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Effect of tannins and medium-chain fatty acids on rumen bacterial community of beef calves during the transition period to a high-concentrate diet

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GOBIERNO DE ESPAÑA MINISTERIO DE CULTURA Y DEPORTE

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Introduction

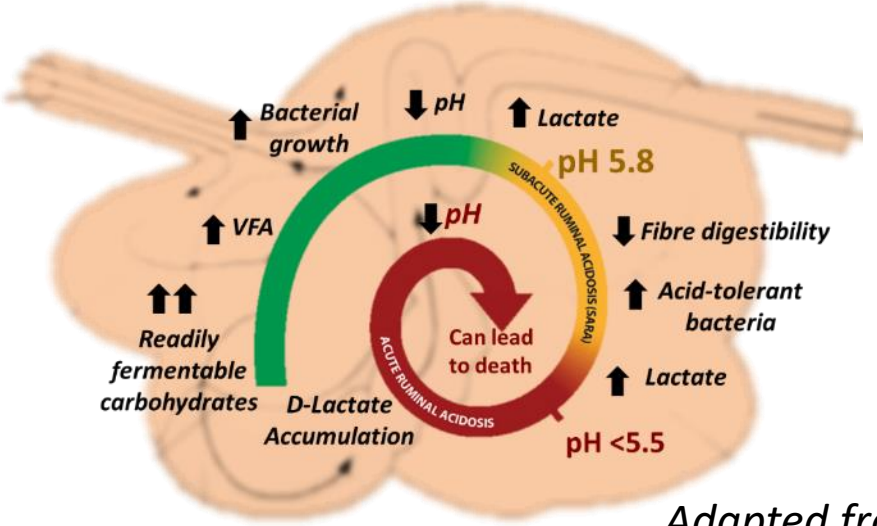
Beef calves are weaned at around 6 months

Milk and pasture→ High-concentrate ration

Transition period: 14-21 days after the feedlot arrival

Inadequate transition = NUTRITIONAL DISORDERS

Brown et al., 2006



Adapted from Nocek,1997

Introduction

Strategies to improve rumen health and animal performance

- Use of ingredients with different acidogenic capacity
- Promote a more homogeneous rate of intake
- Gradual transition to the fattening diet
- Modulate rumen fermentation

González et al., 2012

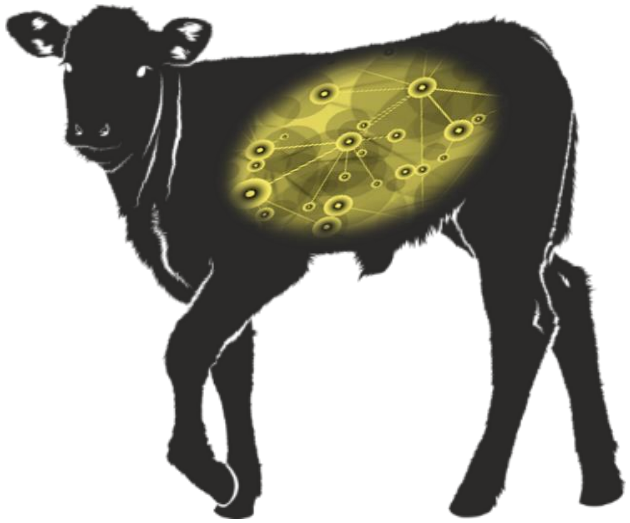
Feed additives such as tannins and medium-chain fatty acids (MCFA) modulate rumen fermentation

Machmüller, 2006
Patra and Saxena, 2011

Introduction

The rumen is a complex and dynamic ecosystem that changes in response to many factors.

(i.e. animal, age, diet, etc.) *Weimer, 2015*



Objective

To study the effect of the inclusion of tannins and MCFA on rumen bacterial community of beef calves during the transition from milk and pasture to a high-concentrate diet.

Materials and methods

18 cannulated calves / 212kg LW /~ 6 months

Milk and grass→ high-concentrate diet

Diet C
60% barley
15% maize
17% soybean meal

Diet T
C + **20 g/kg** of 65:35 chestnut and quebracho tannins

Diet M
C + **6 g/kg** of a MCFA mixture (C_6-C_{12})

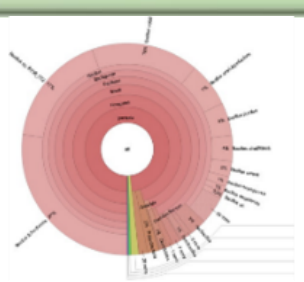
Doses were chosen based in previous in vitro studies (Amanzougarene et al., 2017,2018).

Concentrate + wheat straw were given *ad libitum* for **28 d**

Rumen fluid samples at 0h on days 0, 7, 14, 28

Storage at -80ºC

Materials and methods



Taxonomic Classification

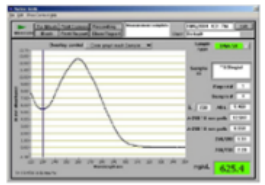
Bioinformatic Analyisis

Ion Reporter Analysis

PCR and 16S DNA gene sequencing

ION TORRENT (PGM)

DNA Extraction



Materials and methods

- Log_{10}-transformed (nº reads +1)
- Bioinformatic analysis with R software ('vegan', 'mixOmics'):
  - Multivariate analysis: PERMANOVA (ADONIS), analysis of similarity (ANOSIM)
  - Spatial ordination: Non-metric multidimensional scaling (NMDS) with Bray-Curtis distance
  - Shannon Index and genera richness
- Bacterial taxa (Log_{10}): PROC MIXED SAS. Diet, day of sampling and their interaction as fixed effects. Animal as random
  - Repeated measures. Mean comparison with Bonferroni's test
  - Differences were considered significant if $P<0.05$. Trend was considered when $0.05 \leq P \leq 0.10$

Results

- Similar (DIET: P>0.10)

-feed intake and rumen fermentation pattern

Additives intake: T: 100 g tannins/d M: 31 g MCFA/d

- PERMANOVA

Diet: P=0.92, R^2=0.007

Day: P<0.001, R^2=0.32

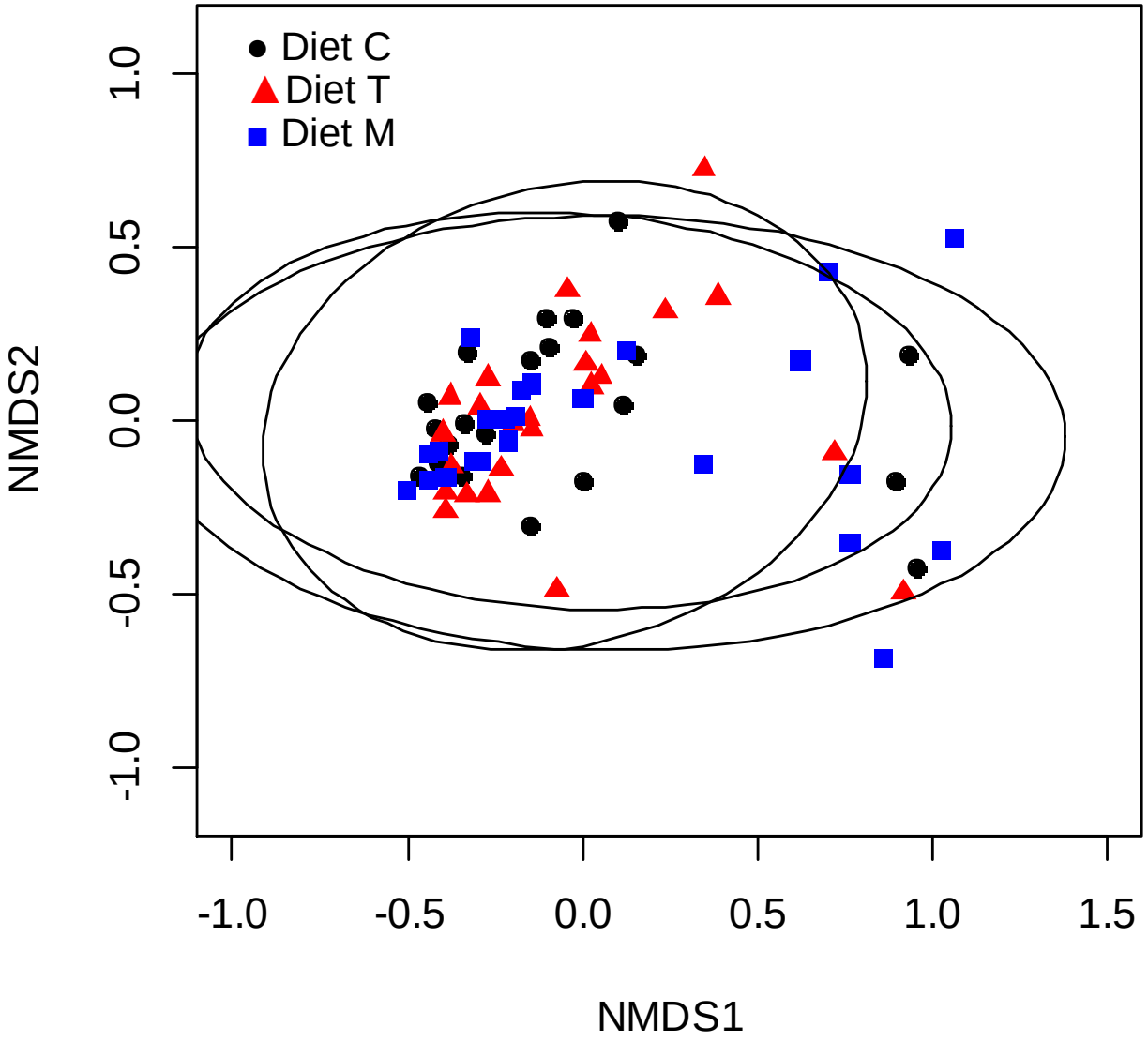
- ANOSIM

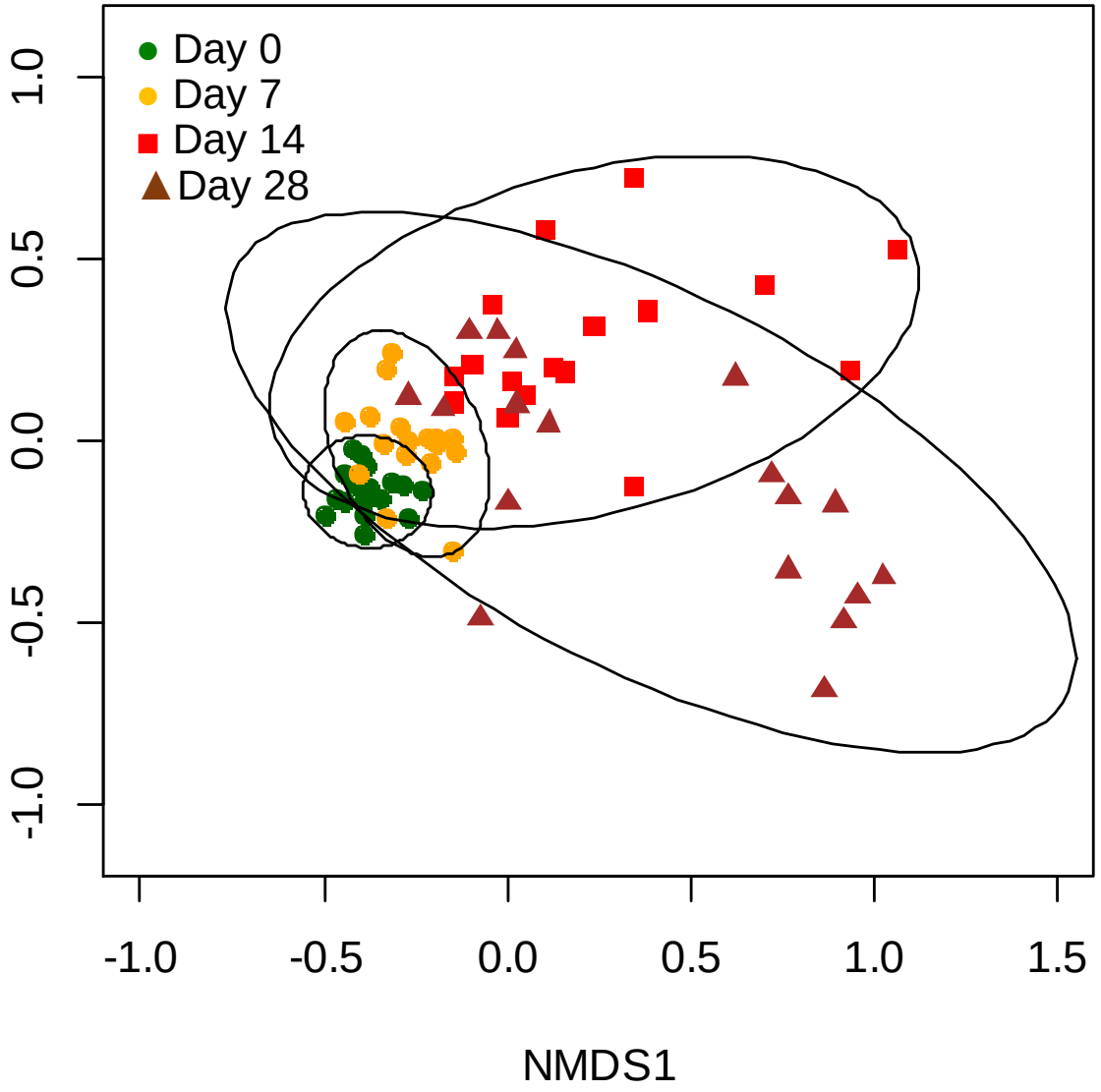
Diet: P=0.97, R=-0.03

Day: P<0.001, R=0.40

The general structure of bacterial community changed over time as a result of the concentrate inclusion

Results- Spatial ordination

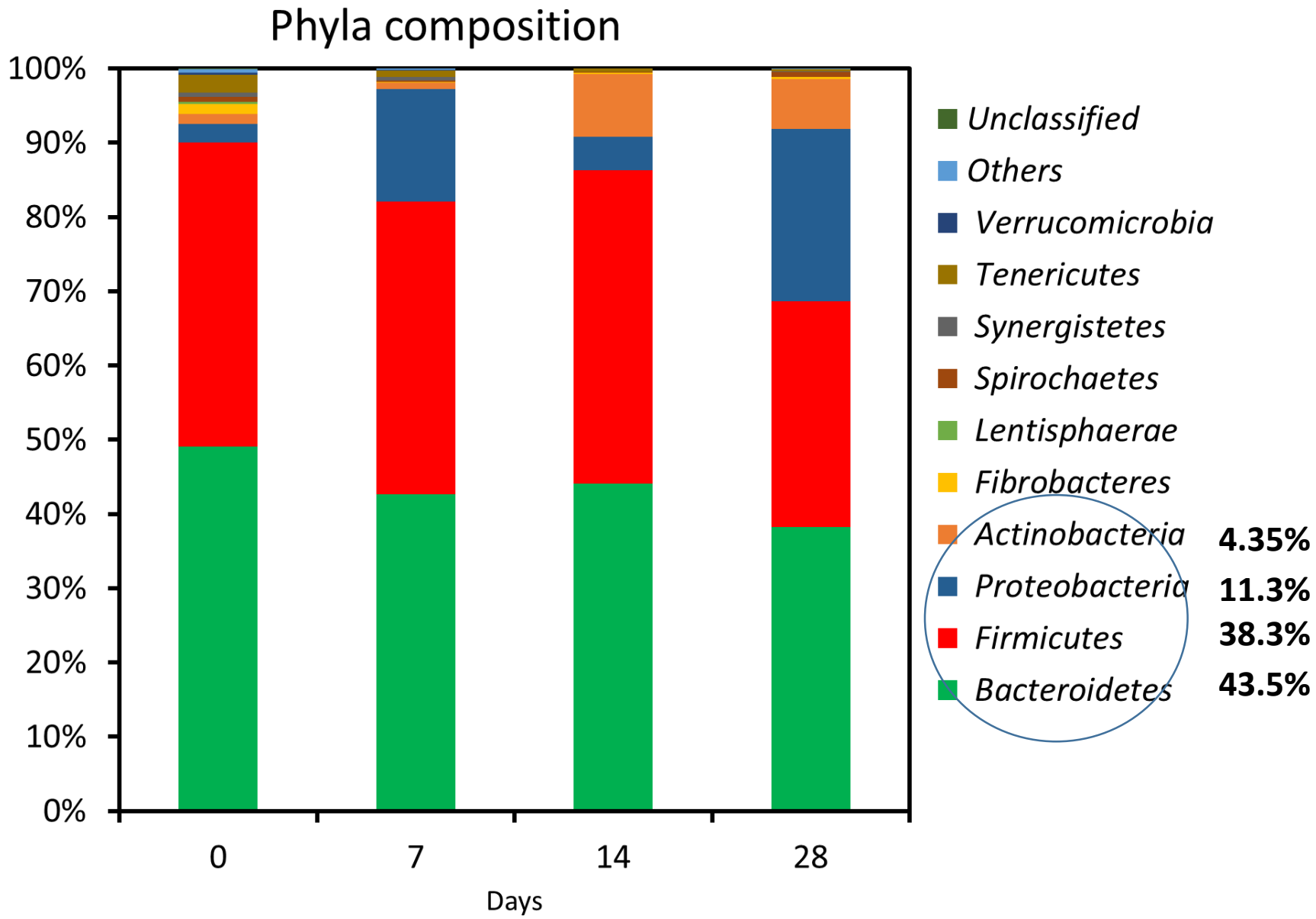




Stress 0.13

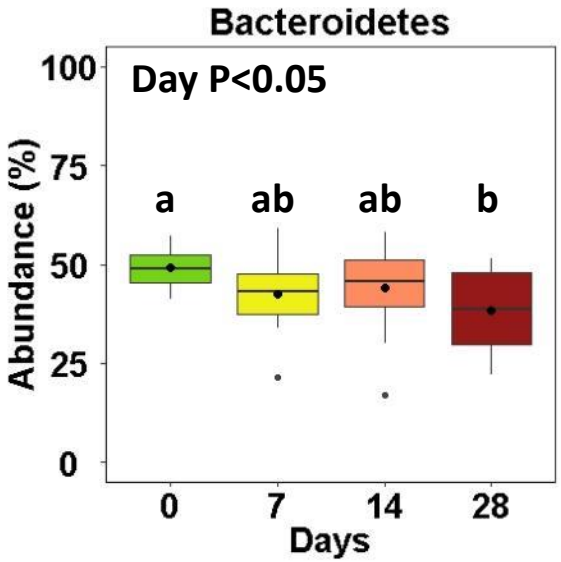
Ellipses show the confidence interval of each group at a 95% level

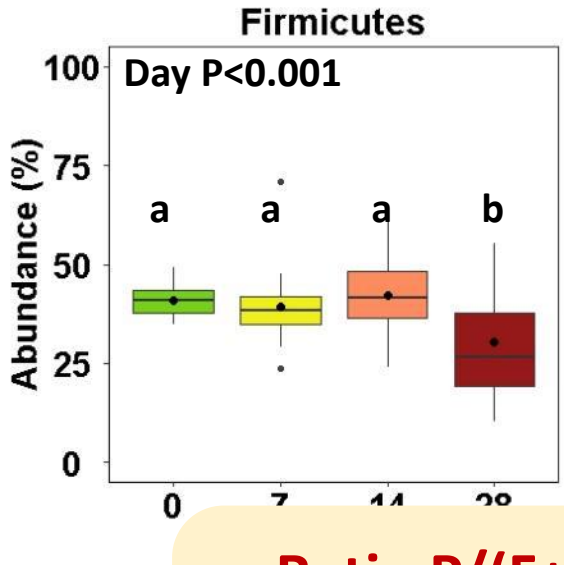
Results- Taxonomic composition

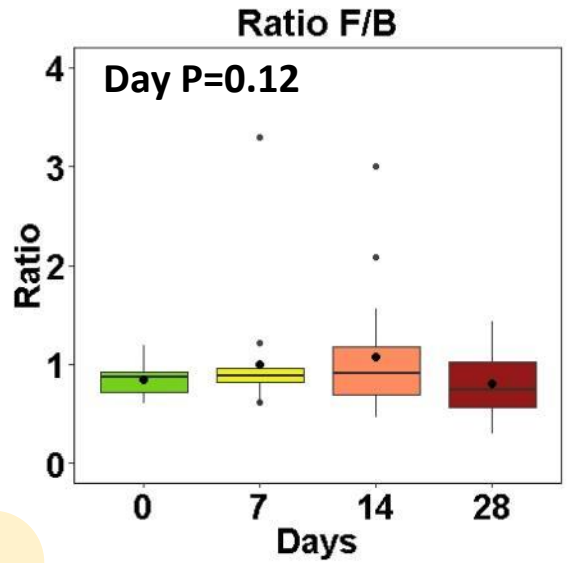


Results- Taxonomic composition

Diet P=NS
Day P<0.001

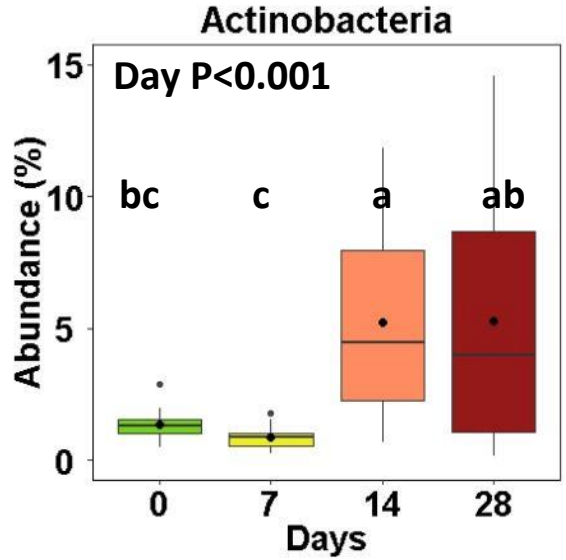


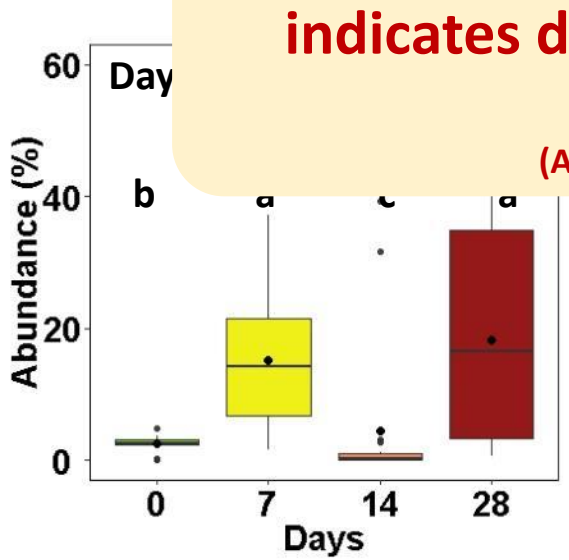


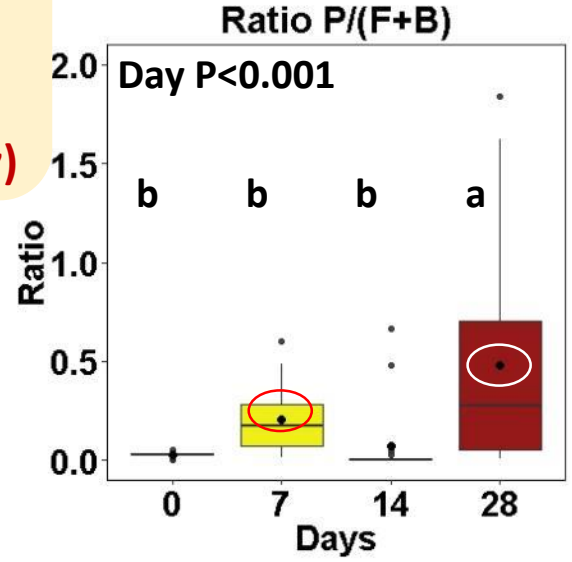


Ratio P/(F+B)> 0.19 indicates dysbiosis

(Auffret et al., 2017)

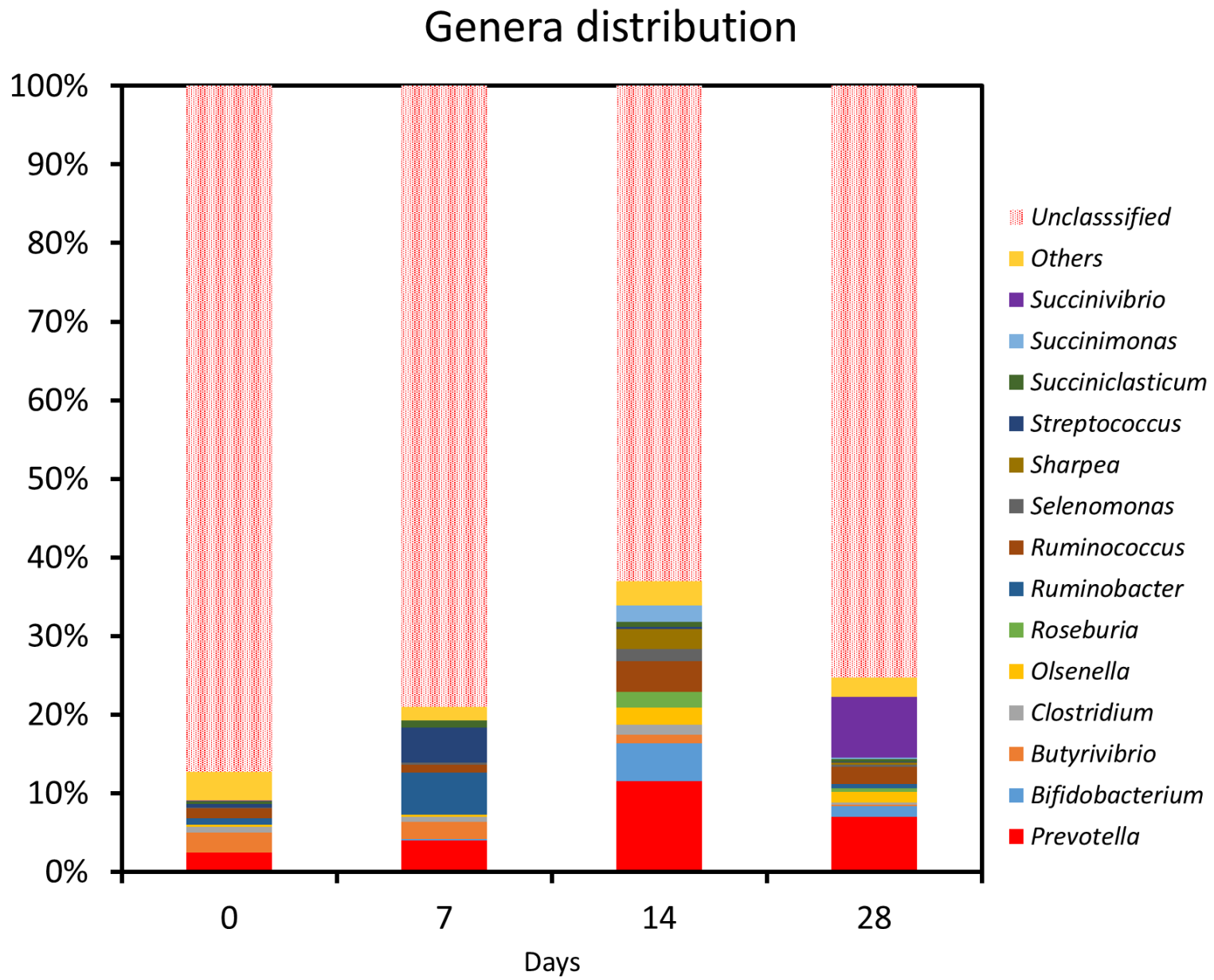




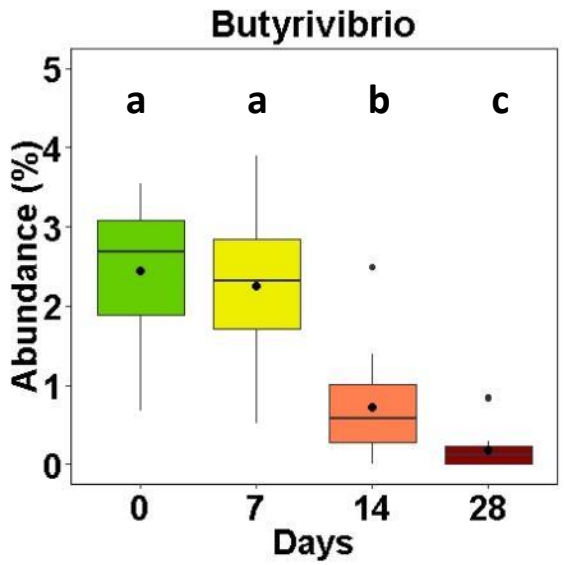


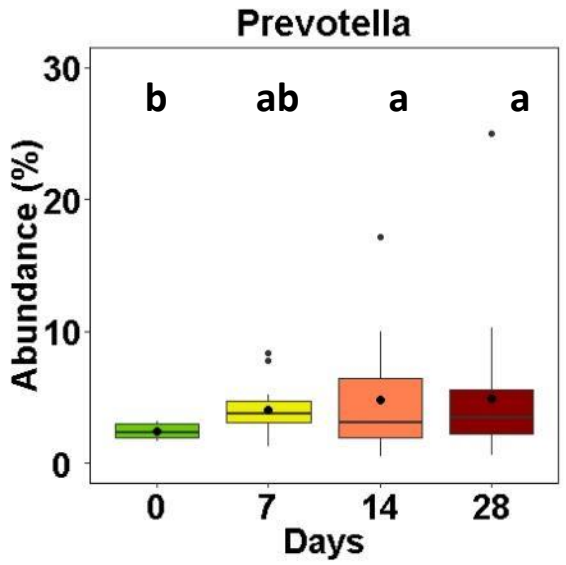
ANOVA was performed with Log_{10}-transformed data.

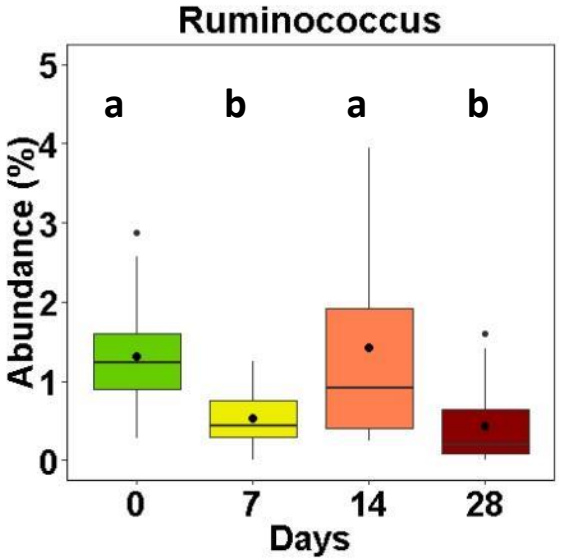
Results- Taxonomic composition

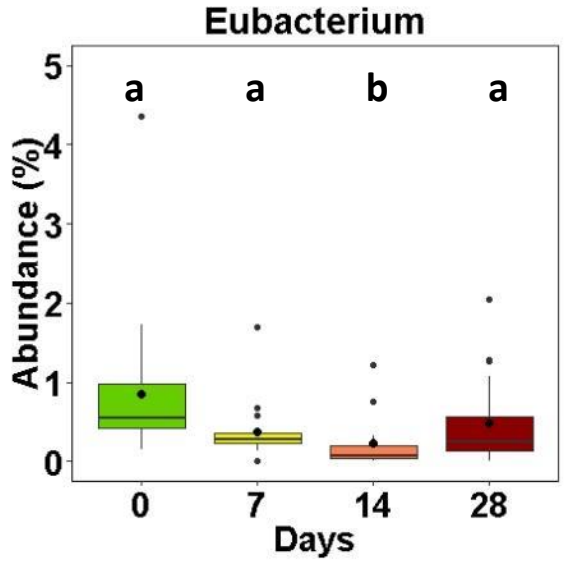


Results- Taxonomic composition









Diet: P=NS

Day: P<0.05 in 95% of the genera

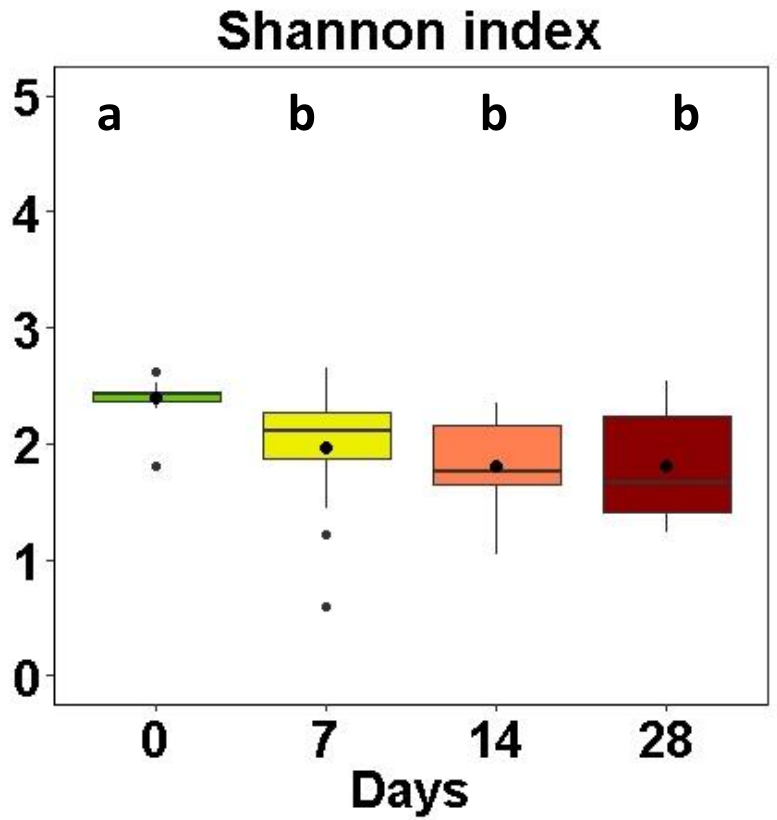
Prevotella, Ruminobacter, Succinivibrio, Selenomonas, Roseburia

Butyrivibrio, Pseudobutyrivibrio, Fibrobacter, Ruminococcus

Bifidobacterium
Sharpea
Lactobacillus

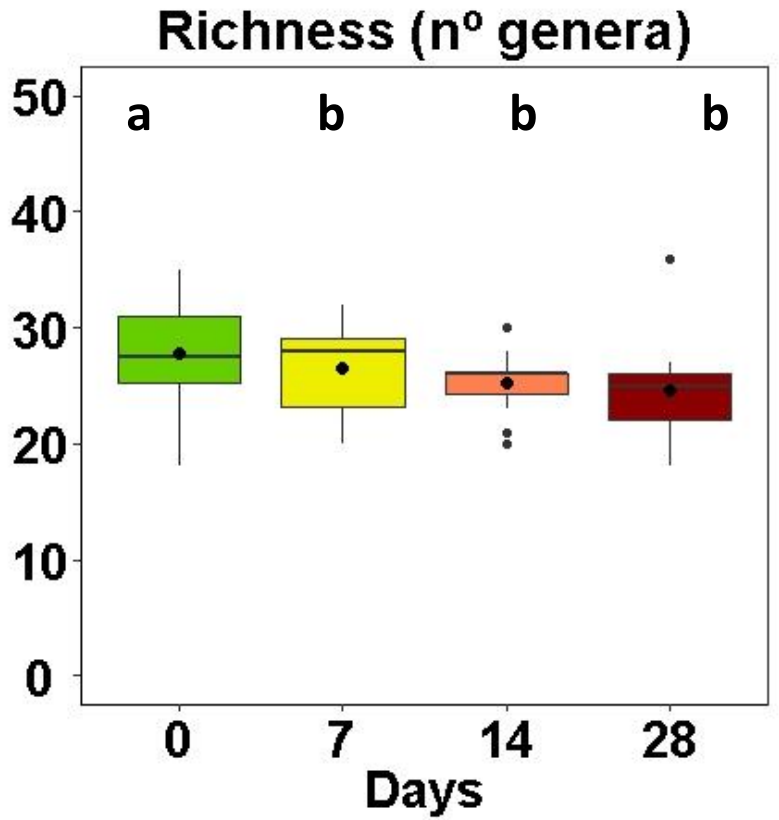
ANOVA was performed with Log_{10}-transformed data

Results- Diversity



Diet: P=0.54

Day: P<0.01



Diet: P=0.48

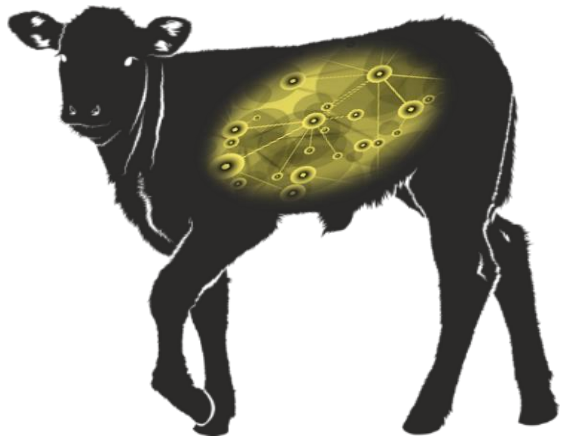
Day: P<0.05

Conclusions

- Transition from a milk and grass diet to a high-concentrate ration strongly altered bacterial composition.

- Bacterial diversity decreased over time but some genera emerged after concentrate inclusion indicating a selection of more tolerant bacteria to the new environmental conditions.

- The inclusion of tannins and medium-chain fatty acids in the adaptation concentrate did not affect rumen bacterial community.



Thanks for your attention

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