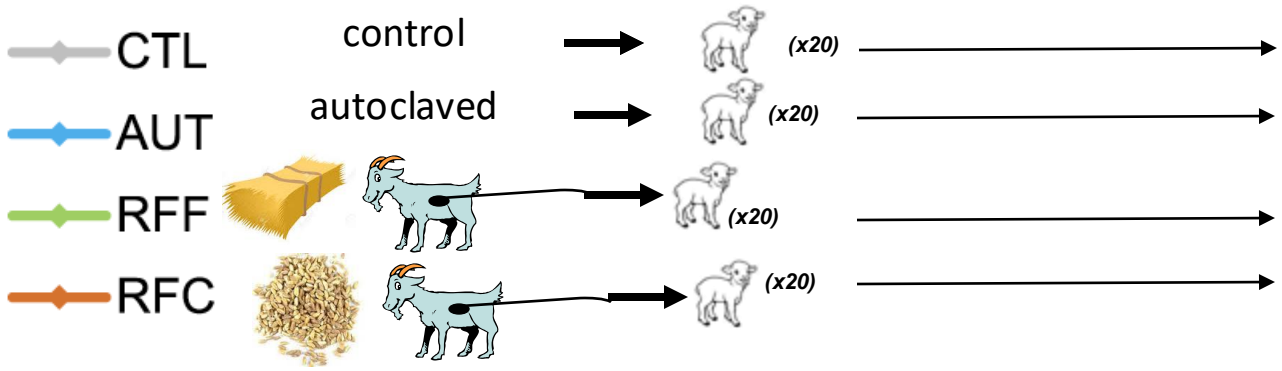


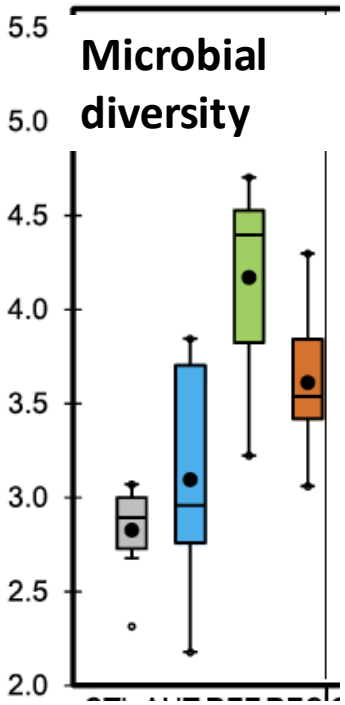


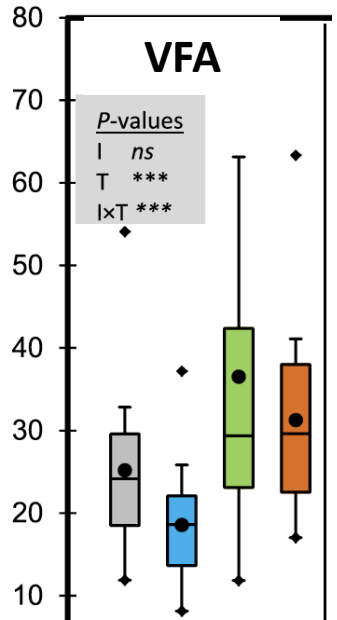
Abecia et al., 2017 PLOS One

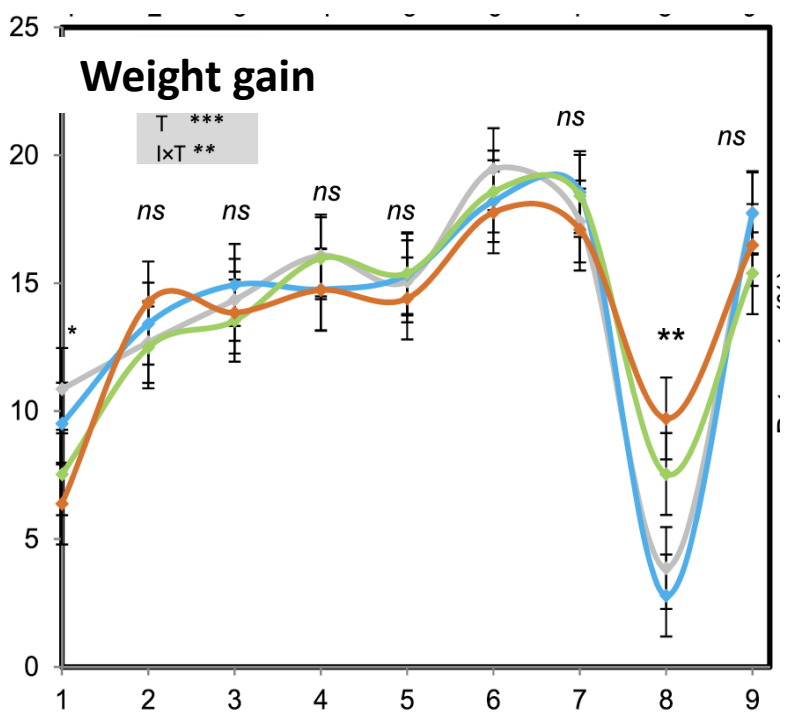
Development of the rumen: microbial

Inoculation with rumen fluid





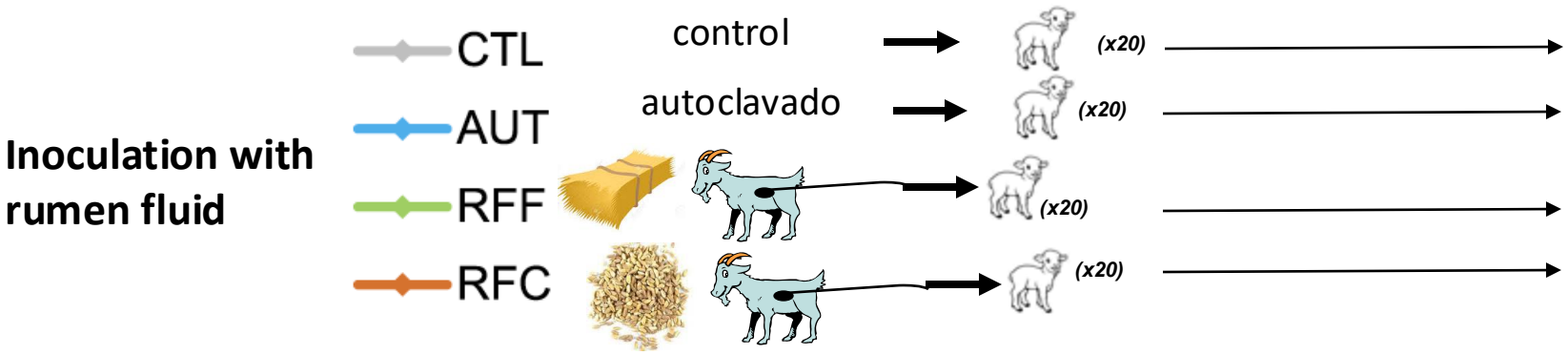




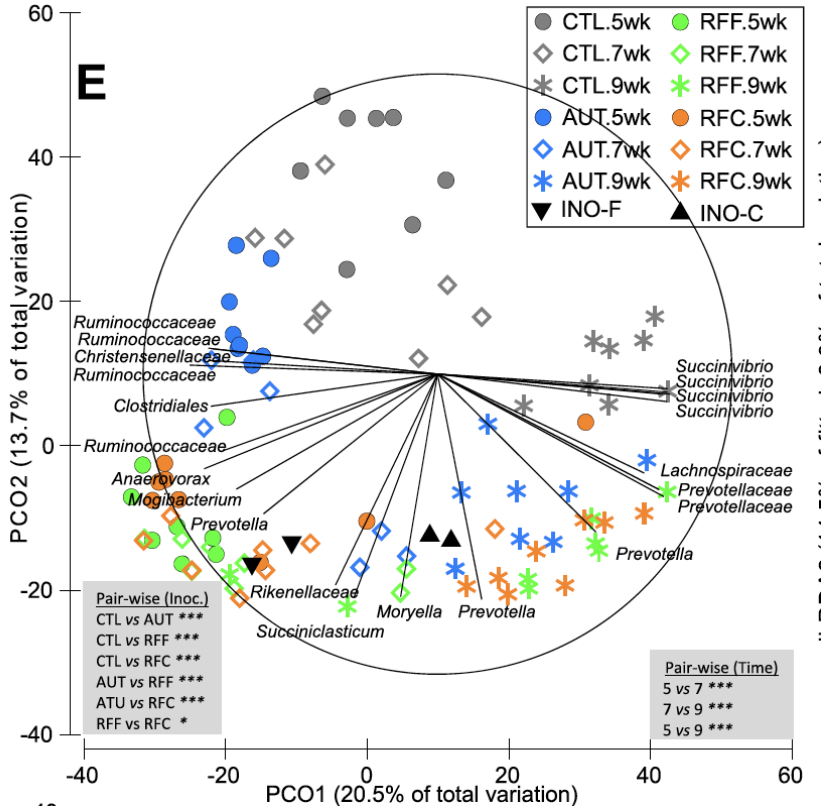
Belanche et al. (2020) J Dairy Sci

Palma-Hidalgo et al. (2021) Animal Microbiome

Development of the rumen: microbial



Ruminal probiotics ?



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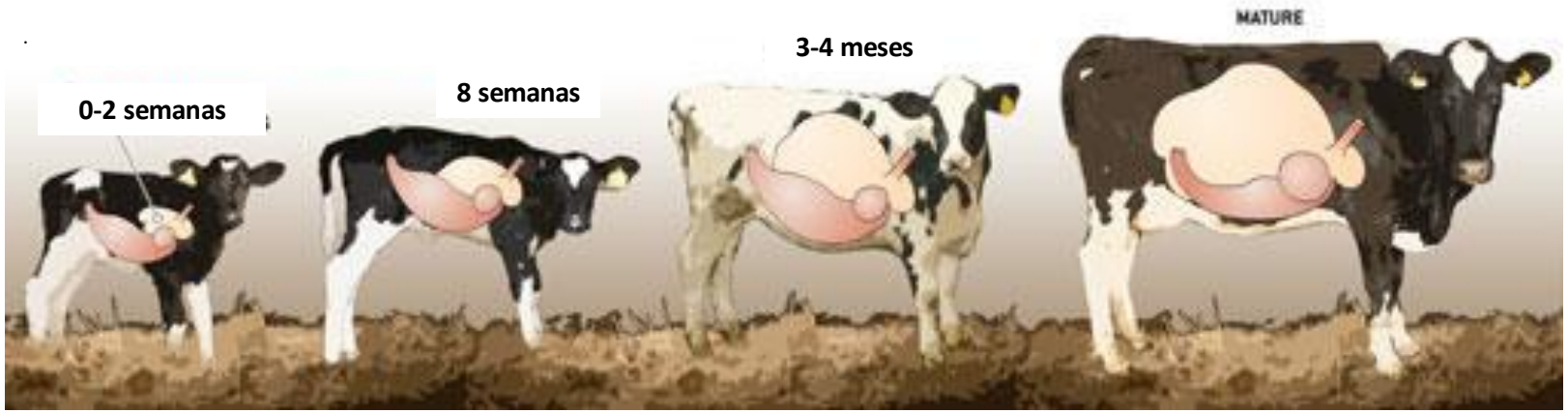
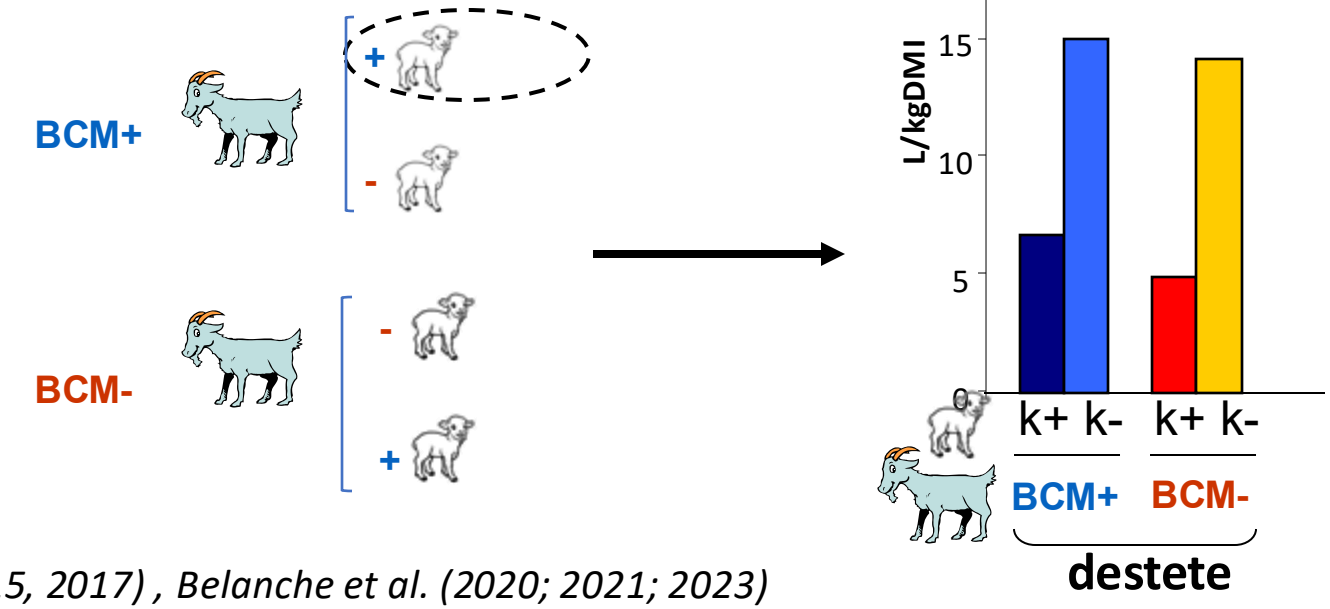
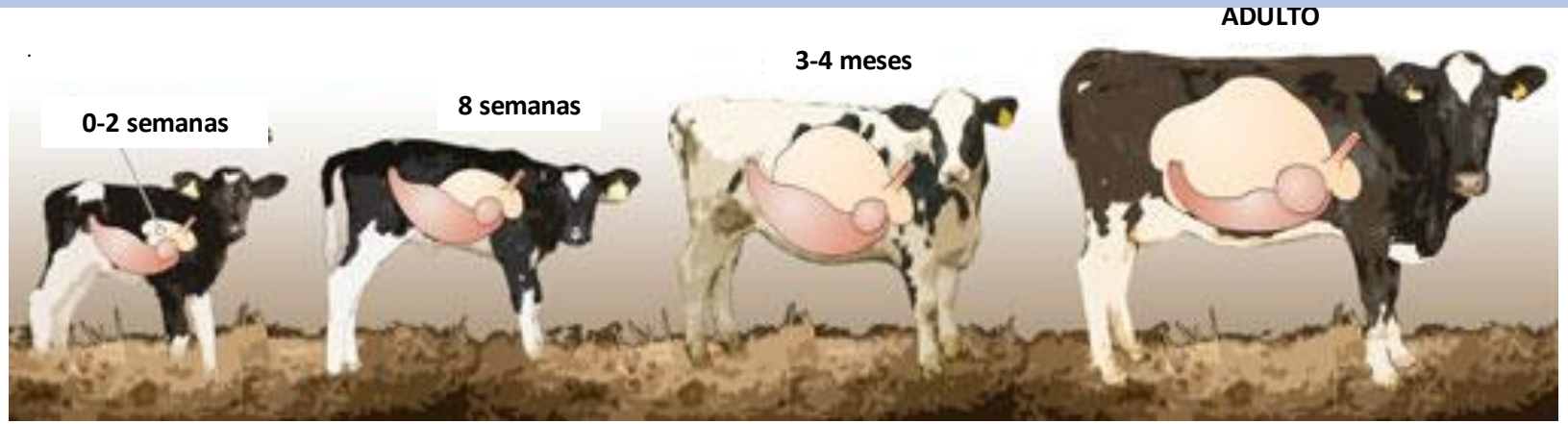
Development of the rumen: microbial



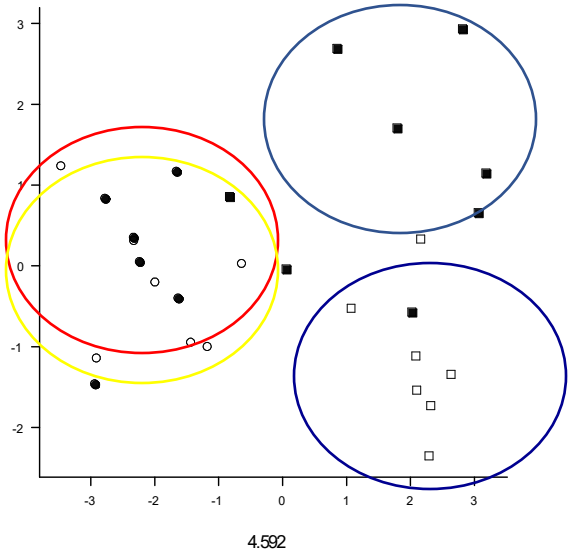


Abecia et al. (2014, 2015, 2017) , Belanche et al. (2020; 2021; 2023)

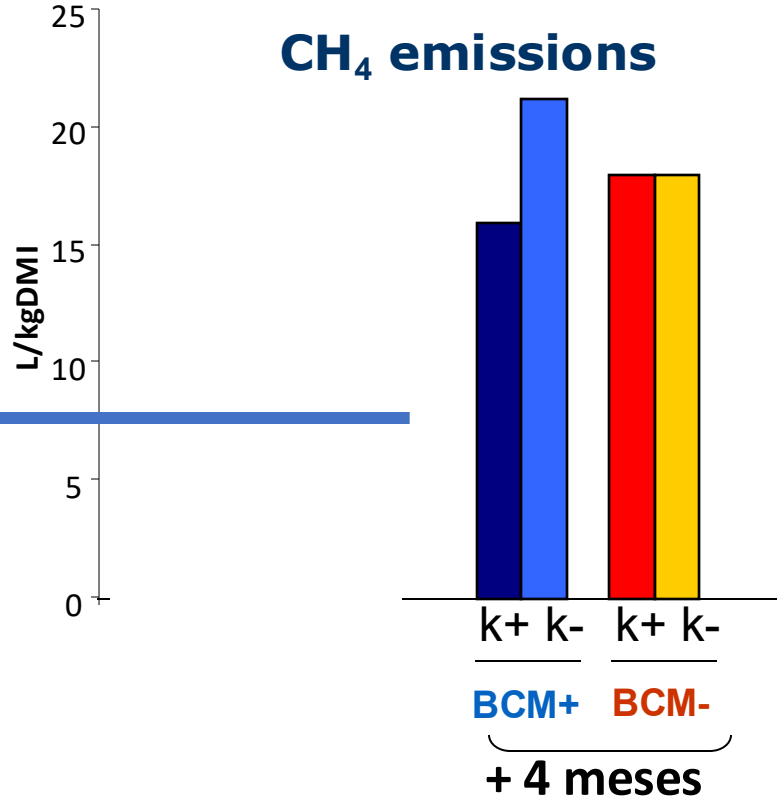
Development of the rumen: microbial



PCA *Archaea*



CH_4 emissions



Abecia et al. (2014, 2015, 2017) , Belanche et al. (2020; 2021; 2023)

Conclusions

- Importance of the microbiota in digestive **function** and **health**
- Rumen development window of time in **Early Life**
- Multiple options of **modulation** …..

Thank you!

rumenlab

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