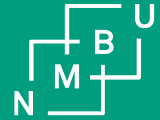




Norwegian University  
of Life Sciences



# Methane emission, microbiome and immune function in dairy cattle



Puchun Niu



Ulrike Gimsa



Phil Pope



Björn Kuhla



Angela Schwarm

EAAP 2021 Davos



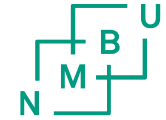
# Background

- Low methane emissions were associated with higher feed efficiency
- Low methane emission is related to less efficient fiber digestion
  - Lack energy to sustain immune response
- How microbial community structure reflects low or high methane emissions?

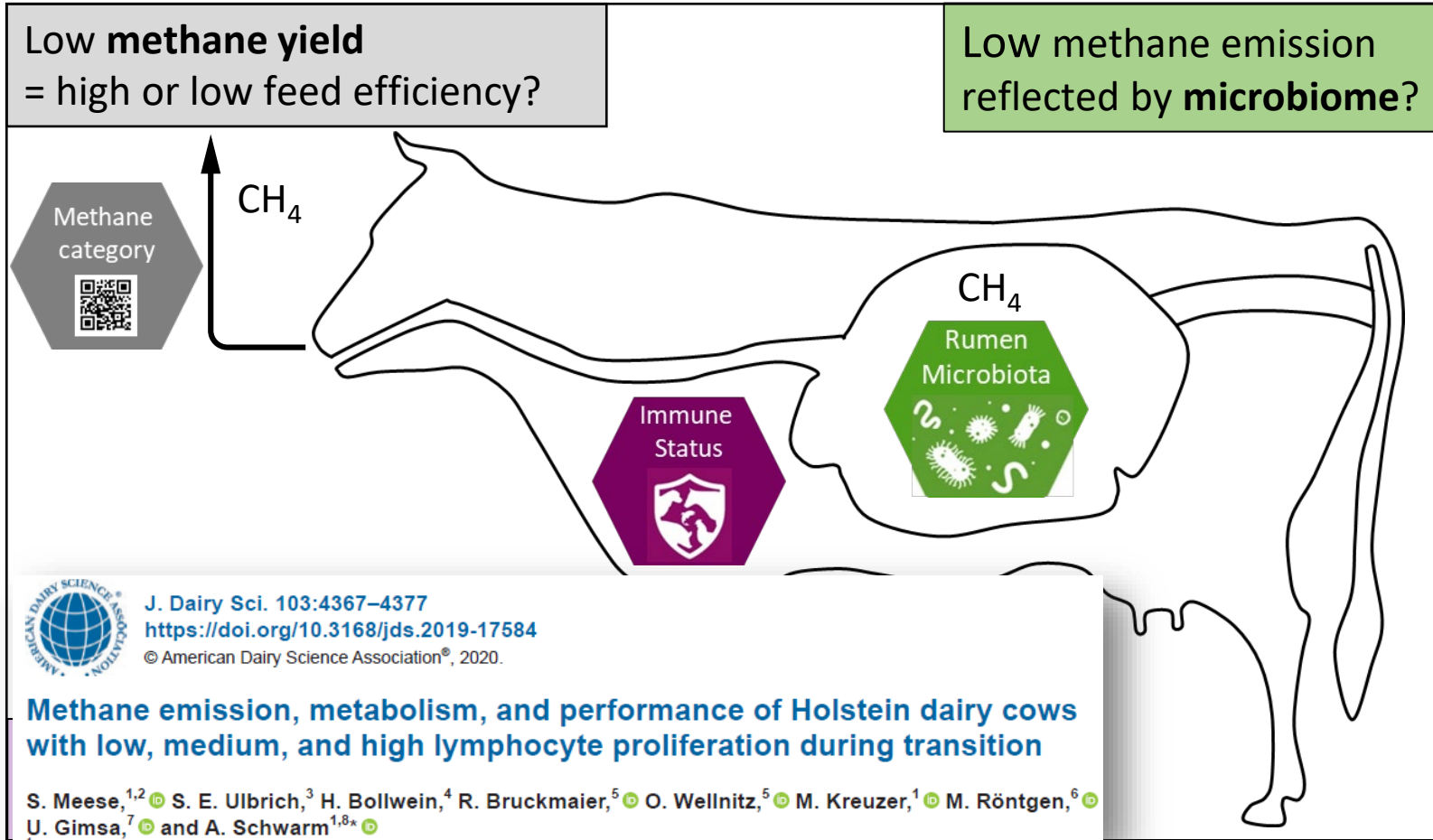


# Objective

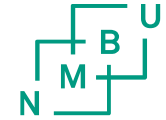
- Delineate interactions between enteric methane ( $\text{CH}_4$ ) emissions, rumen microbiome, and immune function in early and late lactating cows.



# Research questions



# Experimental design and results

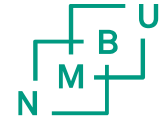


Björn Kuhla

	<b>Early lactation, 31 ± 7</b>	<b>End of lactation, 390 ± 80</b>
Days in milk		
Number of Holstein cows	N = 20	N = 14
2./3./4. lactation	14/6/0	9/4/1
Body weight, kg	650 ± 59	790 ± 76
Dry matter intake (DMI), kg	17 ± 4	16 ± 3
Energy-corrected milk (ECM), kg	41 ± 6	21 ± 3
ECM/DMI, kg/kg	2.5 ± 0.7	1.3 ± 0.3
DMI/BW, kg/kg	2.6 ± 0.7	2.0 ± 0.3
Methane (CH <sub>4</sub> ), g/d	362 ± 54	404 ± 66
CH <sub>4</sub> /DMI, g/kg	22 ± 4	26 ± 3
CH <sub>4</sub> /BW, g/100 kg	56 ± 9	51 ± 7
CH <sub>4</sub> /ECM, g/kg	9 ± 2	20 ± 4

- Statistics: regression analysis and paired t-test

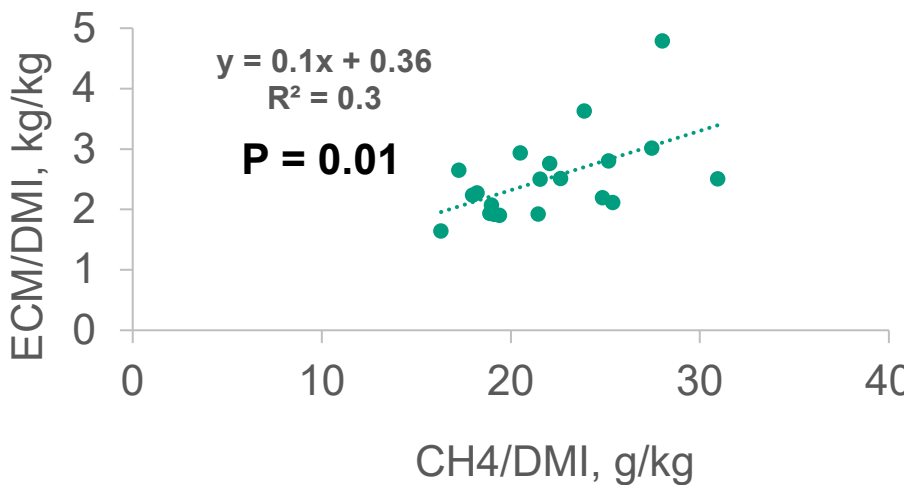
# Results



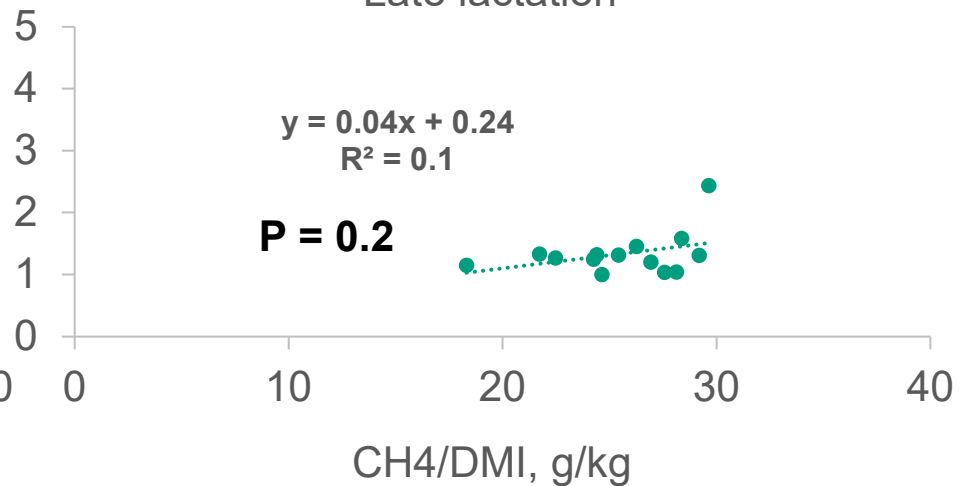
## Low methane yield = low feed efficiency

- Cows producing less CH<sub>4</sub>/DMI (g/kg) were characterized by a LOWER feed conversion efficiency FCE (ECM/DMI)

Early lactation



Late lactation





Ulrike Gimsa

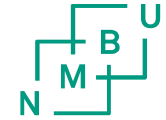


## Immune response and methane emission

- Peripheral blood mononuclear cells (PBMC) proliferation index (PI) to mitogens PHA and ConA
- TNF $\alpha$  concentration in whole blood incubations stimulated by lipopolysaccharide (LPS)
- CH<sub>4</sub>/d, CH<sub>4</sub>/DMI, CH<sub>4</sub>/ECM and CH<sub>4</sub>/BW were not related ( $p > 0.1$ ) to immune response (PI\_PHA, PI\_ConA)

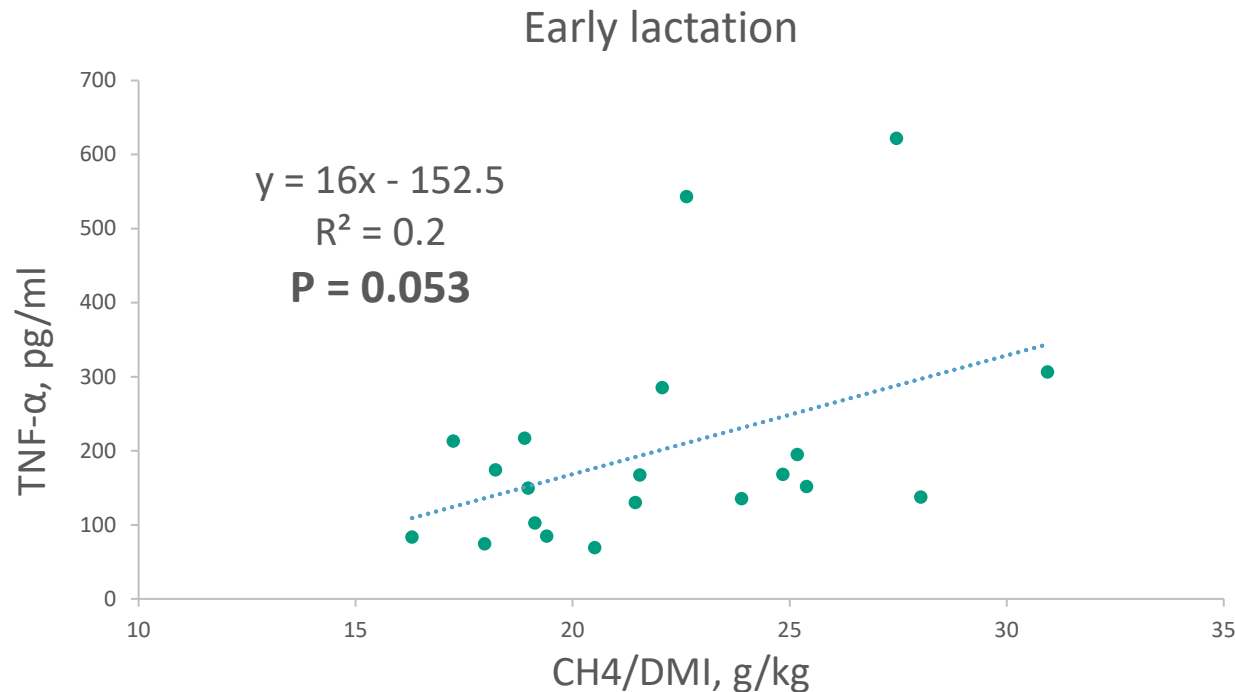


Ulrike Gimsa

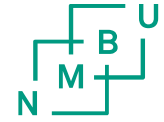


## Immune response and methane emission

- Except that a trend was observed between TNF $\alpha$  concentration and methane yield in early lactation



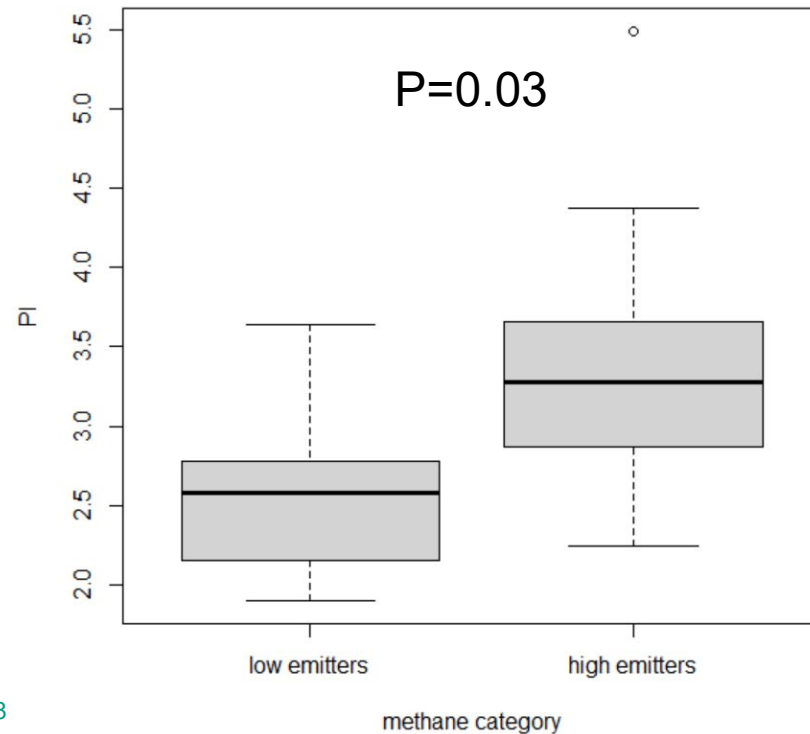




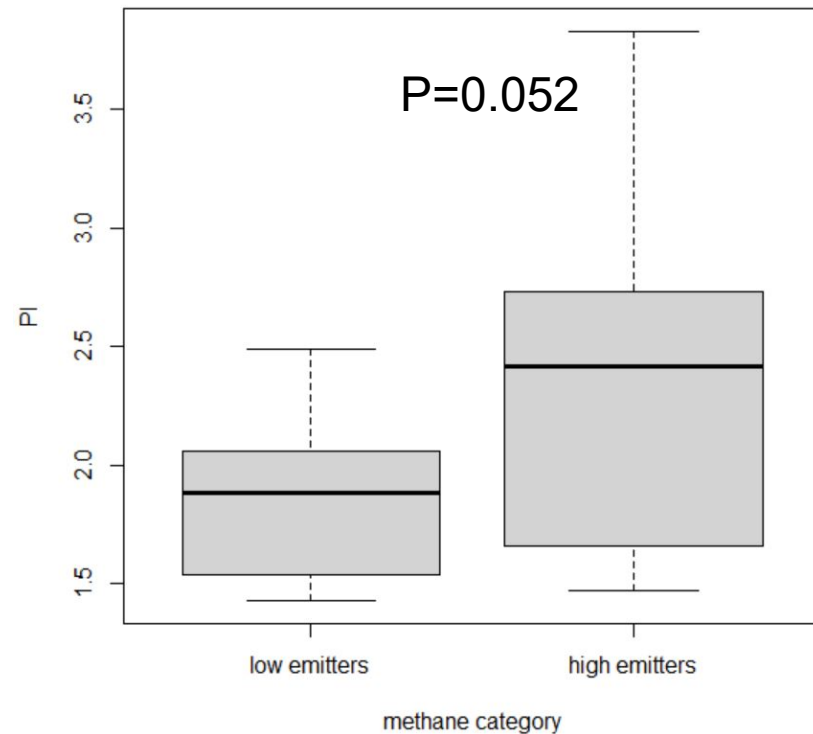
# Immune response and methane emission

- Retrospectively categorized into low and high CH<sub>4</sub>/DMI emitting cows
- Low and high emitters in early lactation differ in immune response to ConA and TNF $\alpha$  (not shown), and tend to be different in response to PHA

immune response to ConA



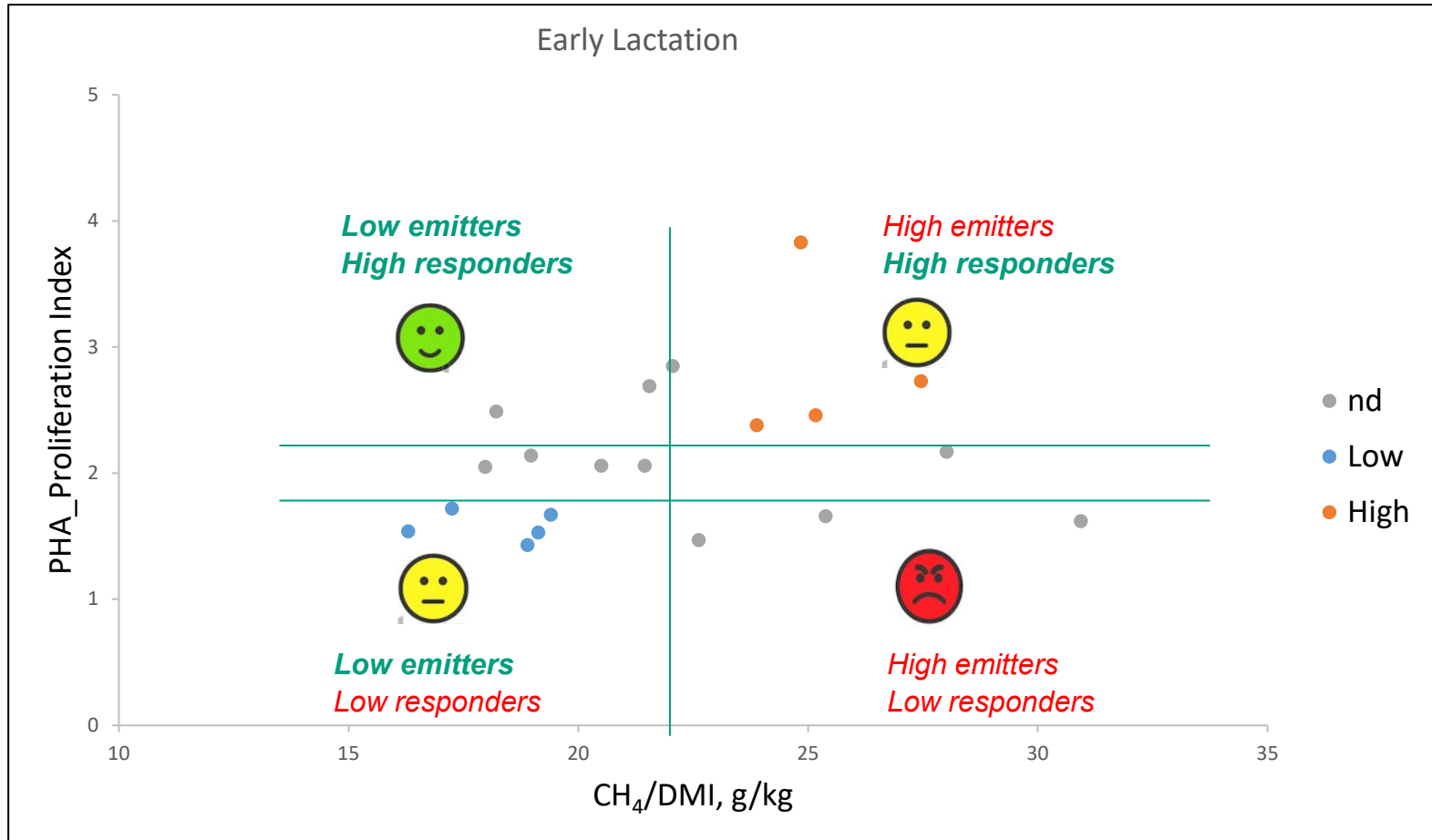
immune response to PHA



# Dilemma

Low methane yield = climate friendly cow

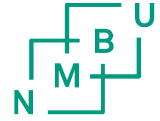
Low proliferative immune response = not resilient cow



# Low methane yield reflected by rumen microbiome?



Phil Pope

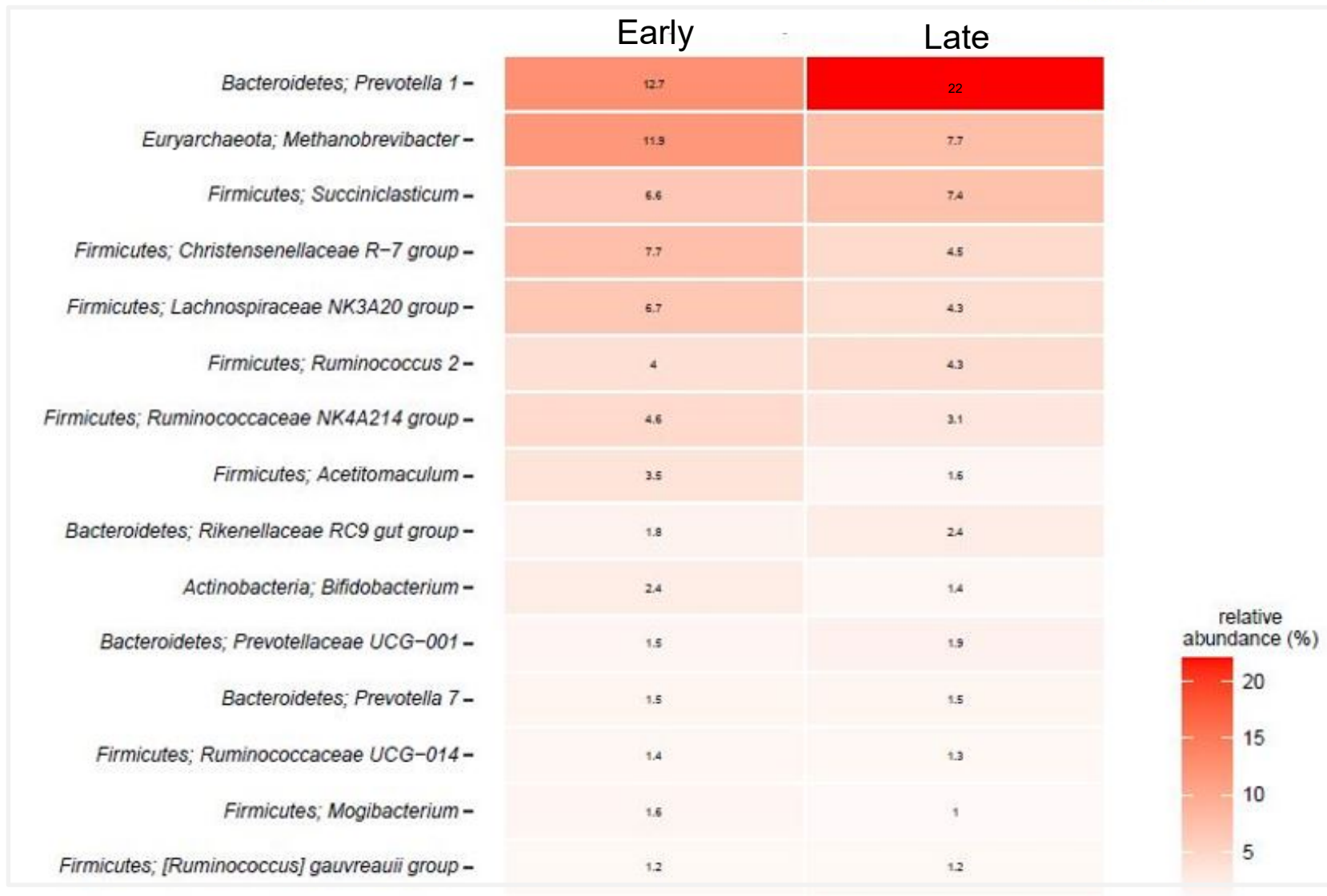
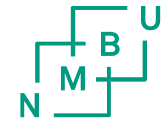


- 16S rRNA sequence analysis for taxonomic identification and relative abundance of microbial populations (Kunath et al. 2018).



- Preliminary results obtained so far comparing lactation stages
- low and high emitters within lactation stage are not compared yet

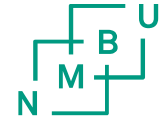
# Comparison of early and late lactation rumen microbes



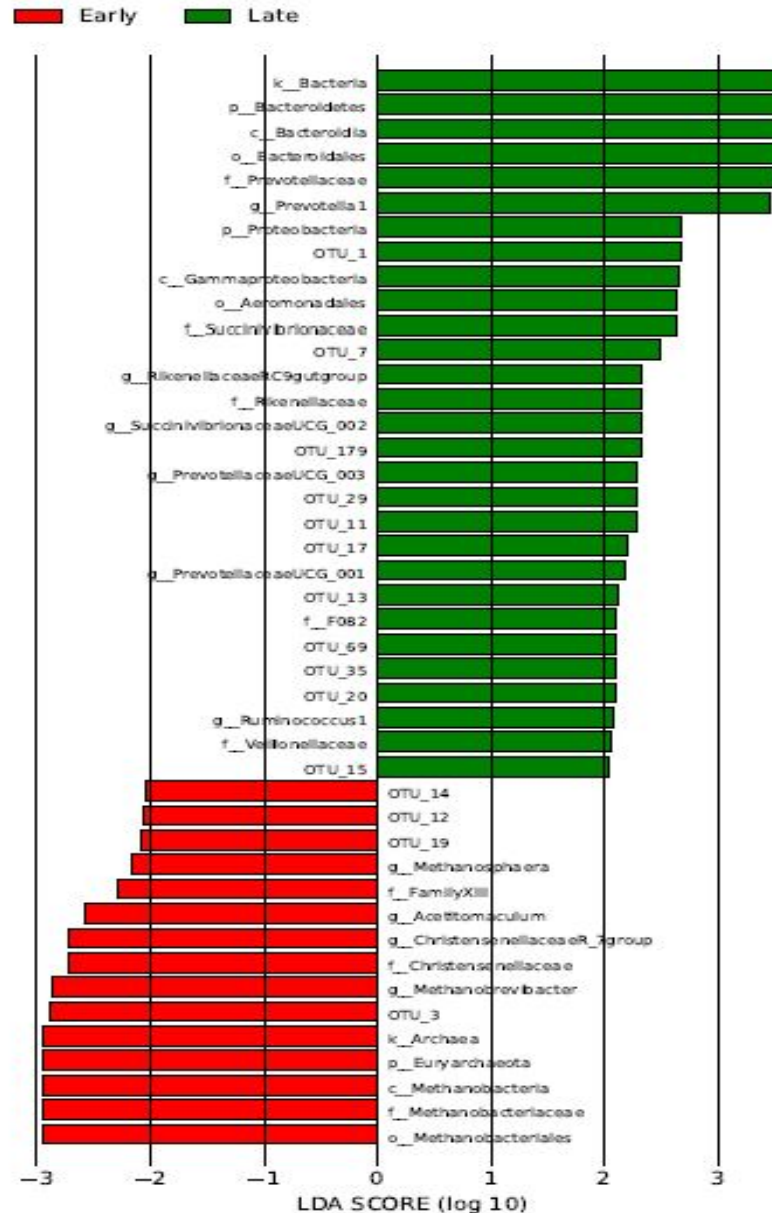
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- **Heatmap of the 15 most abundant genera.**

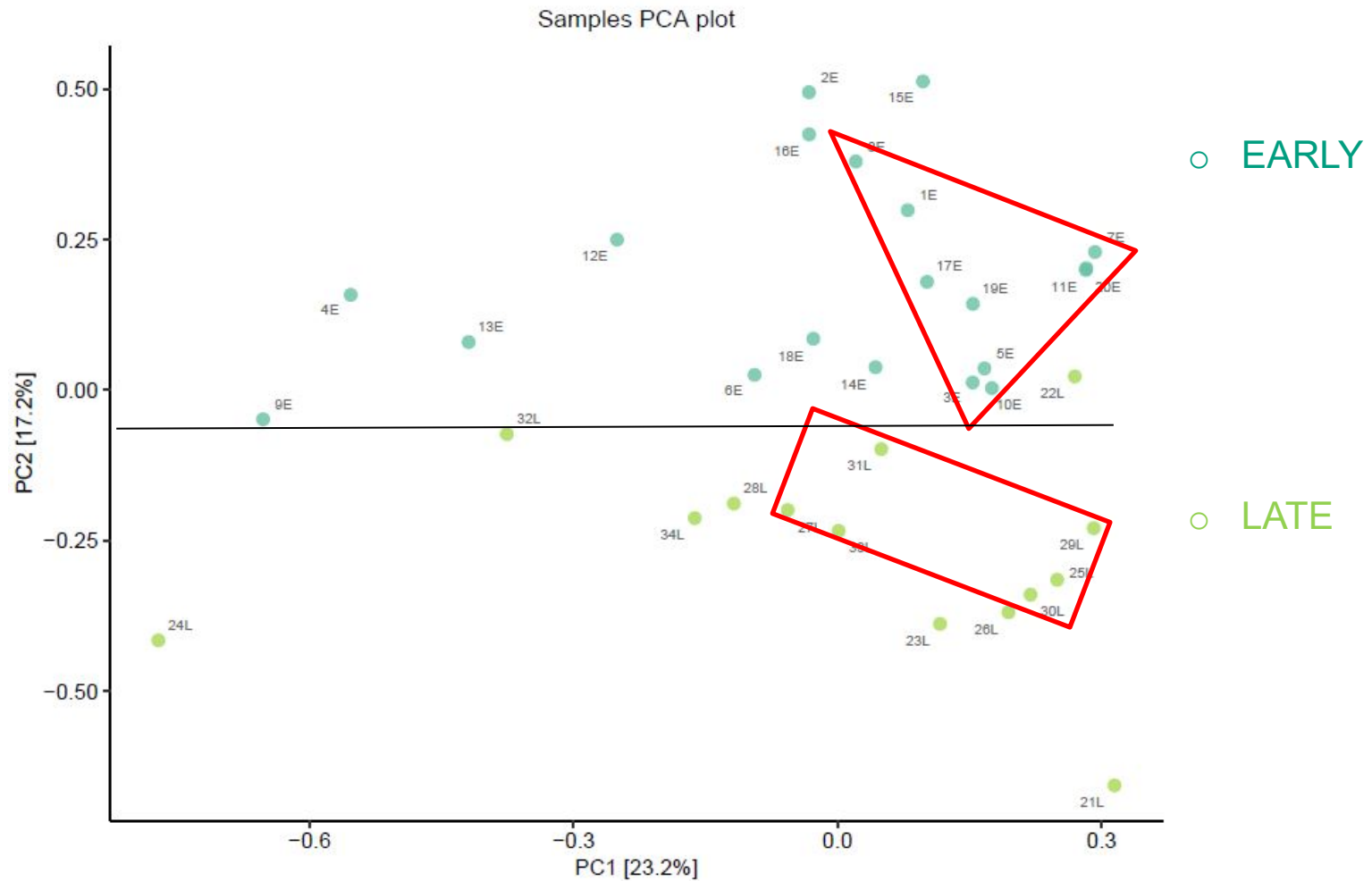
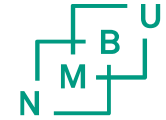
# Comparison of early and late lactation rumen microbes



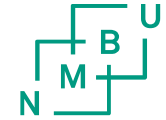
- **Example of graphical output from LEfSe analysis**



# Comparison of early and late lactation rumen microbes



- **Principal component analysis (PCA):** identification of samples with similar microbial communities



# Summary

- Results suggested that low methane emissions were related to lowered feed efficiency and decreased immune function

