SUPPLEMENTING CHEESE WITH POLYPHENOL RICH FRUITS TO INCREASE CONTENT OF BENEFICIAL BIOACTIVE POLYPHENOLS

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FoodTraNet

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Safety Quality Traceability

Aim

- Supplement of Natural products to Cheese:
  - Increase in Bioactive compounds
  - Impact on Fermentation and Microbiota
  - Changes to Amino acids, Sugars, Lipids and other Metabolites

Polyphenols

- Health Benefits
- Compounds of Plant Protection
- Polyphenol Rich Fruits
- Antimicrobial

Cornelian cherry

Blackcurrant

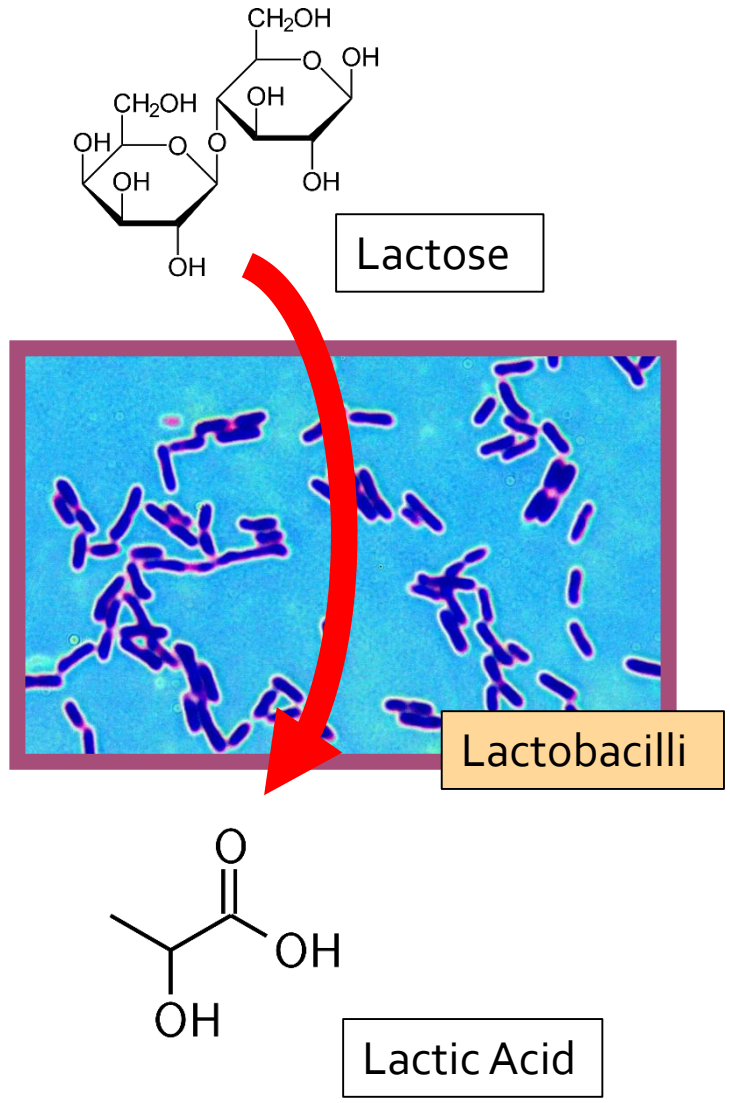
Human Health Benefits

Pro Gut, Pro Cardiovascular, Neuroprotective, Anti-carcinogenic, Anti-diabetic, Anti-inflammatory.

Cheese Production

- Cheese Supplementation
  - Sensory Enhancement
  - Nutrition

- Lactic Acid Bacteria (LAB)
  - Cheese Fermentation



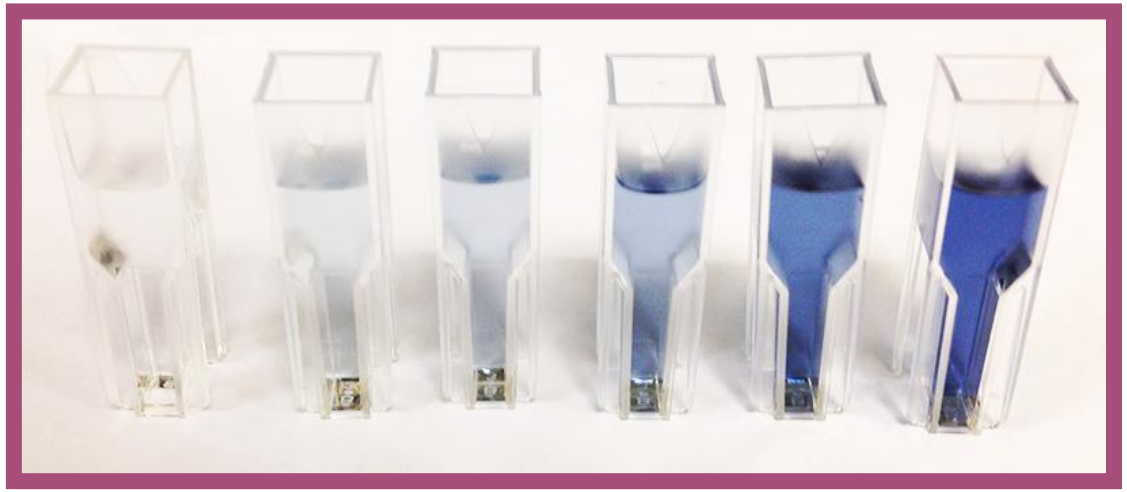
Caciotta Cheese Manufacturing

1) Cooking Pasteurized Milk
2) Addition Starter Culture
3) Addition Rennet
4) Coagulation and Whey Removal
5) **Enrichment (**Organic and non-Organic, dose 0.3% and 0.6%**)**
6) Molding
7) Salting in Brine
8) Maturation (4 weeks)

Methodology – Polyphenol Content

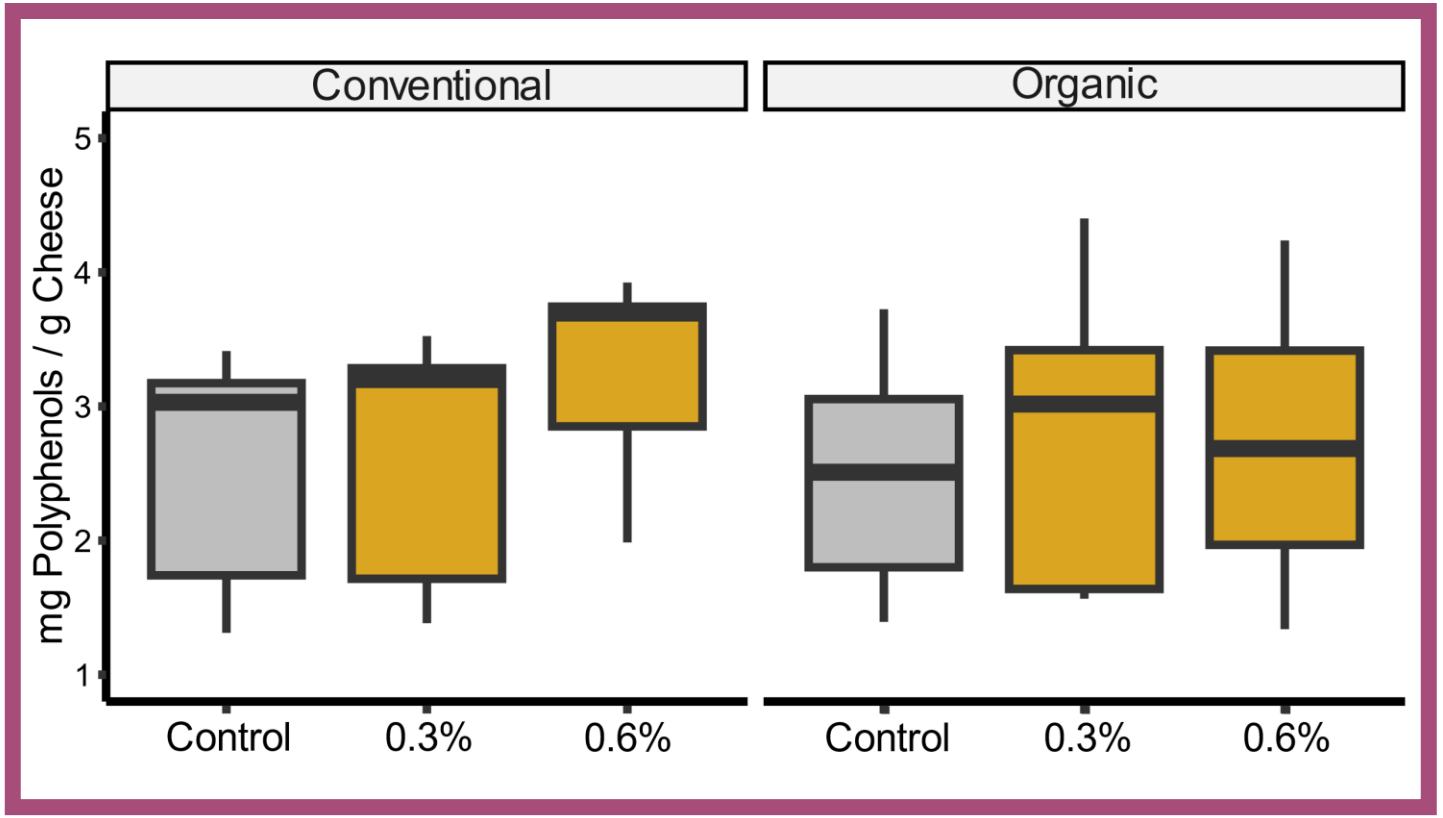
- Polyphenol Content in Cheese
  - Folin-Ciocalteu Reaction
  - Spectrometry
  - Total Polyphenol Content - Gallic Acid Equivalent (GAE)

Thanks to Dr Tiziana Nardin



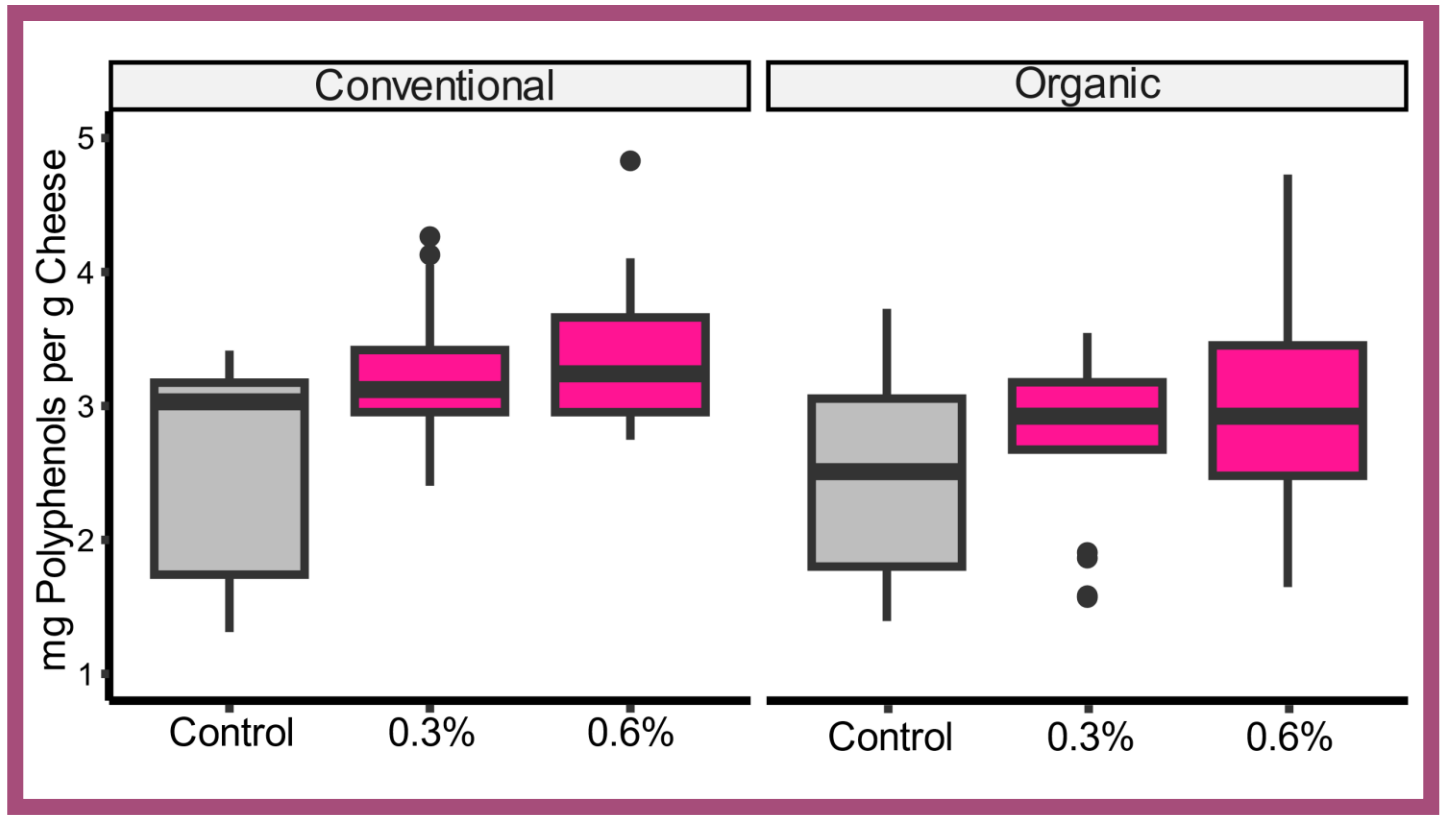
Results – Polyphenol Content

- Blackcurrant Enriched Cheese
- Only Conventional Currants in Higher Dose



Results – Polyphenol Content

- Cornelian Cherry Enriched Cheese
- Polyphenol Content Increased
- Conventional Cherries ↑
- Higher Dose ↑



Results – Polyphenol Content

- Different Effect from Different Fruits
- Farming method, Location or Cultivar

- Different polyphenol profile

- From Literature
- Blackcurrant: delphinidin 3-O-rutinoside and cyanidin-3-O-rutinoside

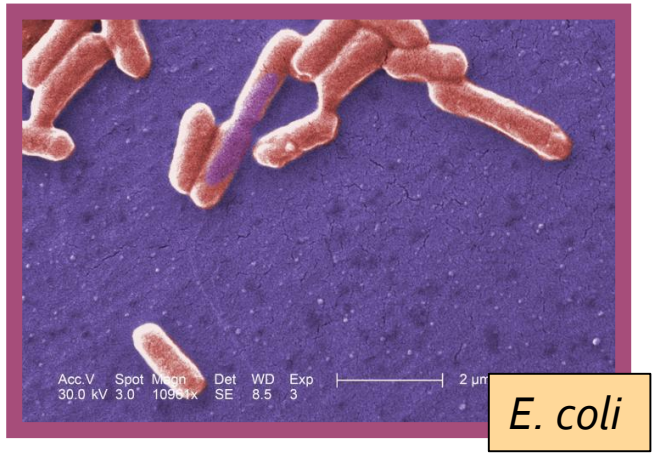
- Cornelian Cherry: cyaniding-3-O-galactoside and pelargonidin-3-O-galactoside

Methodology-Microbiology

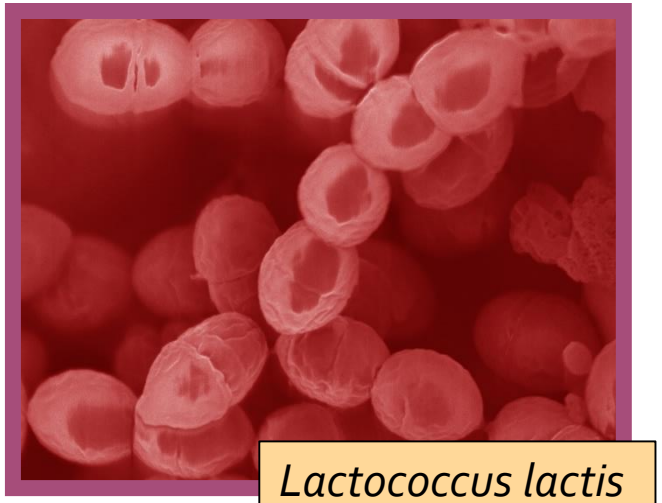
- Microbiota
  - Selective Media to count viable microbial groups
    - Lactic Acid Bacteria (LAB)
    - Coliforms

Thanks to
Maddalena Bosetti

Lactobacillus acidophilus



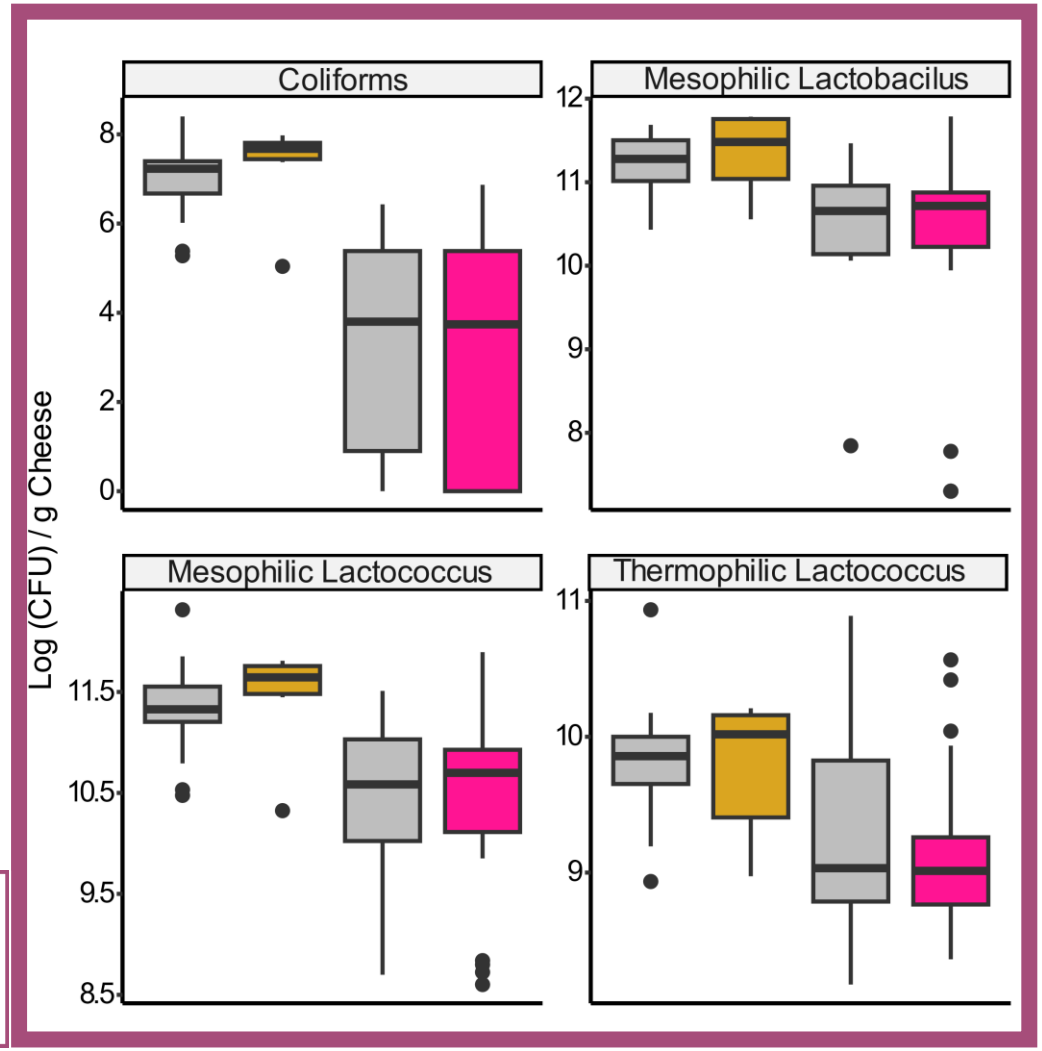
E. coli



Lactococcus lactis

Results - Microbiota

- Enrichment did not impact LAB microbiota
- Acidification by LAB, measured by pH, was within expected limits
- Enriched cheese showed lower pH
- Blackcurrant cheese measured lower pH than Cornelian Cherry cheese



Methodology - Metabolites

- Metabolites and Lipids
  - Aqueous (H_2O+D_2O) and Chloroform ($CDCl_3$) Extraction
  - NMR Spectrometry

- Lipid Profile
  - No differences in this experiment
- Concentrations of Metabolite

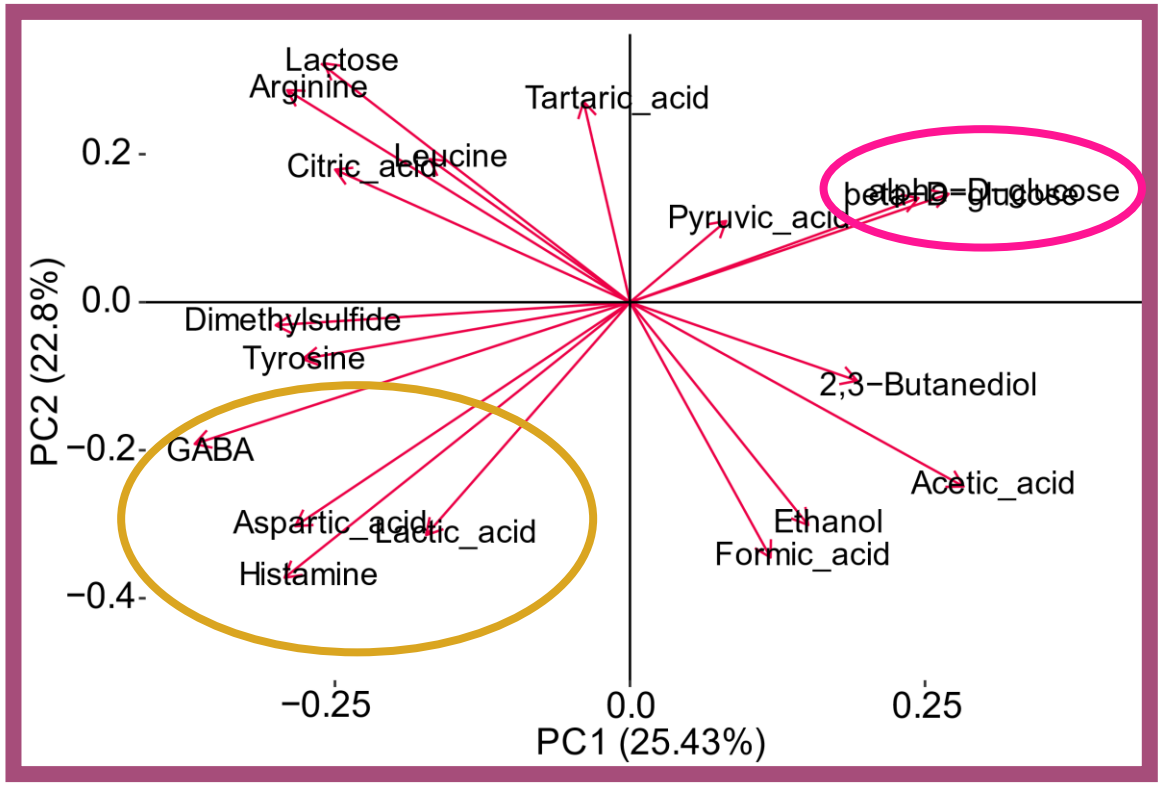
Thanks to Dr Pavel Solovyev

Results – Metabolites

- Concentration of 18 metabolites
- Principle Component Analysis (PCoA) – Reduce dimensions
- Biplot/Loadings Plot

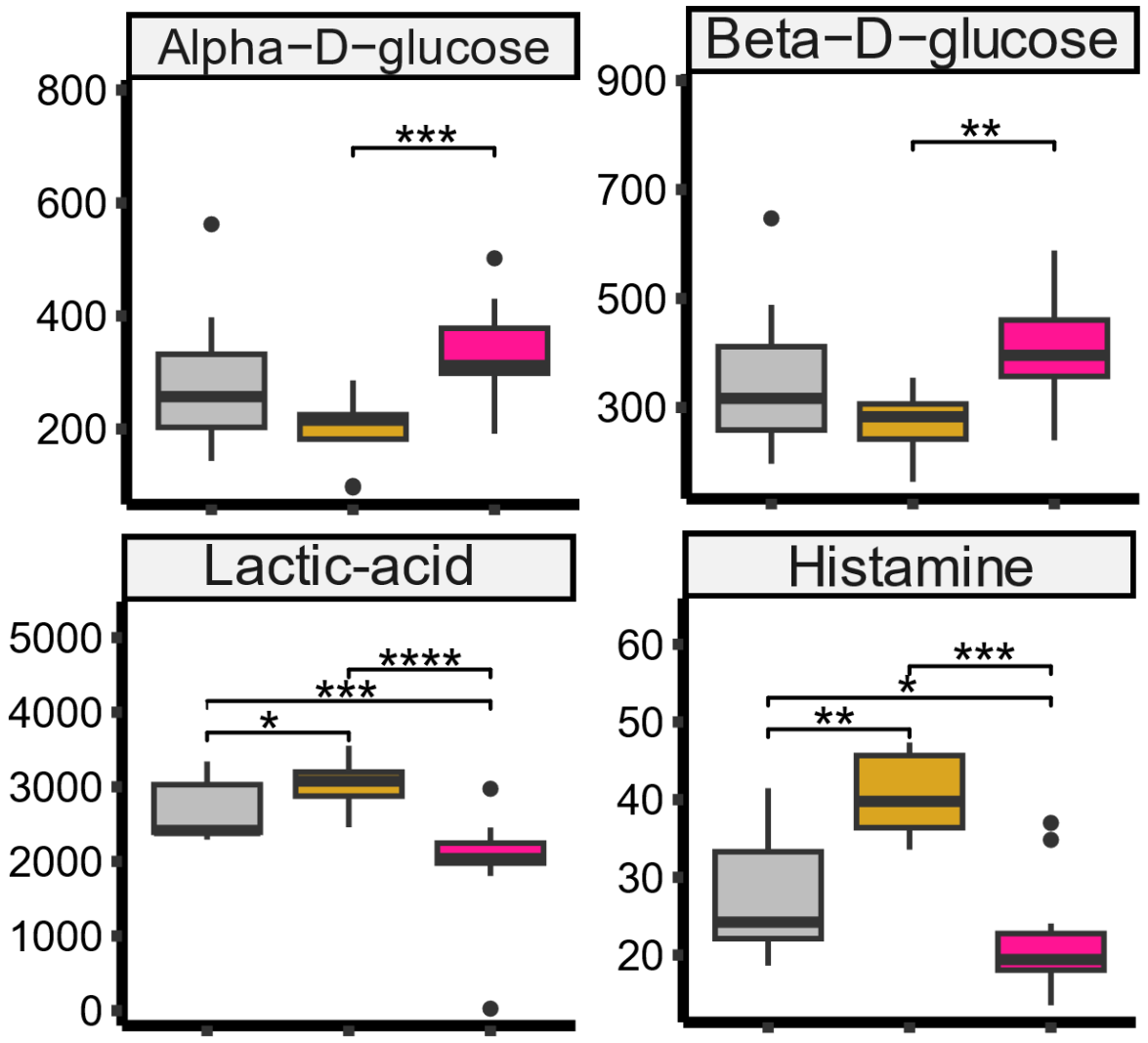
- **Blackcurrant Cheese**: GABA, Histamine, Aspartic Acid, Lactic Acid

- **Cornelian Cherry Cheese**: Glucose



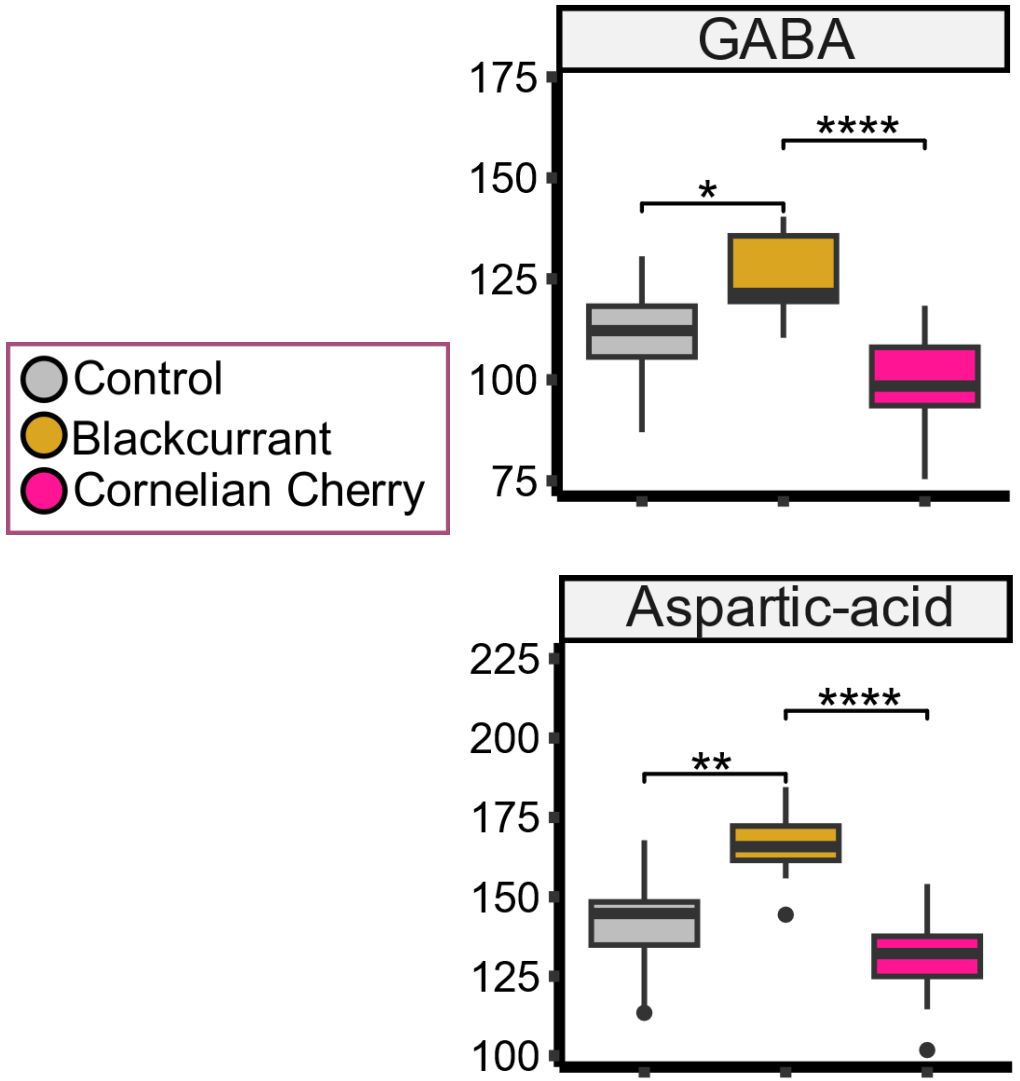
Key Metabolites

- High dose cheese (O.6%)
- Indicators of lactic acid bacteria fermentation
- Histamine at normal non-toxic levels



Key Metabolites

- Bioactive GABA (γ-Aminobutyric acid)
- Signs of LAB proteolysis activity
- Texture, flavor and aroma



Conclusions

- Enrichment increases total content of polyphenols – Dependent on dose and possibly farming method
- Fermentation by LAB was not disrupted by enrichment
- Cheese enriched with Blackcurrant or Cornelian Cherry have distinct metabolic profiles. Lipid profile was not different
- Signs of higher bacterial activity in blackcurrant cheese: pH and metabolites

Future Works

- Impact of different polyphenols
- Improvement of polyphenol enrichment – Dose, Ingredient, Manufacturing
- Upscaling to industrial proportions

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Improvement of Caciotta-like cheese nutritional value by means of enrichment with blackcurrant (*Ribes nigrum*) and Cornelian cherry (*Cornus mas*)

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- **Cornelian Cherry** and **Blackcurrant** cheese, two clusters.
- Not distinct from **control** or between low dose (Δ) or high dose (□)