University of Reading

NETTLEBED CREAMERY

Artisan cheese and the gut microbiota: potential implications for health

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Executive Cheesemaker at Nettlebed Creamery

Background

2015-2018	2018-2020	2020-2021	2021-present	2022-present
BSc Biomedical Sciences; Durham University	Lead Cheesemaker at Nettlebed Creamery	MSc Molecular Biosciences (Microbiology); University of Bath	Executive Cheesemaker at Nettlebed Creamery	PhD Food and Nutritional Sciences; University of Reading

The potential impact of artisan cheese on the gut microbiota

Why cheese?

The gut microbiome has been shown to be closely aligned with overall health, and it can be augmented by the consumption of fermented foods

Cheese is a fermented product containing cultures with recognised probiotic potential

Including *Lactococcus lactis, Streptococcus salvarius* subsp. *thermophilus* and *Lactobacillus delbreuckii* subsp. *bulgaricus*

The cheese matrix of protein and fat provides a protective coating for the probiotics which increases the likelihood they will reach the gut microbiome intact[1]

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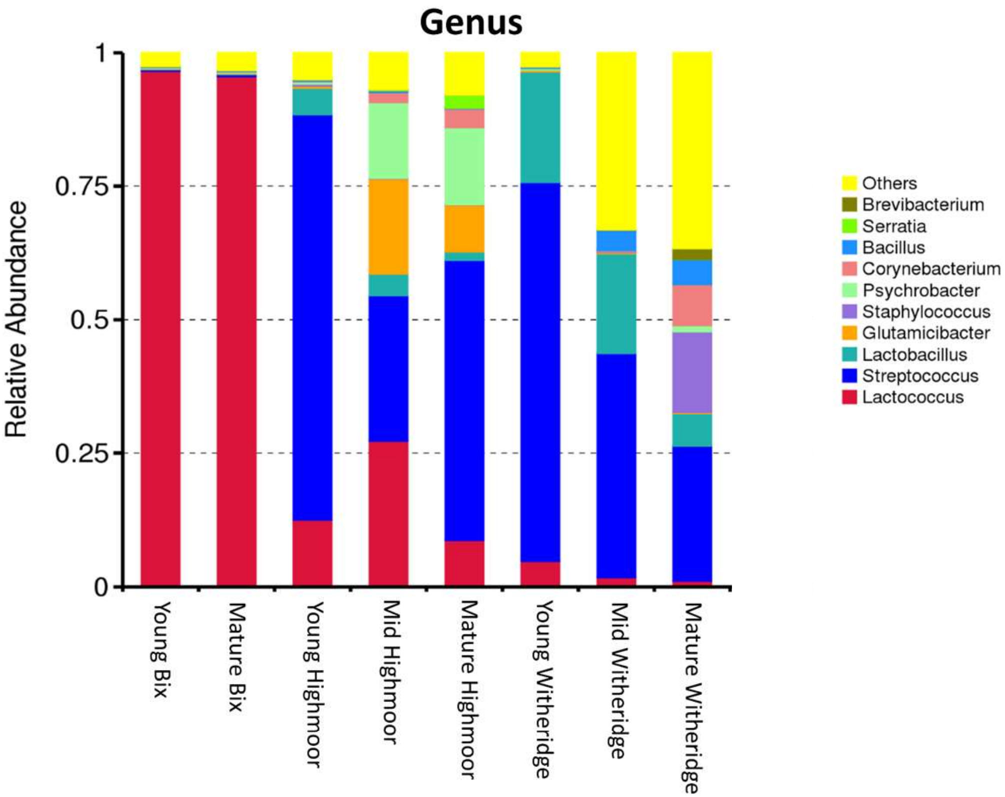
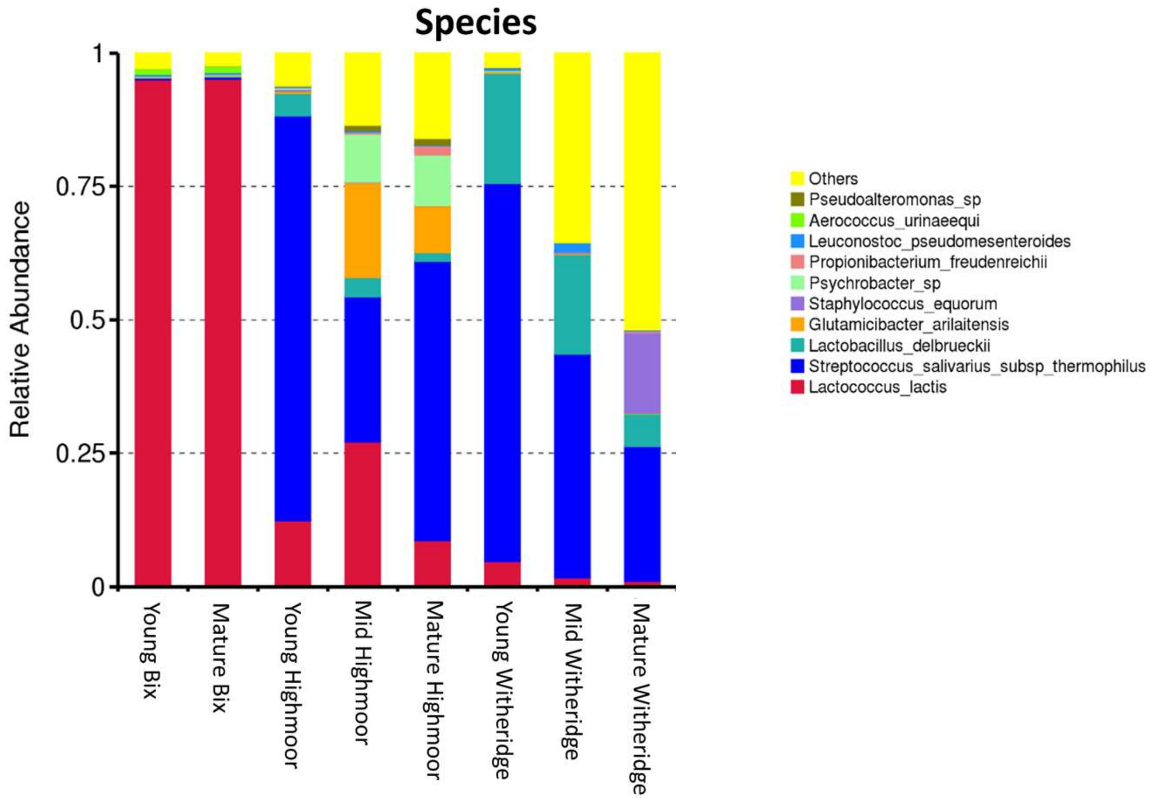
Article

Microbial and Biochemical Characterization of Three Artisan British Cheeses throughout the Maturation Process

Sabrina Longley,* Glenn Gibson, and Anisha Wijeyesekera



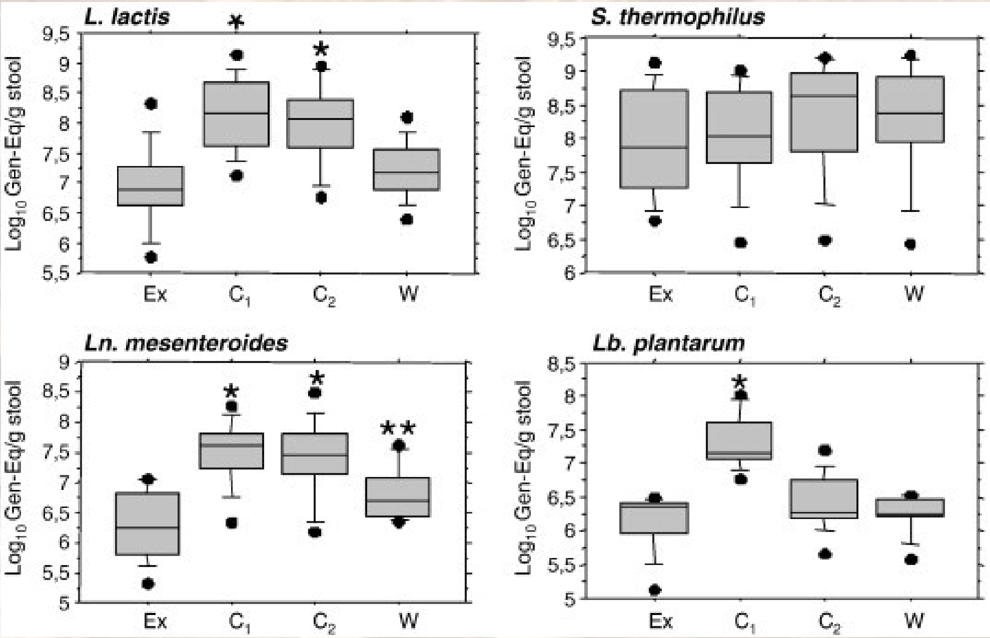
Genus
Relative Abundance
1
0.75
0.5
0.25
0
Young Bix
Mature Bix
Young Highmoor
Mid Highmoor
Mature Highmoor
Young Witheridge
Mid Witheridge
Mature Witheridge
Others
Brevibacterium
Serratia
Bacillus
Corynebacterium
Psychrobacter
Staphylococcus
Glutamicibacter
Lactobacillus
Streptococcus
Lactococcus



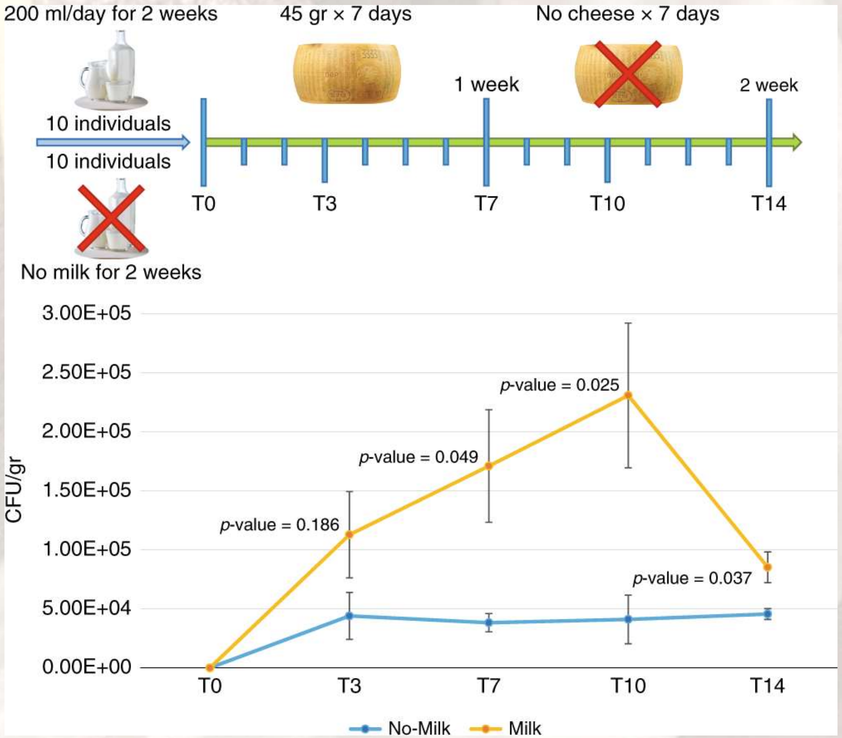
Species
Relative Abundance
1
0.75
0.5
0.25
0
Young Bix
Mature Bix
Young Highmoor
Mid Highmoor
Mature Highmoor
Young Witheridge
Mid Witheridge
Mature Witheridge
Others
Pseudoalteromonas_sp
Aerococcus_urinaeequi
Leuconostoc_pseudomesenteroides
Propionibacterium_freudenreichii
Psychrobacter_sp
Staphylococcus_equorum
Glutamicibacter_arilaitensis
Lactobacillus_delbrueckii
Streptococcus_salivarius_subsp_thermophilus
Lactococcus_lactis

Why cheese?

Previous studies have found gut microbiome markers associated with of regular cheese consumption[2], and cultures present in cheese can persist in the gut microbiome *in vivo*[3,4]

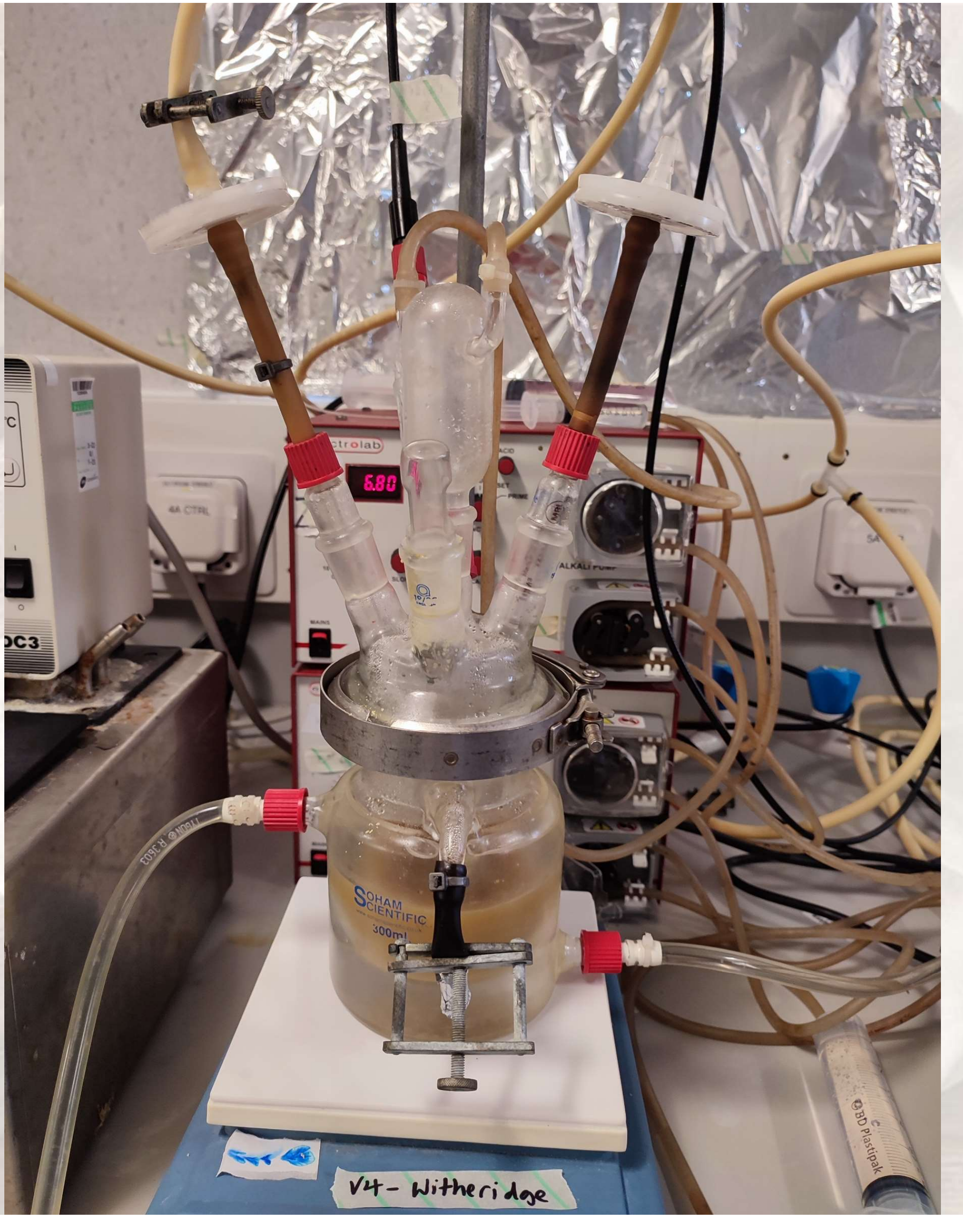


Firmesse et al 2008

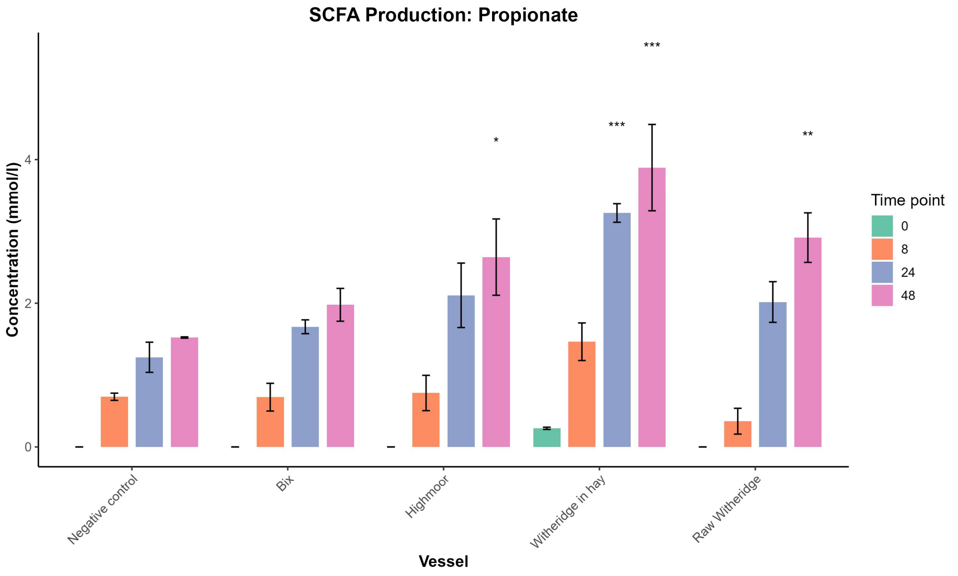


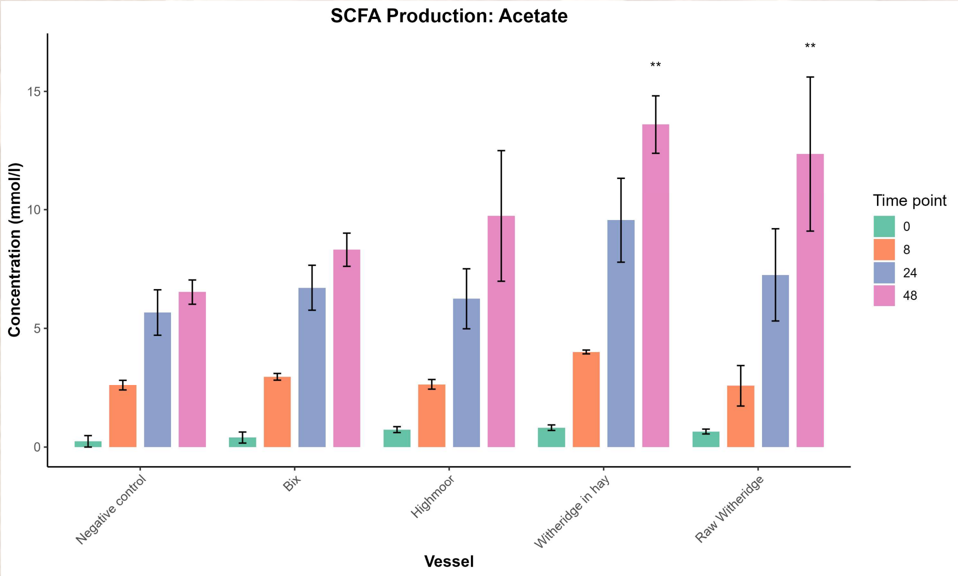
Milani et al 2019

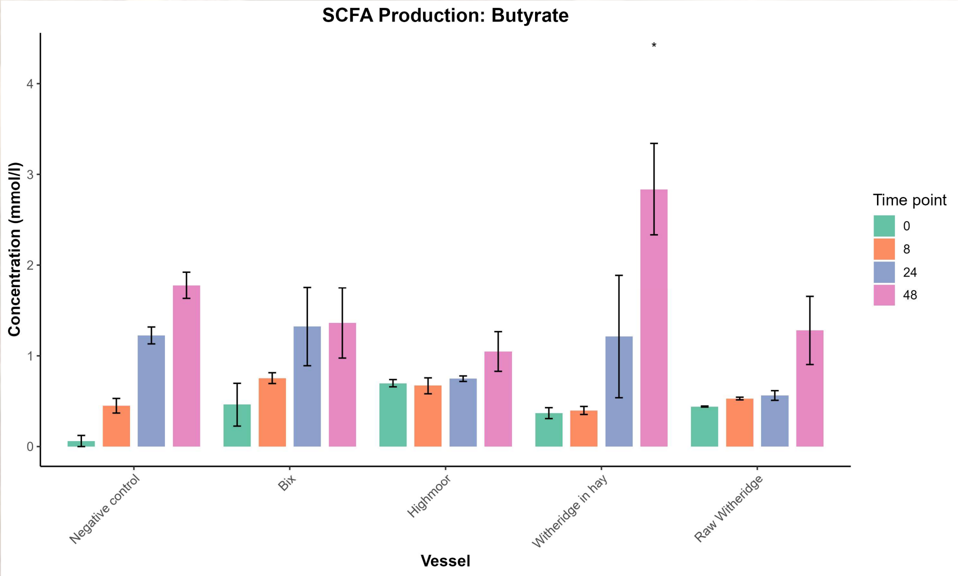
Studying cheese in the gut microbiota?



First round: results

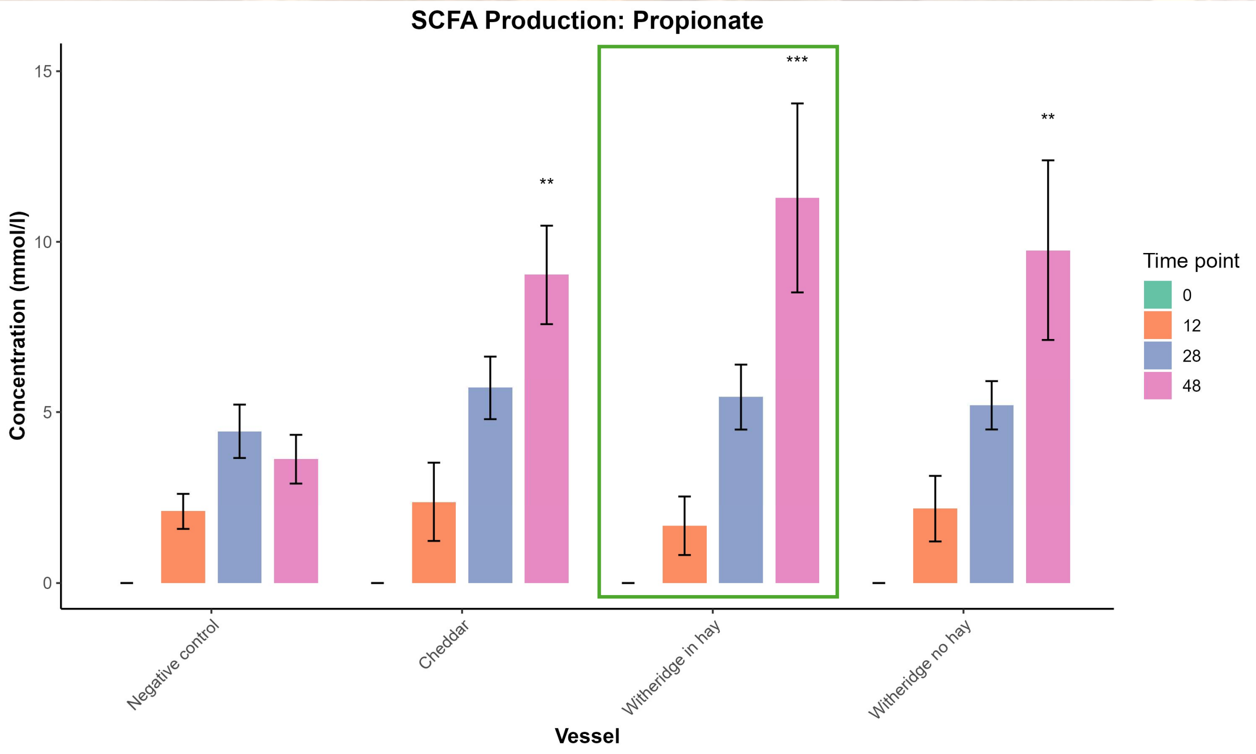


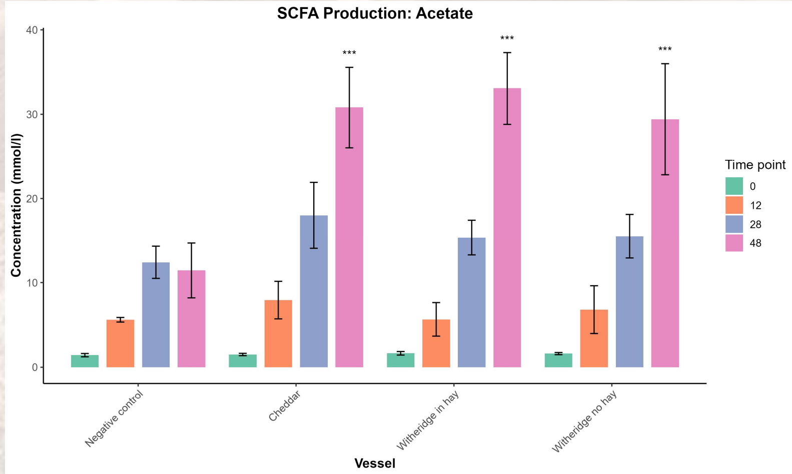


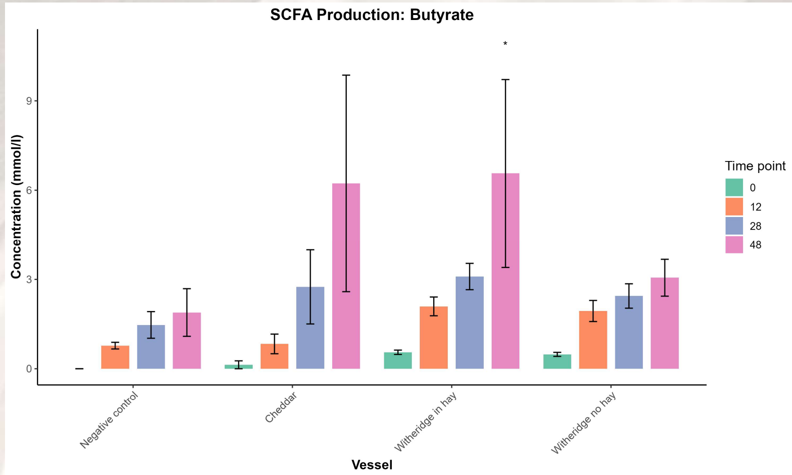


Next round: Fed batch cultures

- Changing pH to mimic transit through gut
- Compared with cheddar and Witheridge not aged in hay

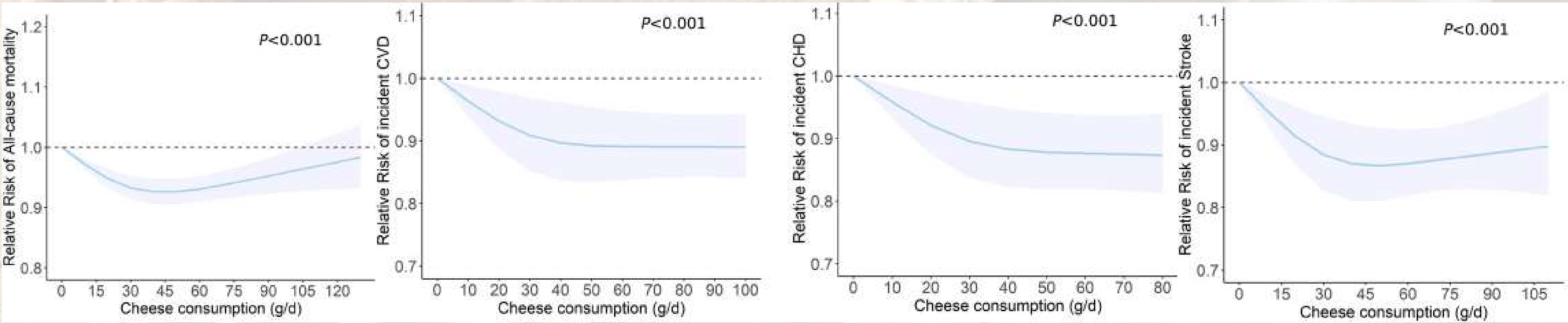






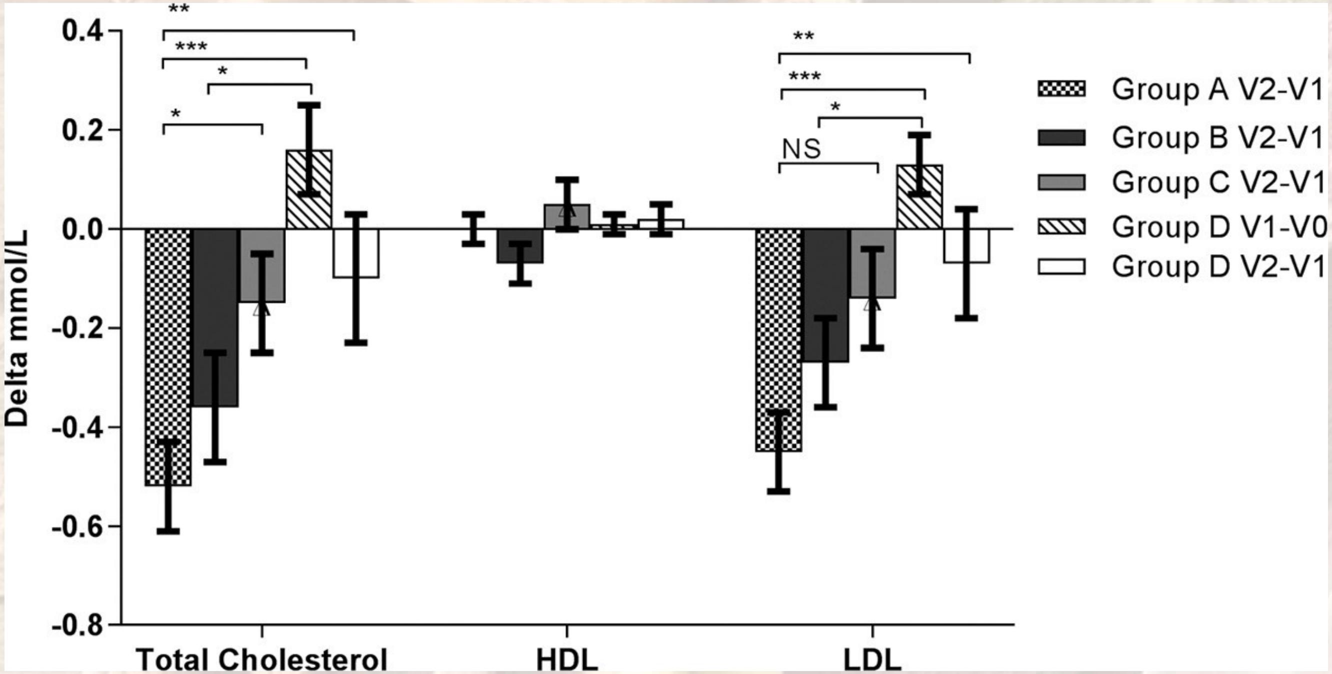
Why cheese?

Cheese is nutrient rich and has been shown to be beneficial for cardiovascular health[5], weight gain[6], and cholesterol levels[7]



Zhang et al 2023

Why cheese?

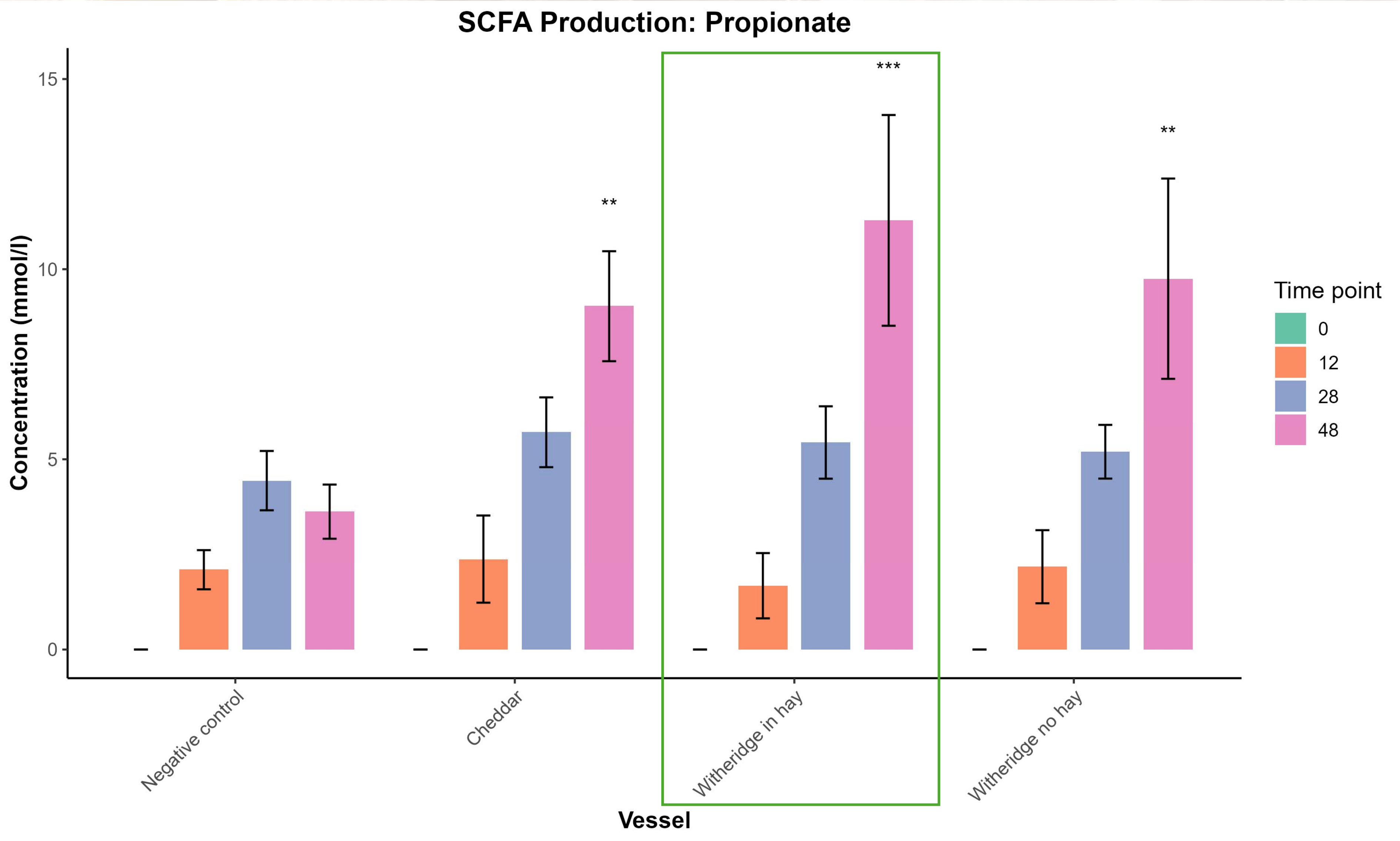


Feeney et al 2018

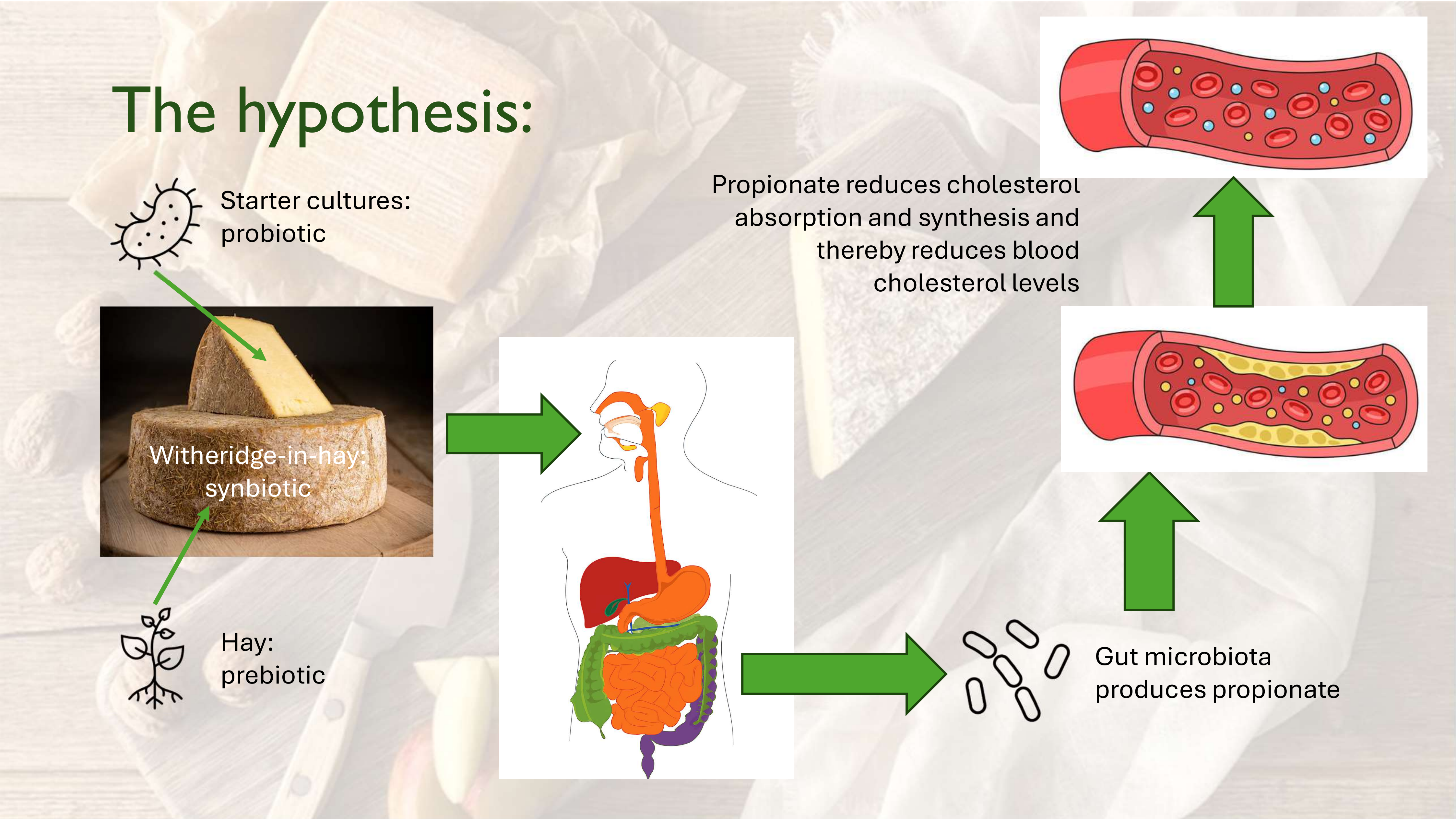
Group A: full-fat Irish cheddar cheese
Group B: reduced-fat Irish cheddar cheese
Group C: butter and calcium supplement
Group D: full-fat Irish cheddar cheese, following 6-week period without any cheese

Cheese and Cardiovascular Health?

- Production of bioactive peptides which can inhibit angiotensin I-converting enzyme (ACE)[9]
- Food matrix of cheese – fat globules encapsulated by casein proteins[10]
- SCFAs, including **propionate**, can block hepatic cholesterol synthesis[11]



SCFA Production: Propionate
Concentration (mmol/l)
0
5
10
15
**
***
**
Negative control
Cheddar
Witheridge in hay
Witheridge no hay
Vessel
Time point
0
12
28
48

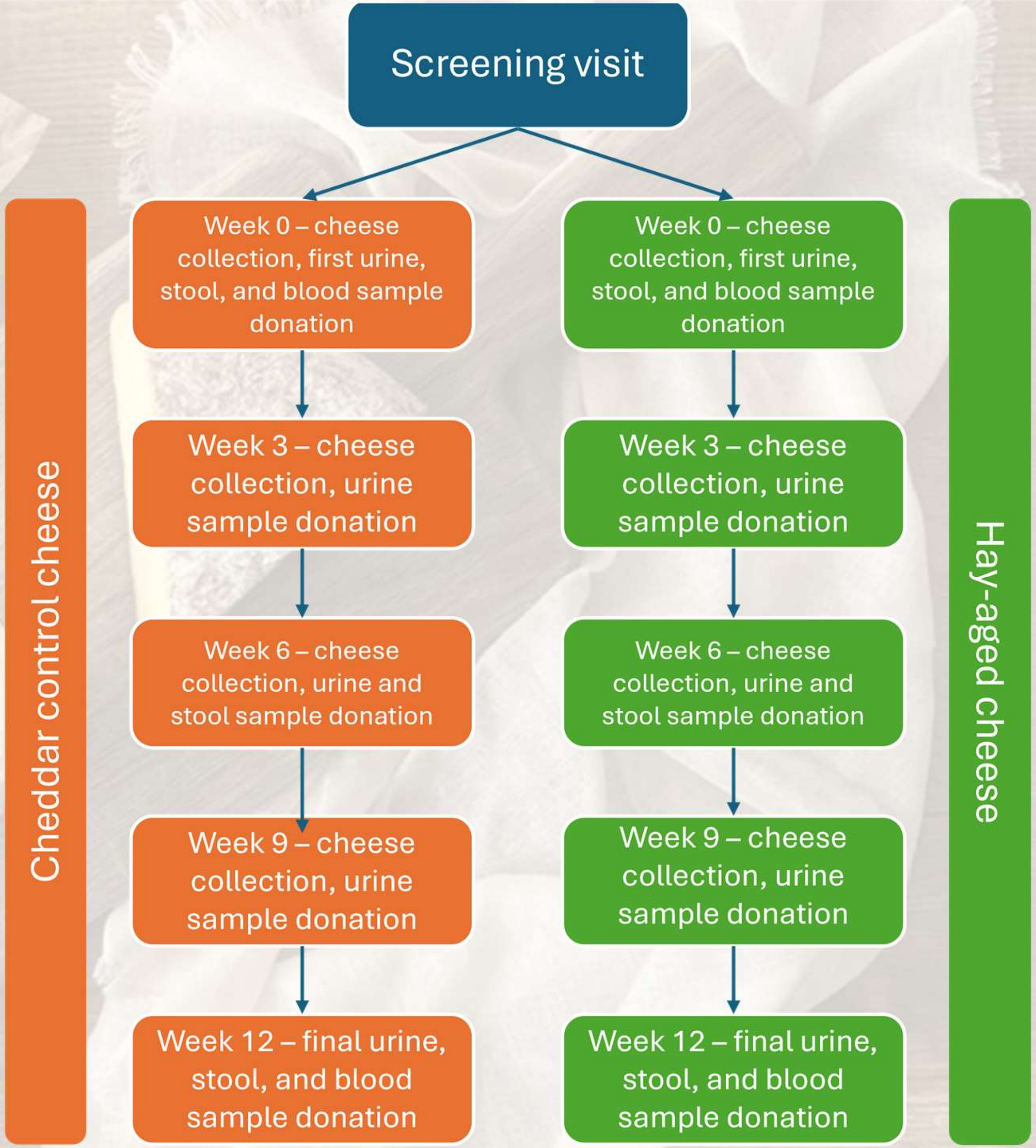

The hypothesis:
Starter cultures: probiotic
Witheridge-in-hay: synbiotic
Hay: prebiotic
Gut microbiota produces propionate
Propionate reduces cholesterol absorption and synthesis and thereby reduces blood cholesterol levels

Human intervention study in progress:

The potential of a hay-aged cheese to reduce cholesterol mediated by changes in the gut microbiome

- Primary objective:

  Reduction in total cholesterol following 12 weeks of daily cheese consumption
- Recruitment of participants with a total cholesterol 5-7.5 mmol/L
- Assessing changes in blood lipids, stool microbiota composition, urine metabolome



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- All of the Food Microbial Sciences Unit for support and help in the lab
- Those at Nettlebed Creamery:
    - All of the Production team for making fabulous cheese
    - Rose for all her support
    - Patrick for the inspiration

"Life is great. Cheese makes it better." - Avery Aames

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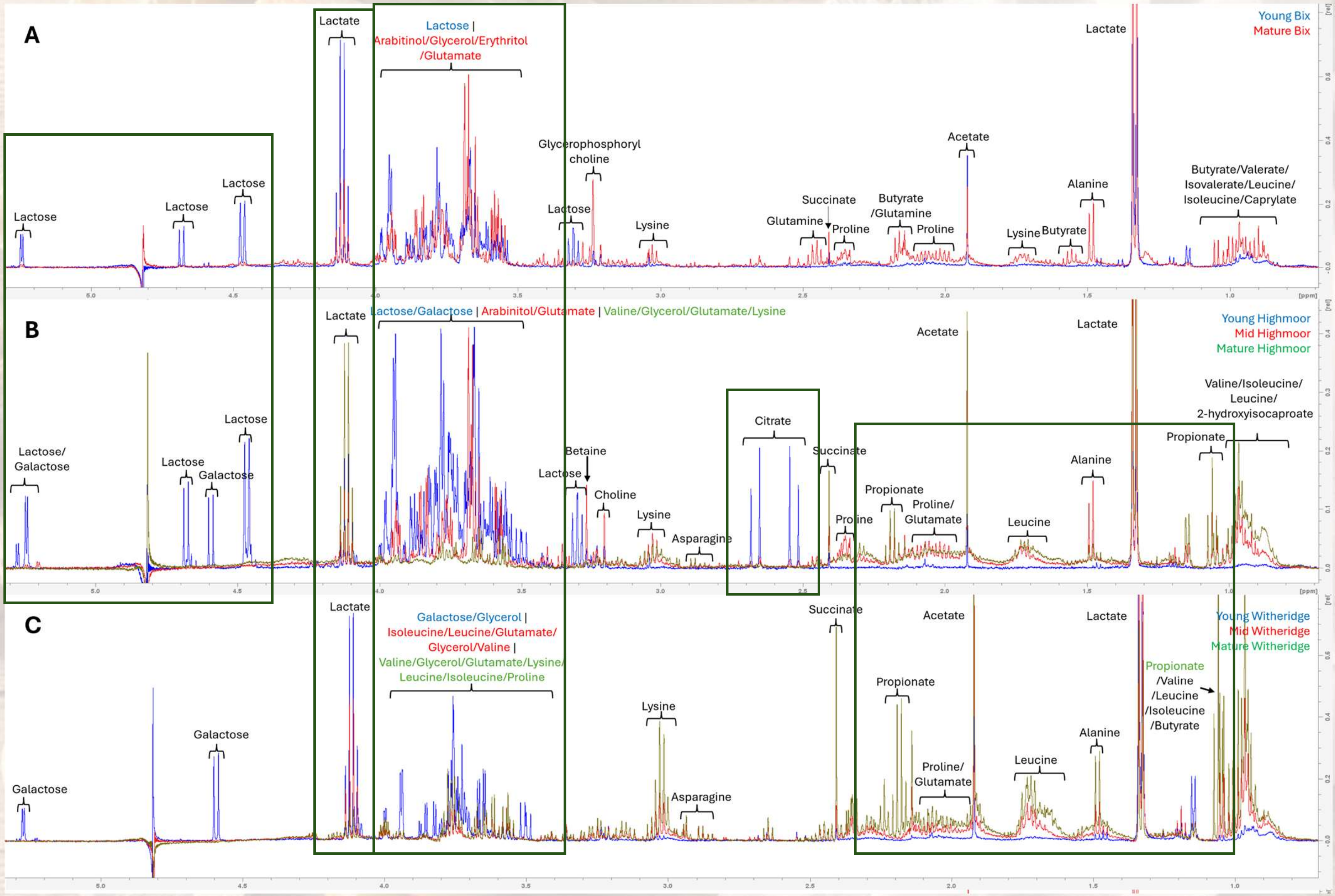
A
Young Bix
Mature Bix
Lactate
Lactose | Arabitinol/Glycerol/Erythritol/Glutamate
Glycerophosphoryl choline
Lactose
Lysine
Glutamine
Succinate
Proline
Butyrate /Glutamine
Acetate
Alanine
Butyrate
Butyrate/Valerate/ Isovalerate/Leucine/ Isoleucine/Caprylate
B
Young Highmoor
Mid Highmoor
Mature Highmoor
Lactose/Galactose | Arabinitol/Glutamate | Valine/Glycerol/Glutamate/Lysine
Lactose/ Galactose
Galactose
Betaine
Choline
Asparagine
Citrate
Propionate
Proline/ Glutamate
Leucine
Valine/Isoleucine/ Leucine/ 2-hydroxyisocaproate
C
Young Witheridge
Mid Witheridge
Mature Witheridge
Galactose/Glycerol | Isoleucine/Leucine/Glutamate/ Glycerol/Valine | Valine/Glycerol/Glutamate/Lysine/ Leucine/Isoleucine/Proline
Propionate /Valine /Leucine /Isoleucine /Butyrate
[ppm]
[rel]