Rhine-Waal University of Applied Sciences and AgResearch

Investigating *in vivo* digestion of sheep and cow milk in a rat model

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- **Results**
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  - Serum
- **Metabolites of interest**
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- **Conclusion**

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Hypothesis

- Sheep and cow milk are compositionally different; such differences can result in differences in digestion and assimilation of these milks by the body.

Aim

- To investigate the differences in digestion and assimilation of sheep and cow milk in an *in vivo* rat model, using nuclear magnetic resonance (NMR) metabolomics

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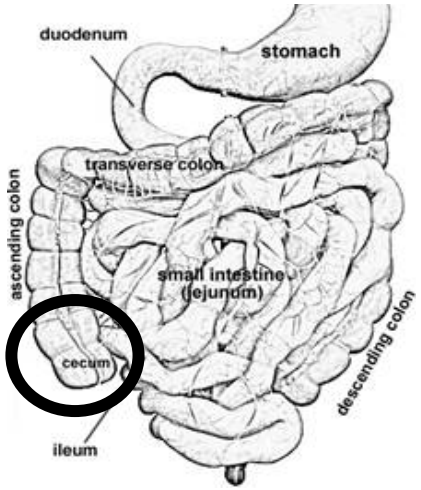
Methods

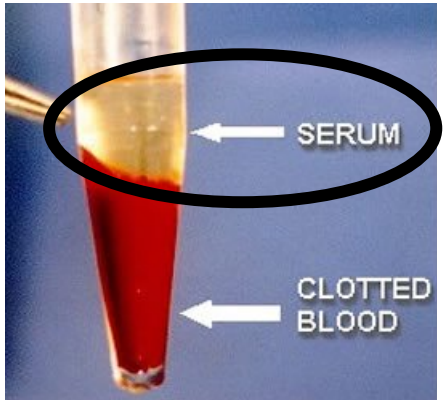
Sheep milk  X 12

Diluted sheep milk  X 12

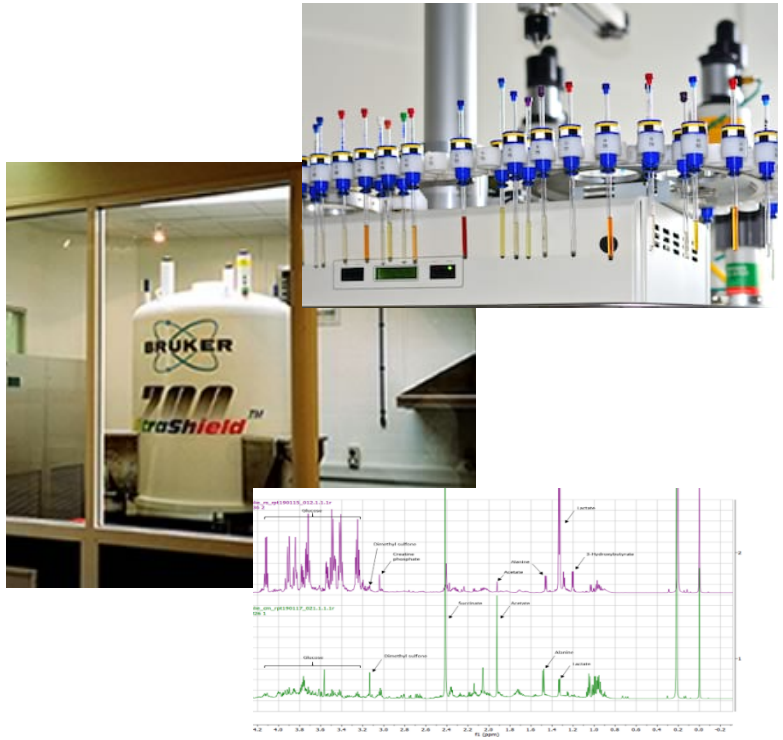
Cow milk  X 12



Caecal contents



Serum



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NMR spectroscopy

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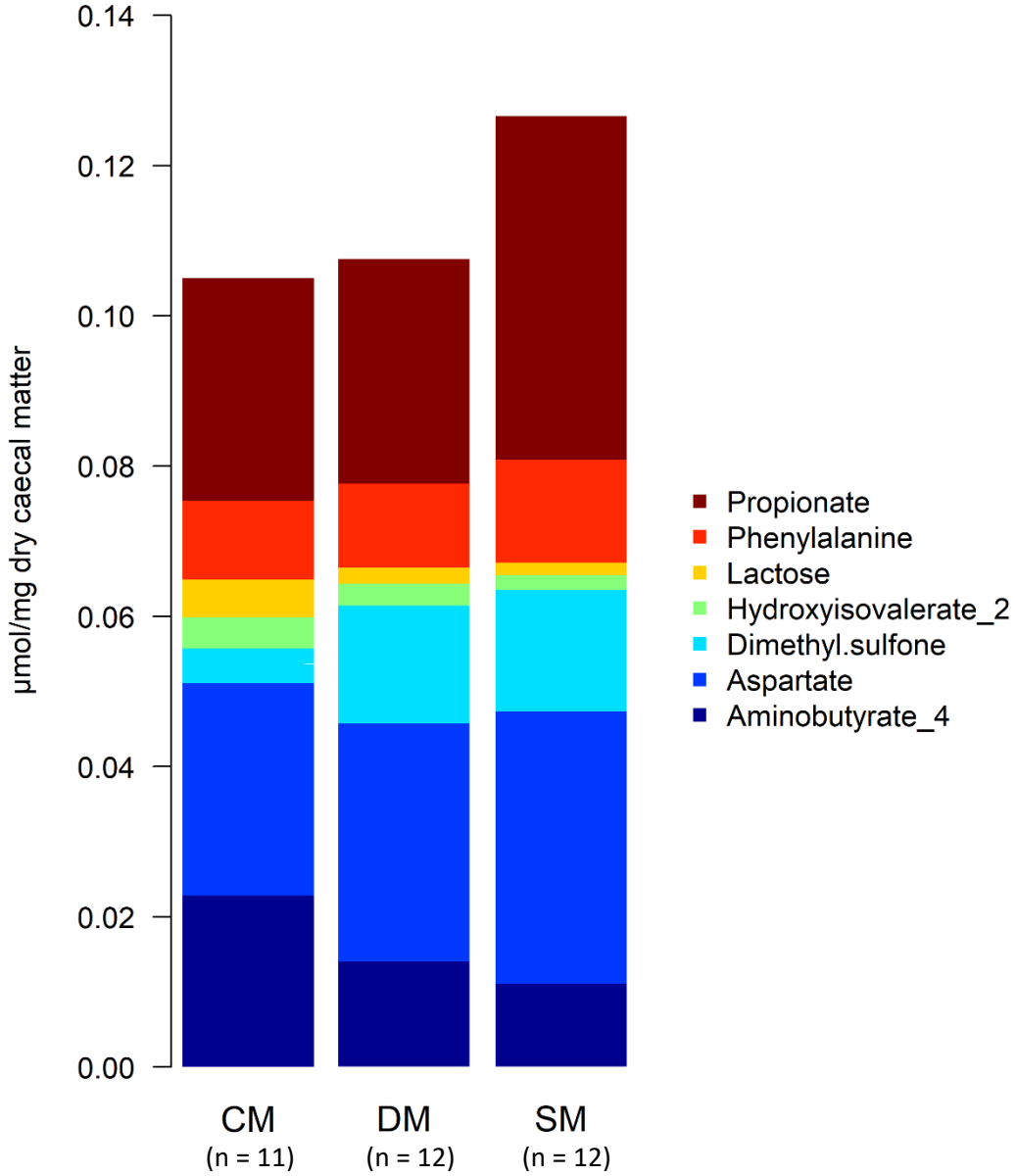
RESULTS: Caecal material

- Statistical analysis – Student's T-test in R
- 8 metabolites with significantly different concentrations ($p < 0.05$)



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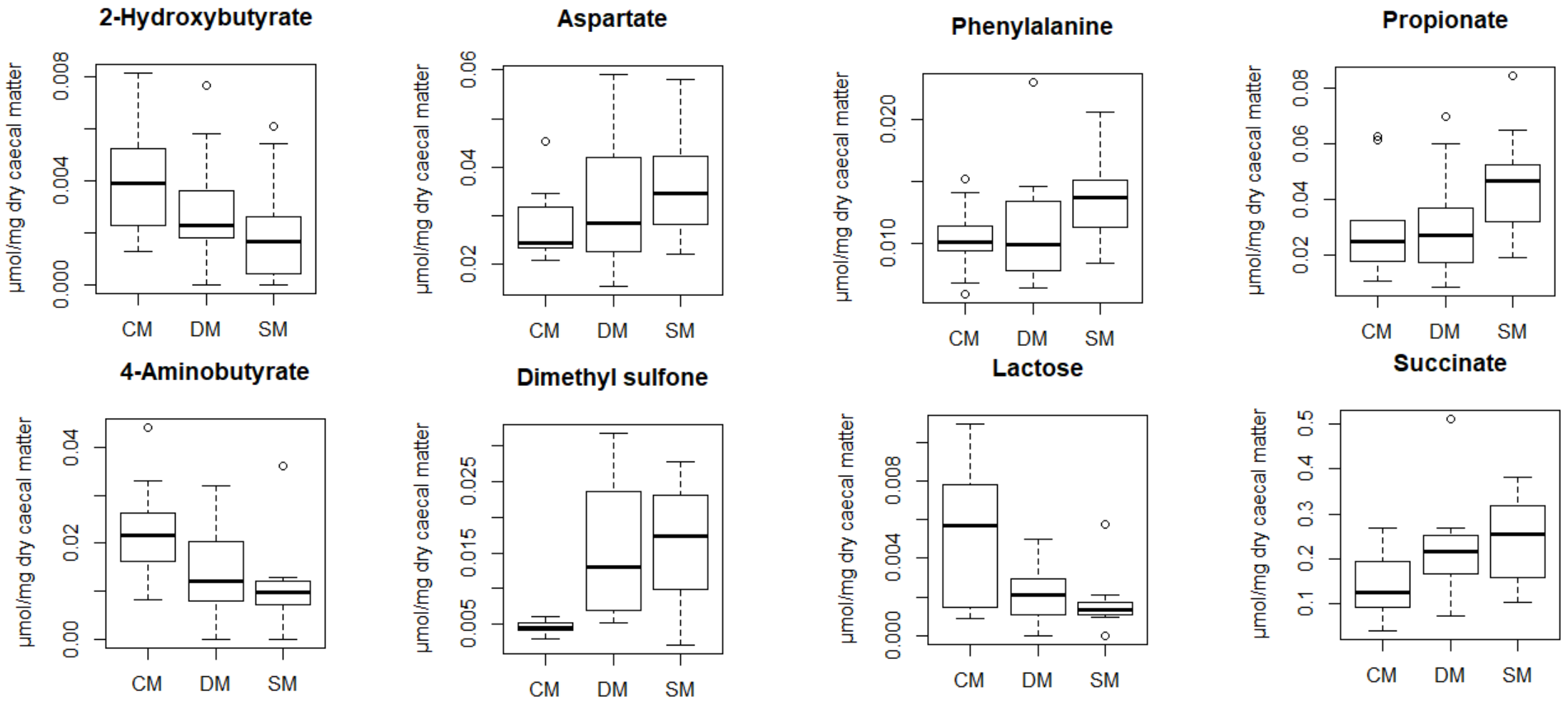
RESULTS: Caecal material



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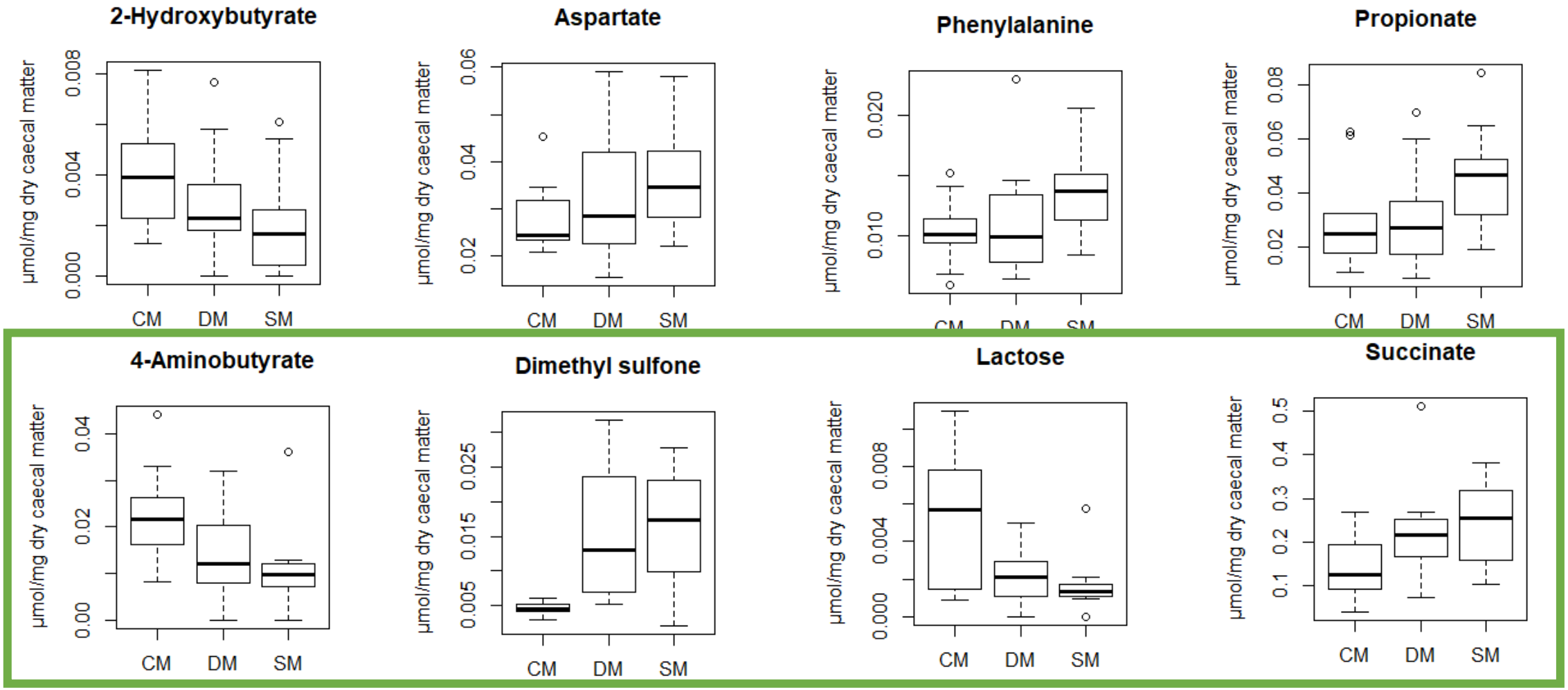
RESULTS: Caecal material



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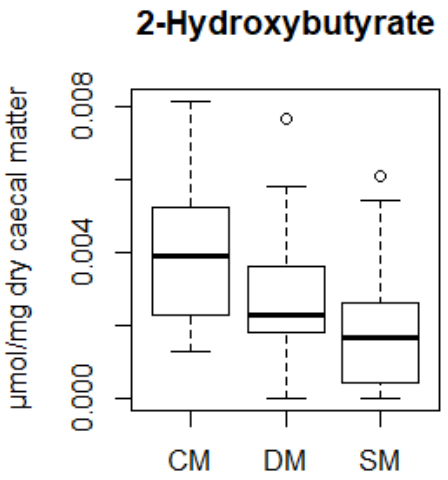
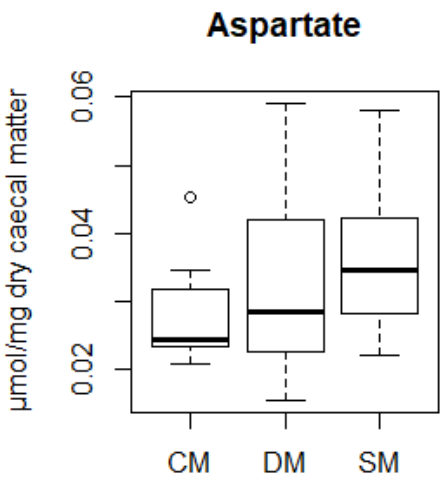
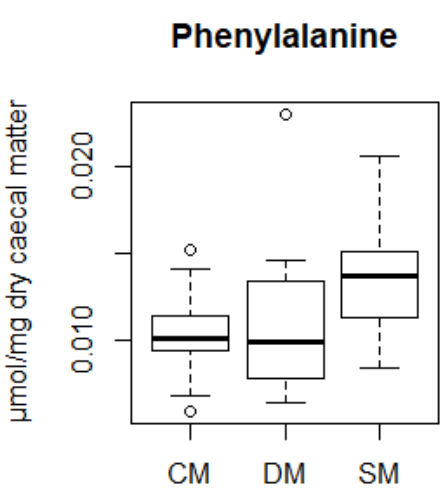
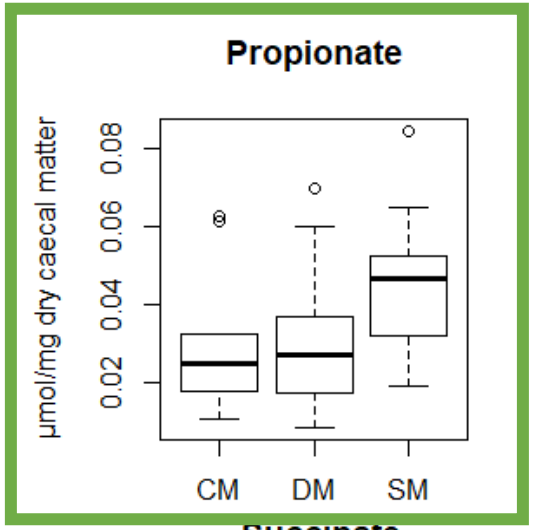
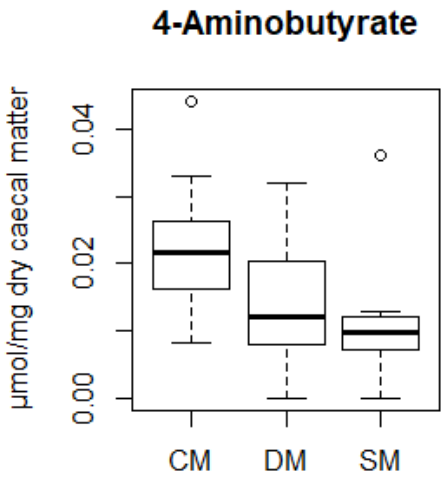
RESULTS: Caecal material

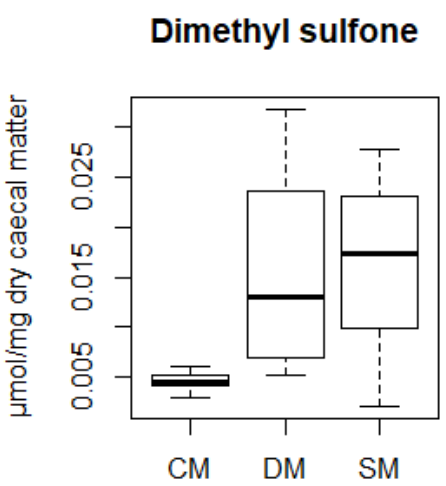


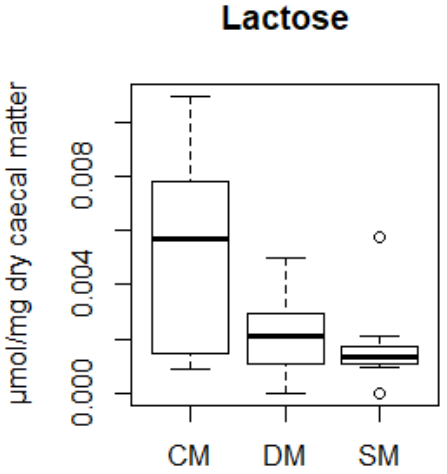


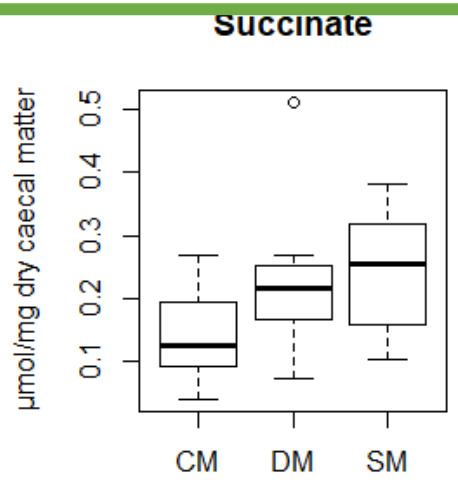












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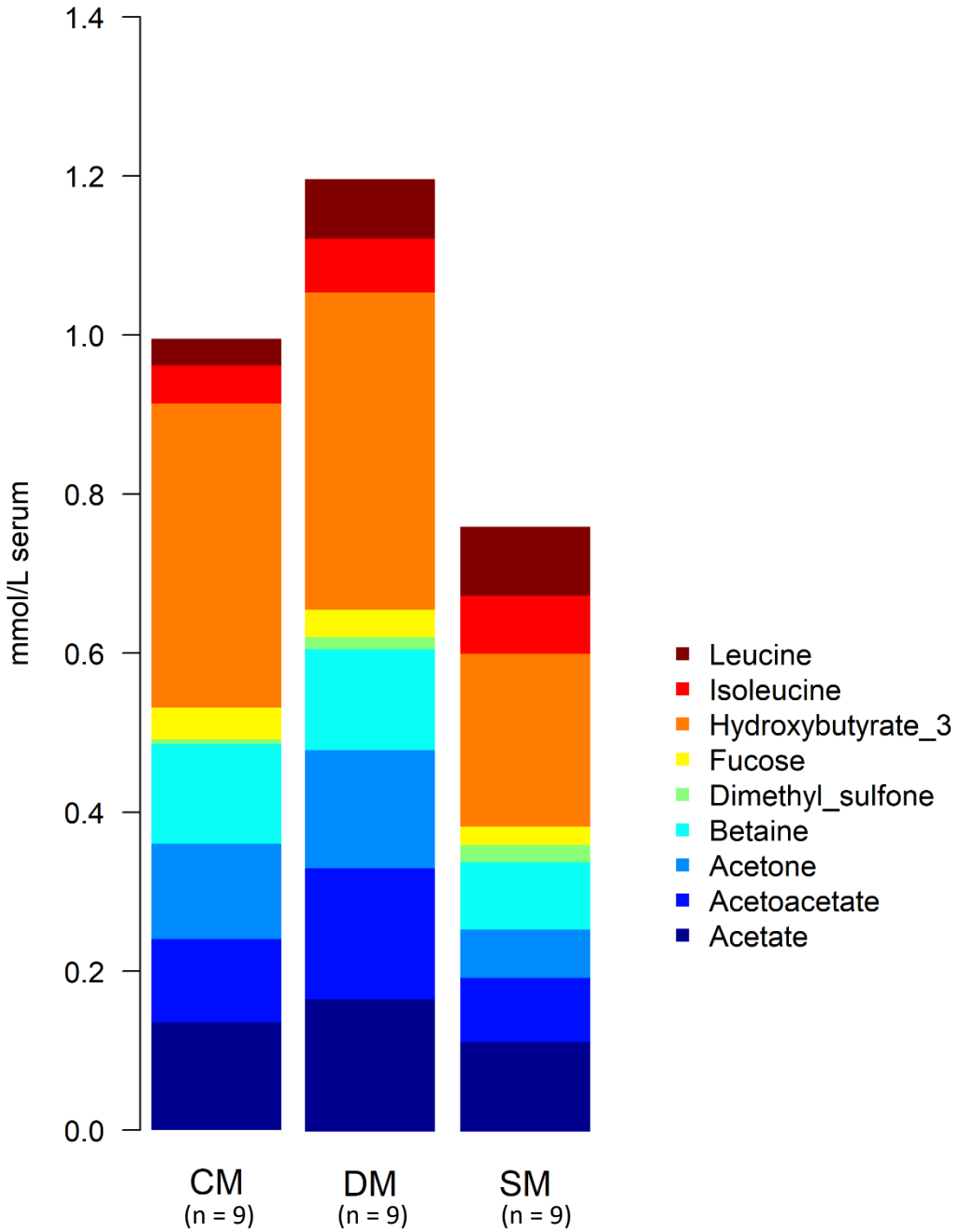
RESULTS: Serum

- Statistical analysis – Student's T-test in R
- 10 metabolites with significantly different concentrations ($p < 0.05$) (including glucose)



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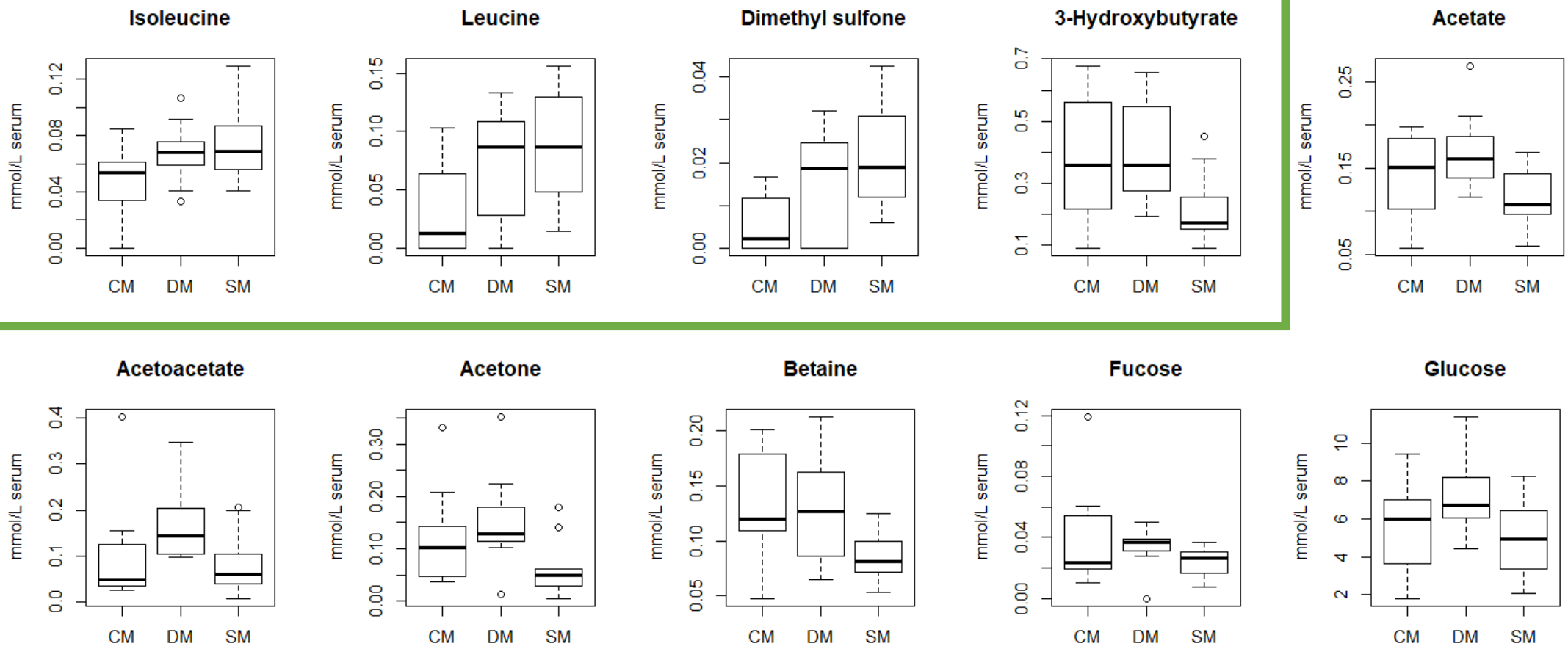
RESULTS: Serum



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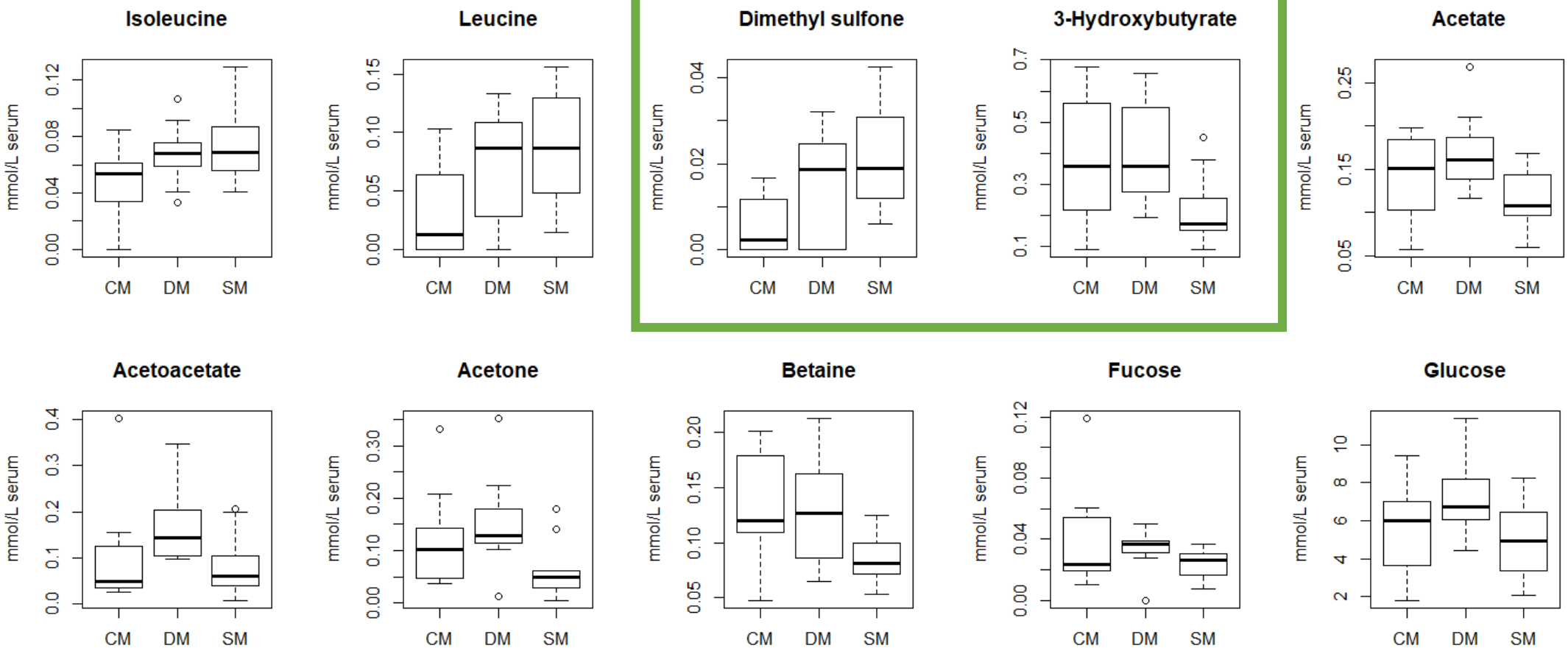
RESULTS: Serum



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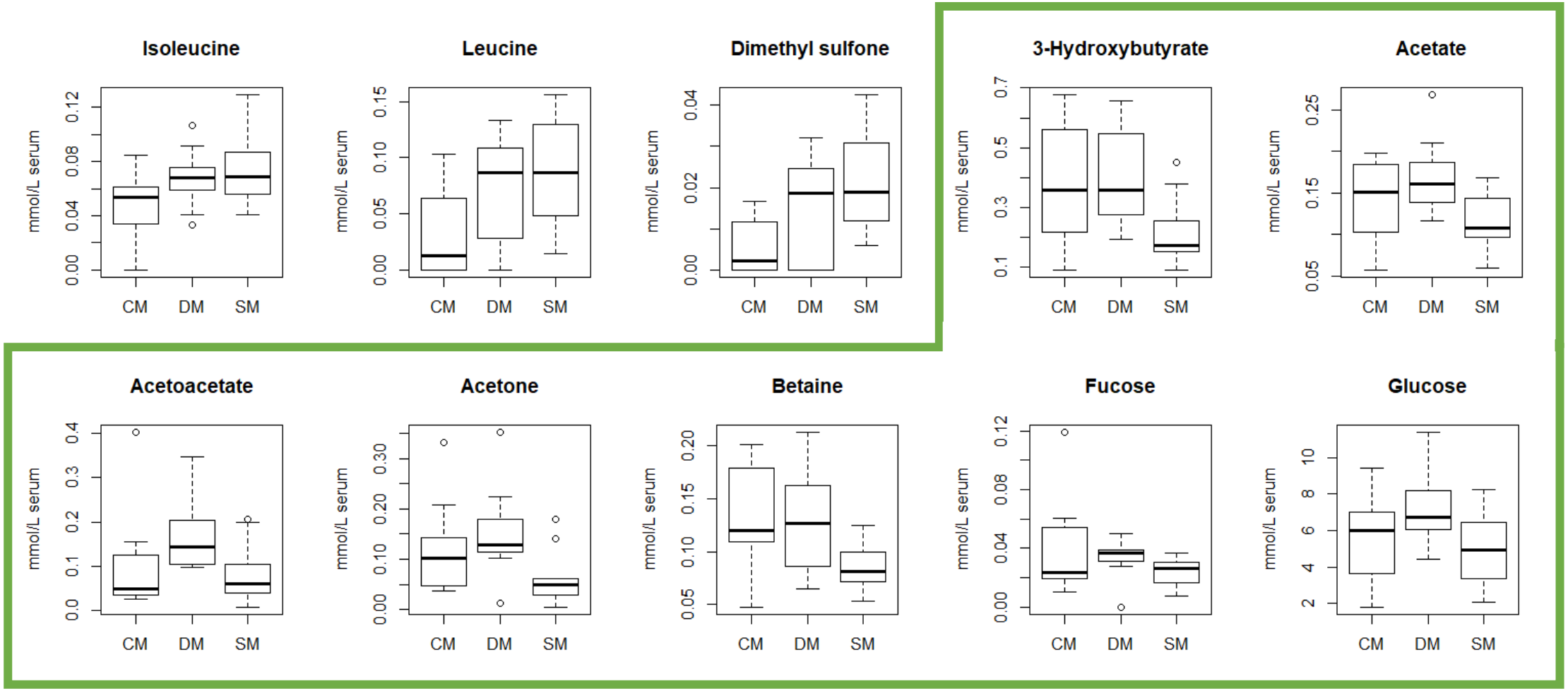
RESULTS: Serum



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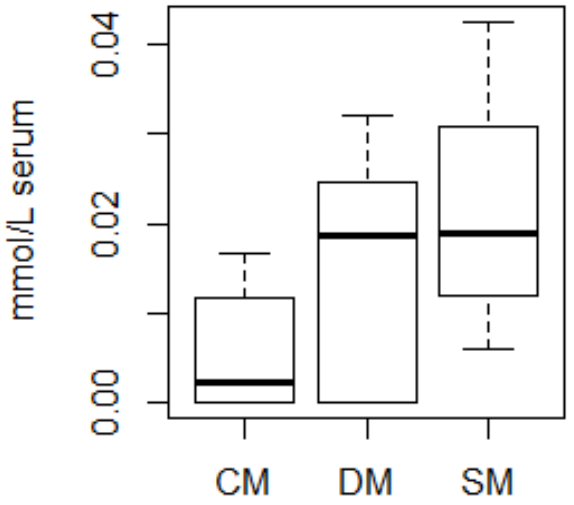
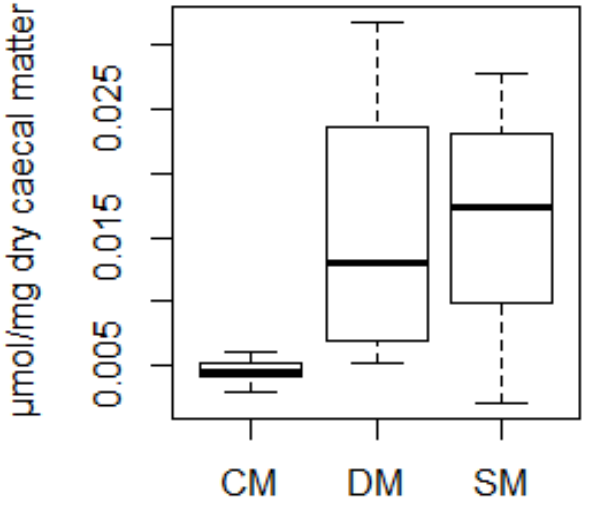
Dimethyl sulfone
(Methylsulfonylmethane, MSM)

- Both serum and caecal material: significantly higher in SM and DM groups than CM group
  → Possibly linked to sheep milk
- Naturally occurring anti-inflammatory and antioxidant
- Sources: mainly milk, also grains and some vegetables
- Shown to be effective in:
  - Management of rheumatic and arthritic pain
  - Reducing knee cartilage degradation in osteoarthritis
  - Autoimmune disease mediation
  - Protecting against oxidative stress in high-intensity sports
- Sheep milk - potential role in mediating arthritic pain, inflammation and autoimmune diseases

Serum



Caecal material



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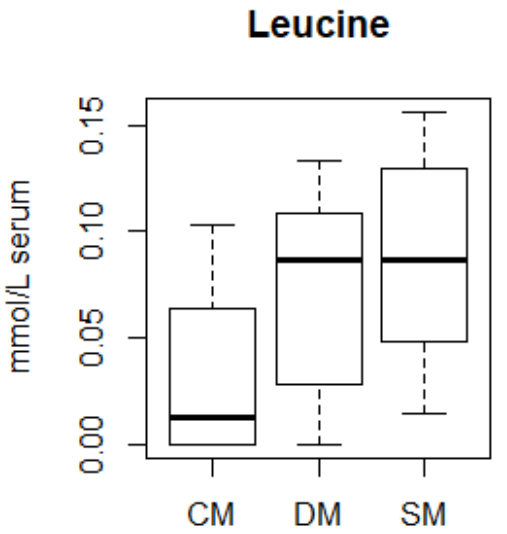
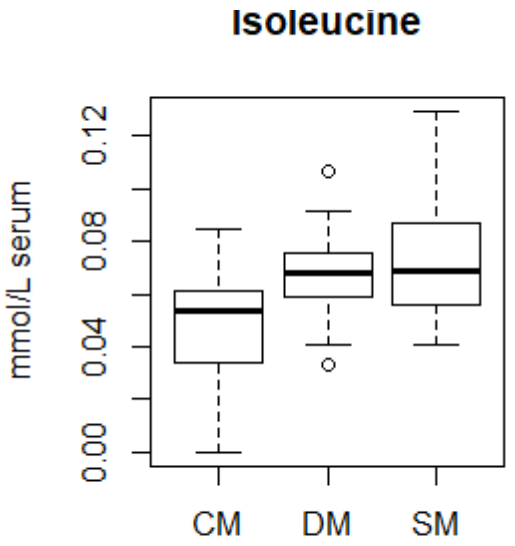
Serum: Leucine and isoleucine

- Significantly higher serum concentrations in SM group than CM group
- Essential, branched-chain amino acids; need to be acquired externally
- Leucine: regulates blood glucose levels
- Role in protein synthesis, immune system, energy production, neurotransmitter synthesis
- Results align with HPLC free amino acid work done

- Similar % in milks analysed: higher concentrations here due to better release of these AAs from SM?
- Consuming SM increases circulating essential (branched-chain) amino acids





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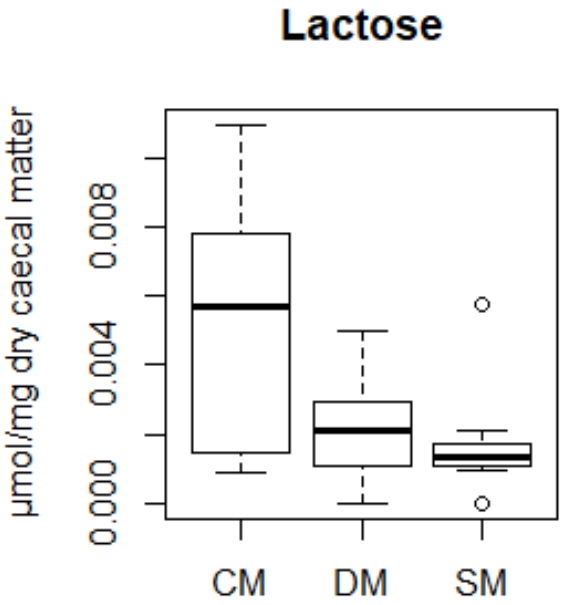
Caecal contents: Lactose

- Significantly higher in CM group than in SM group
- A milk sugar, present in most milks
- Lactose metabolised into monosaccharides glucose and galactose both microbially and by the body
  → no significant difference in glucose concentrations
- Macronutrient analysis of milk powders showed higher levels of lactose in SM



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CONCLUSION

- Digestion of sheep and cow milk result in differences in rat serum and caecal metabolite profiles
- Milk differences drive differences in the metabolite profile, whether by compositional differences, direct effect on digestion, assimilation or effect on the microbiome.
- Sheep milk consumption leads to higher levels of:
    - MSM – SM has potential role in mediating arthritic pain, inflammation and autoimmune diseases
    - Leucine and isoleucine – SM increases circulating essential (branched-chain) amino acids
- These differences raise the potential for sheep and cow milk to have differential effects on the human body

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Acknowledgements:

Dr. Linda Samuelsson, for her enthusiasm, motivation and encouragement!

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Image sources

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