



New research on the formation of biogenic amines in cheese, combining pilot-plant experiments and a real-world case study on the role of *Latilactobacillus curvatus*

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Agroscope - Liebefeld -> Posieux

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Laboratories



Pilot Plant



Starter Culture Production



Consultation



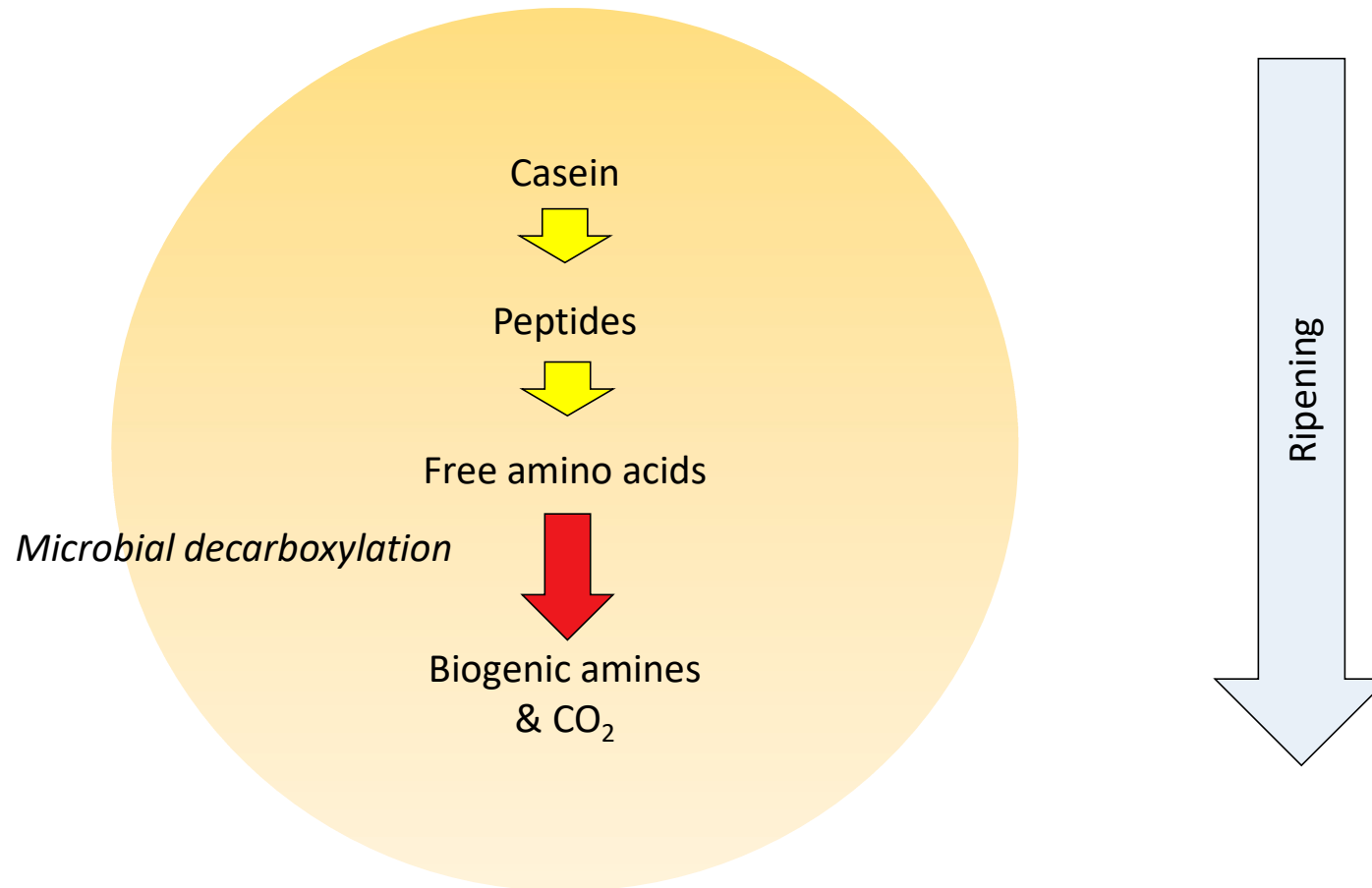


Outline

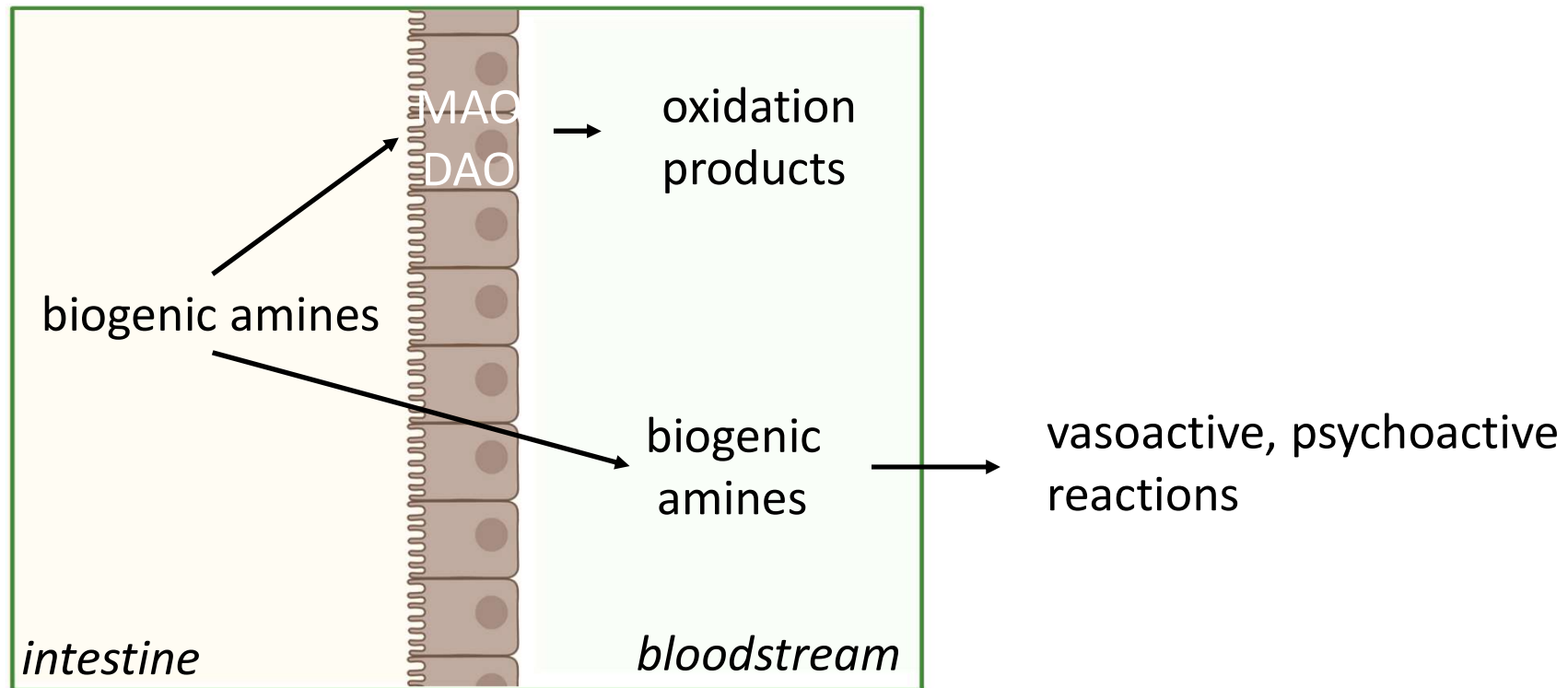
1. Introduction: Why biogenic amines matter to cheesemakers
2. Pilot plant study: Effects of *Latilactobacillus curvatus* on Model Raclette cheese
3. From pilot plant to practice: A current real-world case involving *L. curvatus*



Biochemistry of biogenic amines in cheese



Biogenic amines interfere with human physiology ...

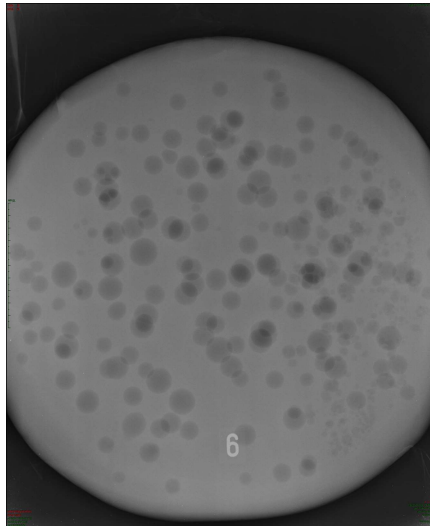


MAO: Monoamine Oxidase
DAO: Diamine Oxidase

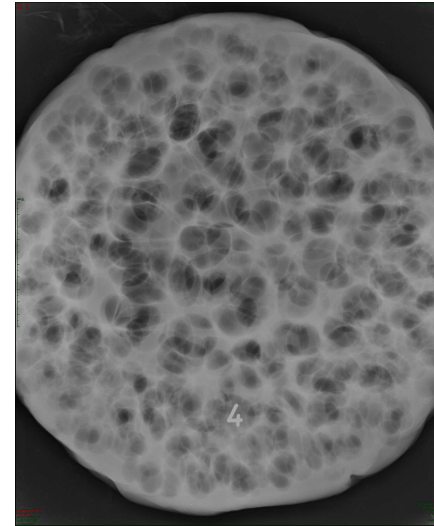
Rahmdel, S., Luqman, A., & Götz, F. Microbiota-derived aromatic amino acid decarboxylases: linking microbial fitness and host neurochemical communication. *mBio*, 0, e02052–02025. doi:10.1128/mbio.02052-25



... and produce gas



Cadaverine: not detected
Putrescine: not detected
C3: 89 mmol/kg
C4: 0.6 mmol/kg



Cadaverine: 1940 mg/kg
Putrescine: 484 mg/kg
C3: 82 mmol/kg
C4: 0.5 mmol/kg

Swiss-type cheese, 90 d (unpublished)



Why research on biogenic amines is needed

Impact

- Biogenic amine formation in cheese can lead to significant financial losses for cheese producers.

Knowledge gaps

- Limited studies on the effects of biogenic amine-producing bacteria in cheese or cheese models
- Limited methods for their specific identification and quantification in milk and cheese
- Incomplete understanding of the factors driving biogenic amine formation

Research outcome

- Predict biogenic amine and CO₂ accumulation
- Trace potential sources of contamination
- Mitigate biogenic amine formation



Studies demonstrating the effects of biogenic amine-producing bacteria in cheese

Bacterium	Biogenic Amine	Activity
<i>Lentilactobacillus parabuchneri</i> , <i>Tetragenococcus halophilus</i> (pHDC ⁺)	Histamine	Neurotransmitter
<i>Enterococcus</i> sp., <i>Latilactobacillus curvatus</i>	Tyramine	Neurotransmitter (trace amine)
?	β-Phenylethylamine	Neurotransmitter (trace amine)
?	Tryptamine	Neurotransmitter (trace amine)
<i>Enterobacteriaceae</i> (<i>Hafnia alvei</i> , <i>Morganella morganii</i>), <i>Paucilactobacillus wasatchensis</i>	Cadaverine	toxic in large doses
<i>Enterobacteriaceae</i> , <i>P. wasatchensis</i>	Putrescine	toxic in large doses



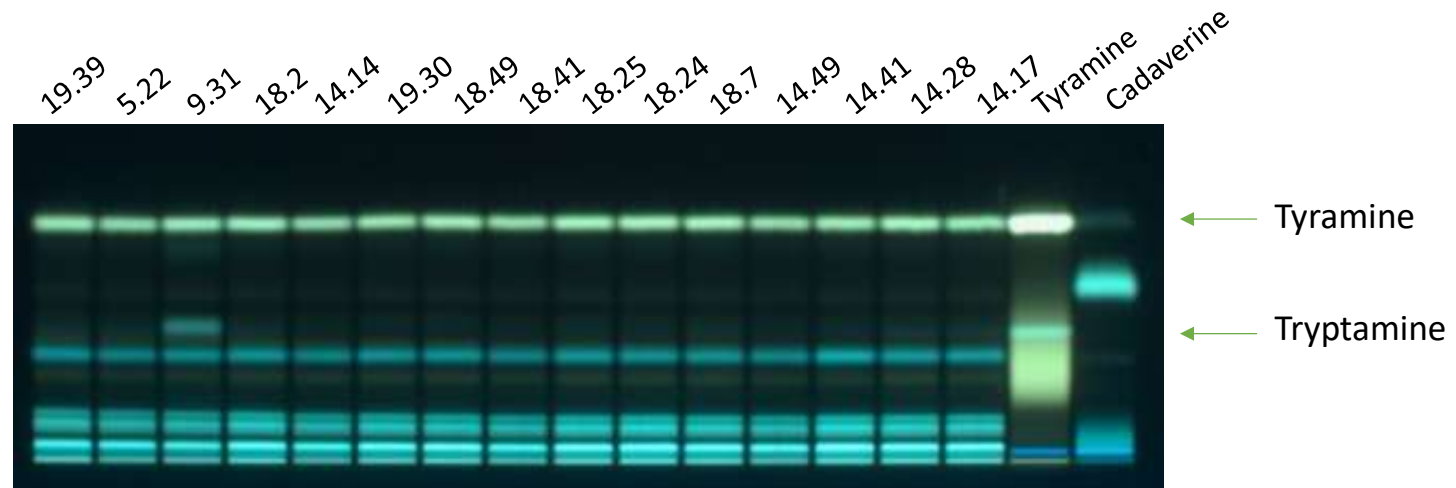
Why *Latilactobacillus curvatus*?



- Cheddar cheese contained tyramine (641 mg/kg), β -phenylethylamine (207 mg/kg), and tryptamine (13 mg/kg)
- no enterococci
- *Latilactobacillus curvatus* producing tyramine and **β -phenylethylamine** was isolated
- a species-specific PCR detected *L. curvatus* only on the surface not in the inside



Why *Latilactobacillus curvatus*?



In a screening of *L. curvatus* isolates obtained from Raclette cheese, we identified **tryptamine**-producing strains.



Investigate the influence of *L. curvatus* in model cheeses

Objectives

- determine growth in cheese (species-specific, quantitative PCR)
- influence on proteolysis (OPA, nitrogen fractions)
- understand metabolism (lactic acid, volatile organic acids, free amino acids, biogenic amines)
- influence on eye formation (X-ray imaging)



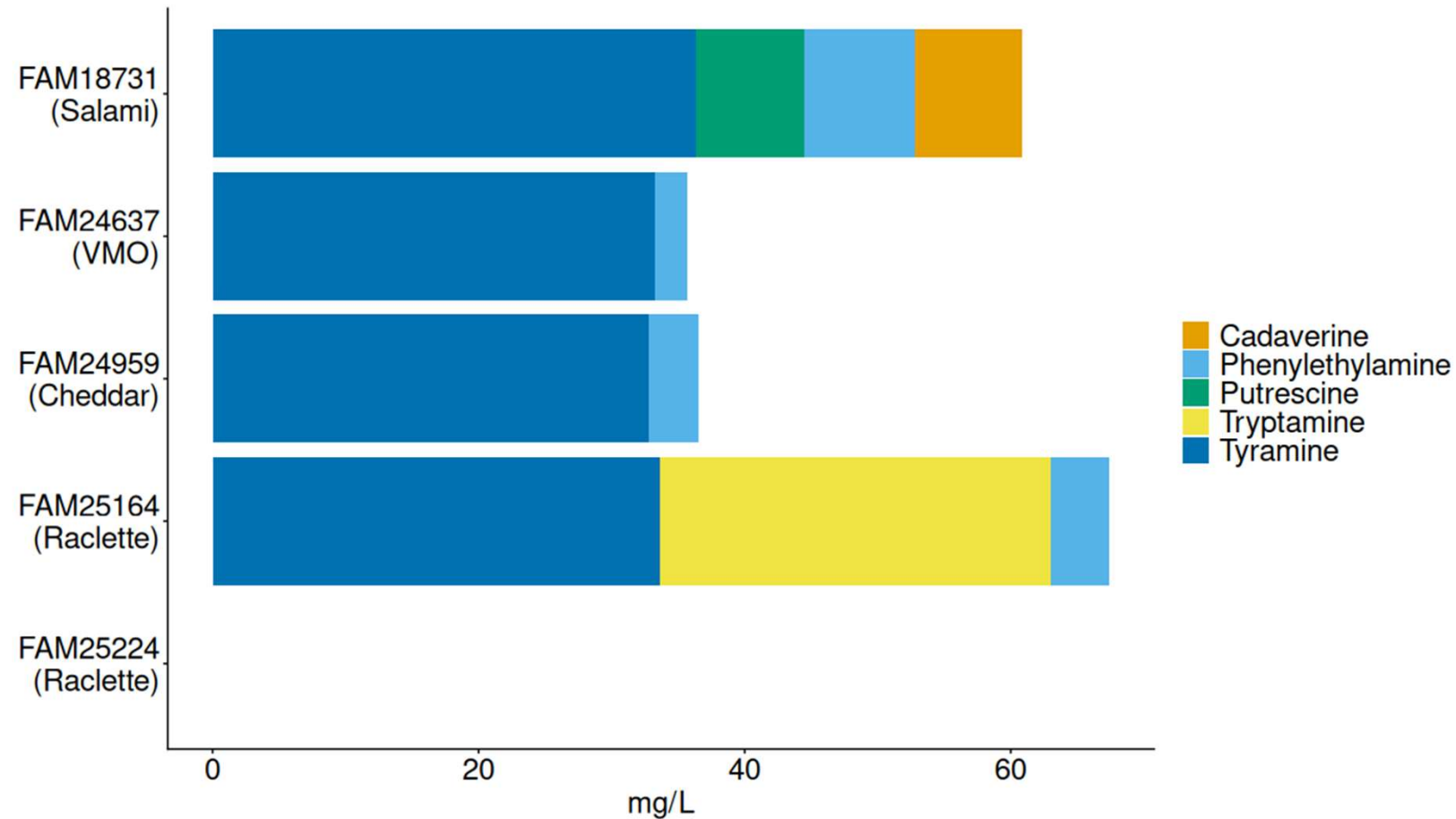
Experimental setup

Variant	Inoculum	Starter	Repetition	Cheese
Control	No <i>L. curvatus</i>	RSW901	2	Model Raclette
FAM18731	<i>L. curvatus</i> FAM18731	RSW901	3	Model Raclette
FAM24637	<i>L. curvatus</i> FAM24637	RSW901	4	Model Raclette
FAM24959	<i>L. curvatus</i> FAM24959	RSW901	4	Model Raclette
FAM25164	<i>L. curvatus</i> FAM25164	RSW901	4	Model Raclette
FAM25224	<i>L. curvatus</i> FAM25224	RSW901	4	Model Raclette





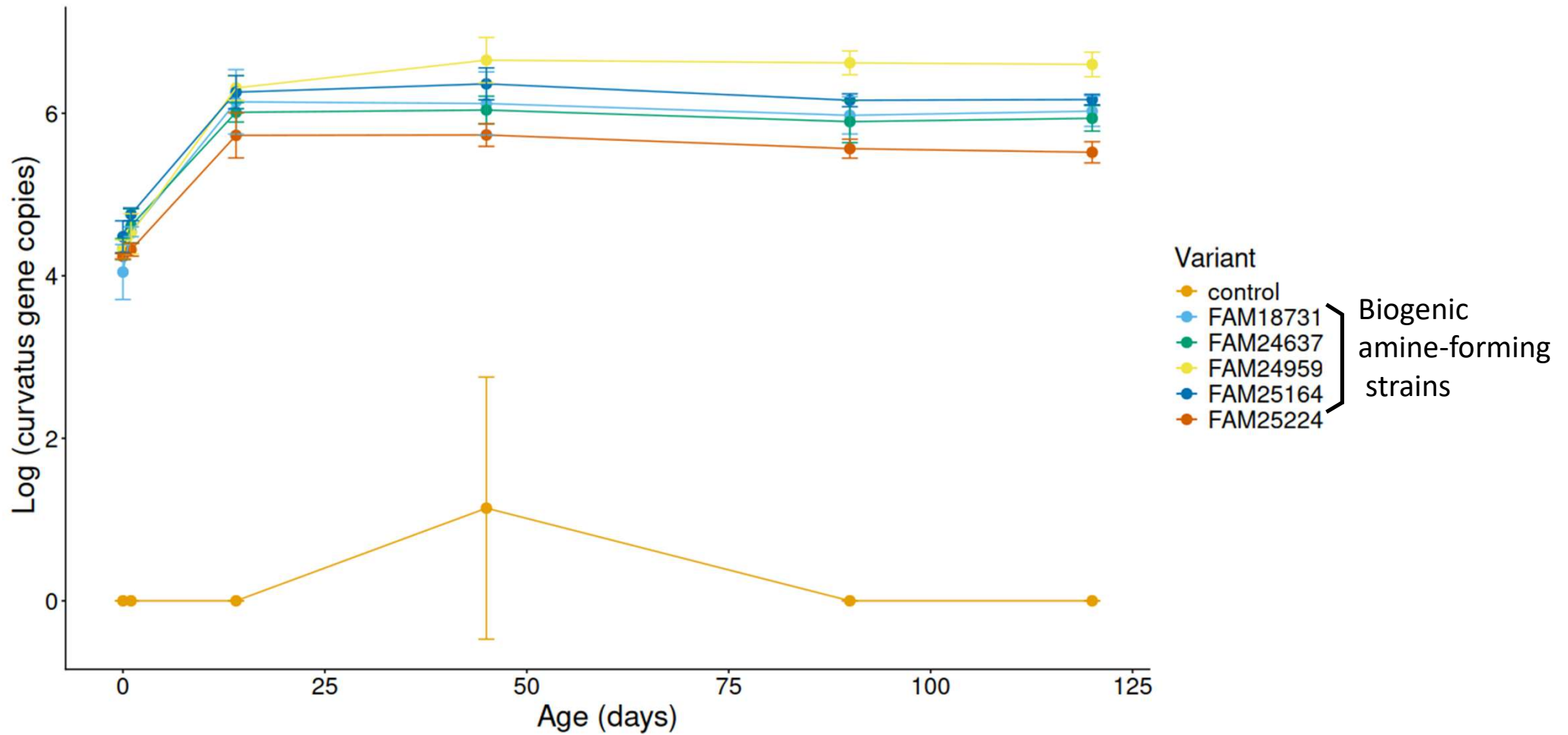
Biogenic amine-profiles of the five *L. curvatus* strains used



VMO: Vacherin Mont d'Or

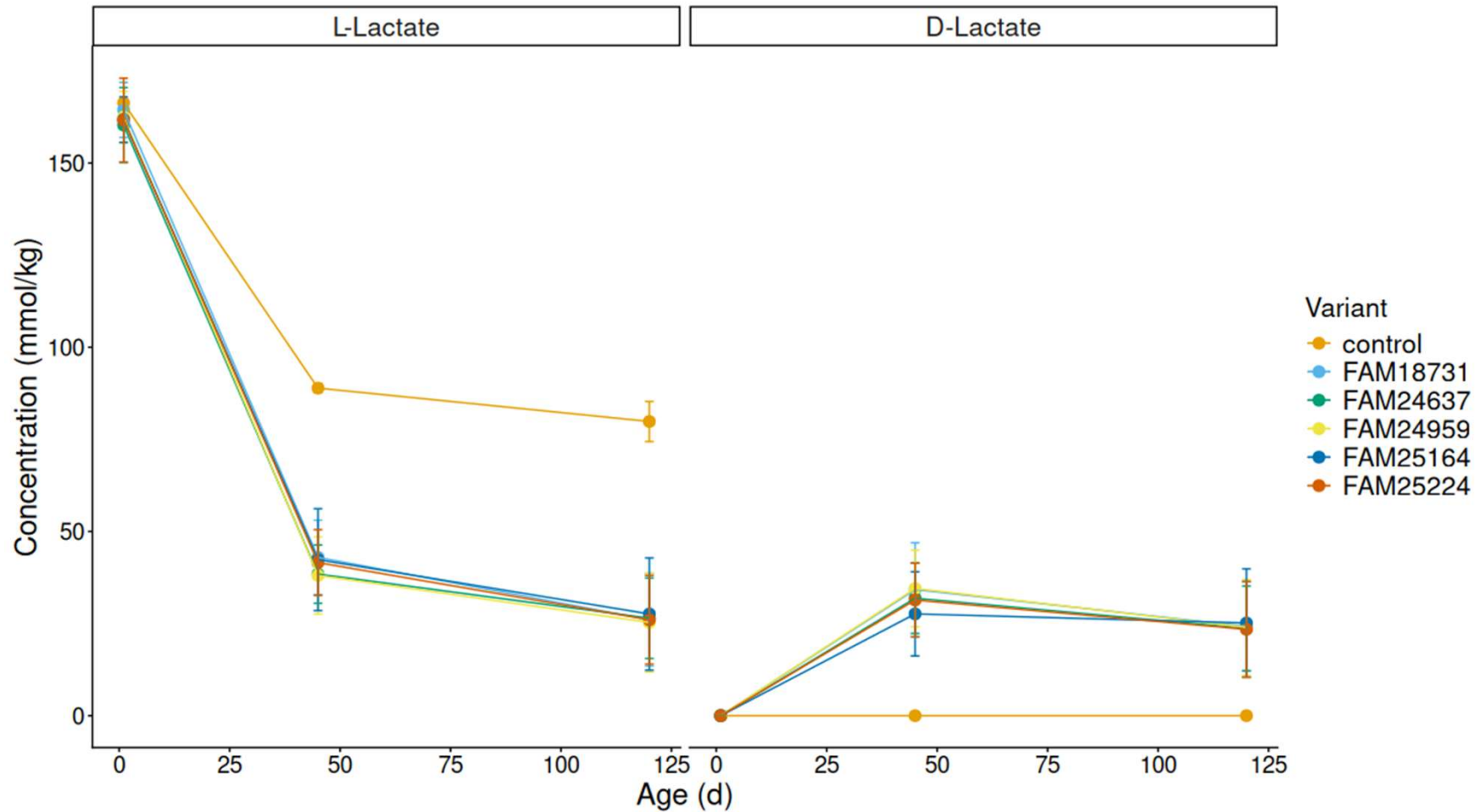


Growth of *L. curvatus* (quantitative PCR)



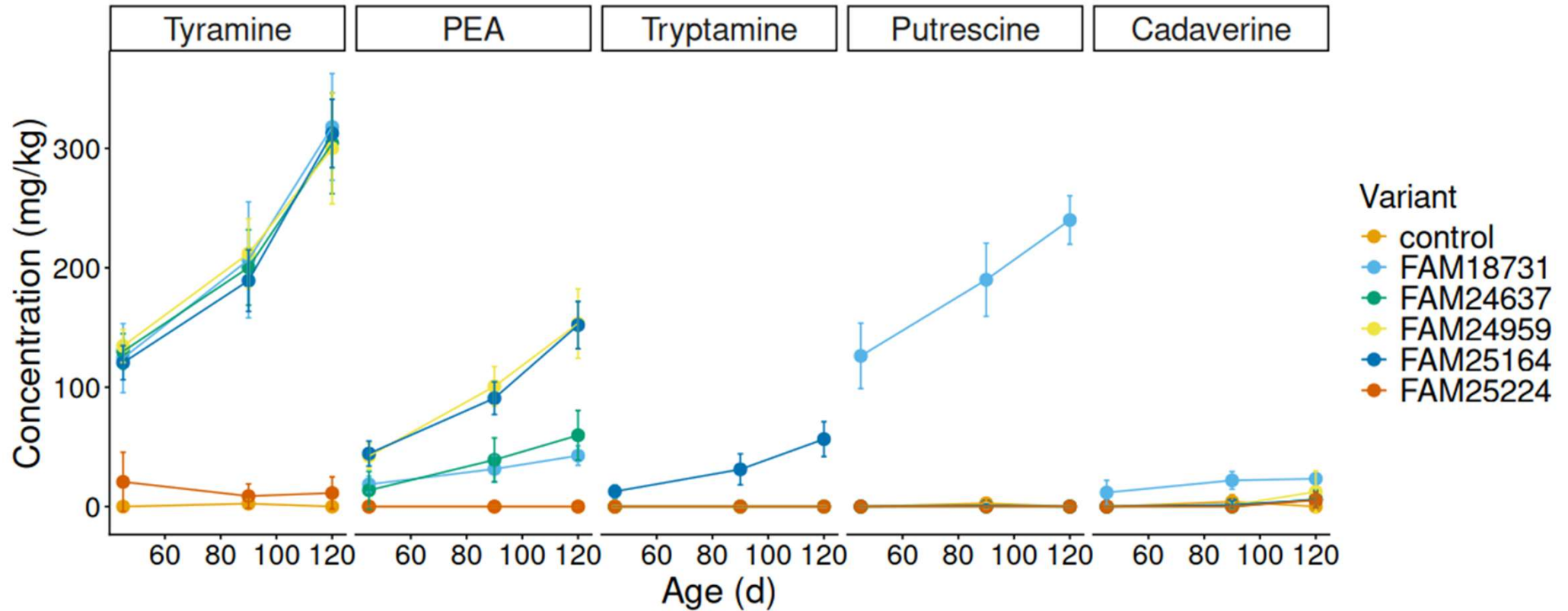


Lactate metabolism





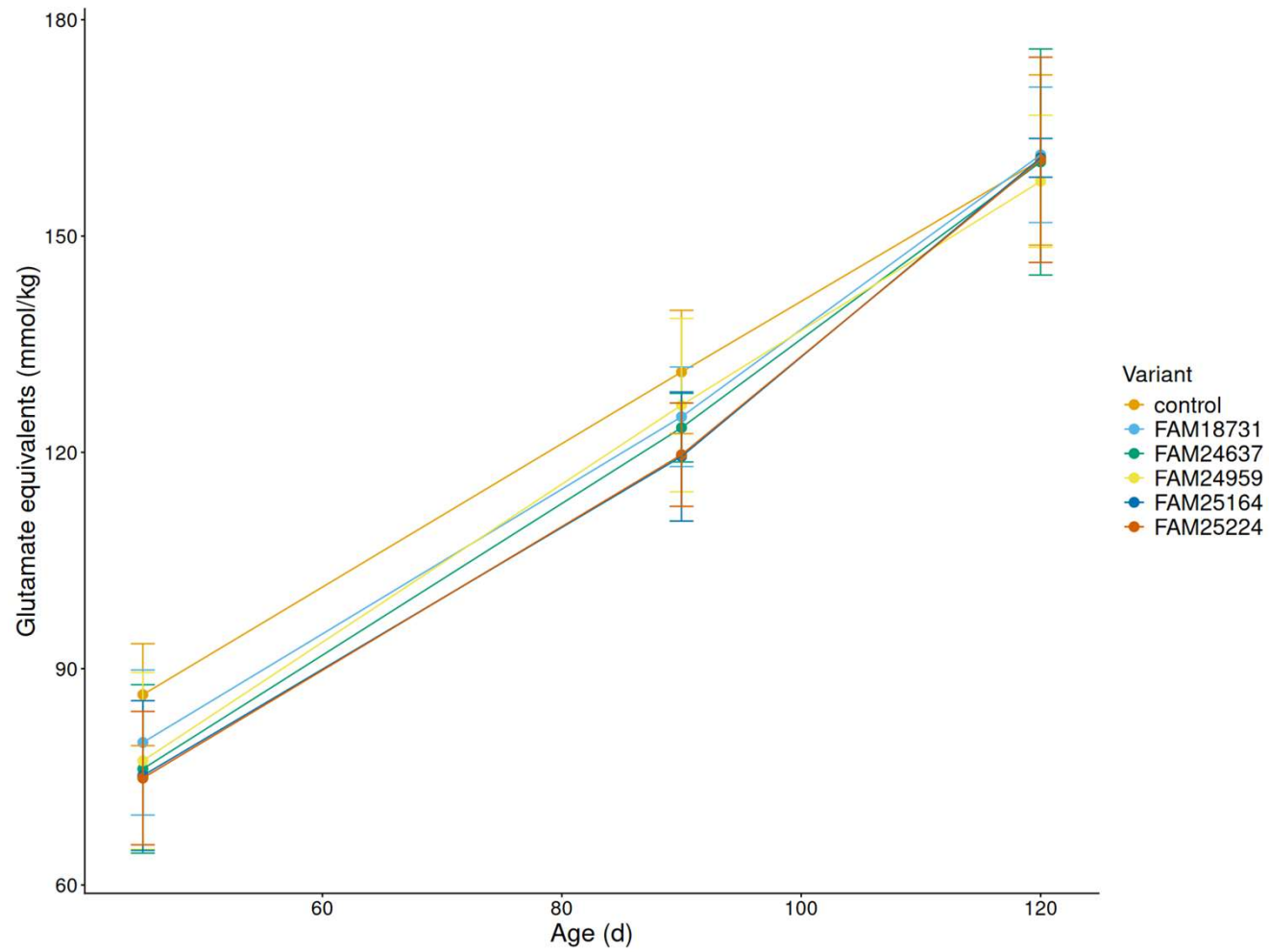
Formation of biogenic amines



PEA: β -Phenylethylamine

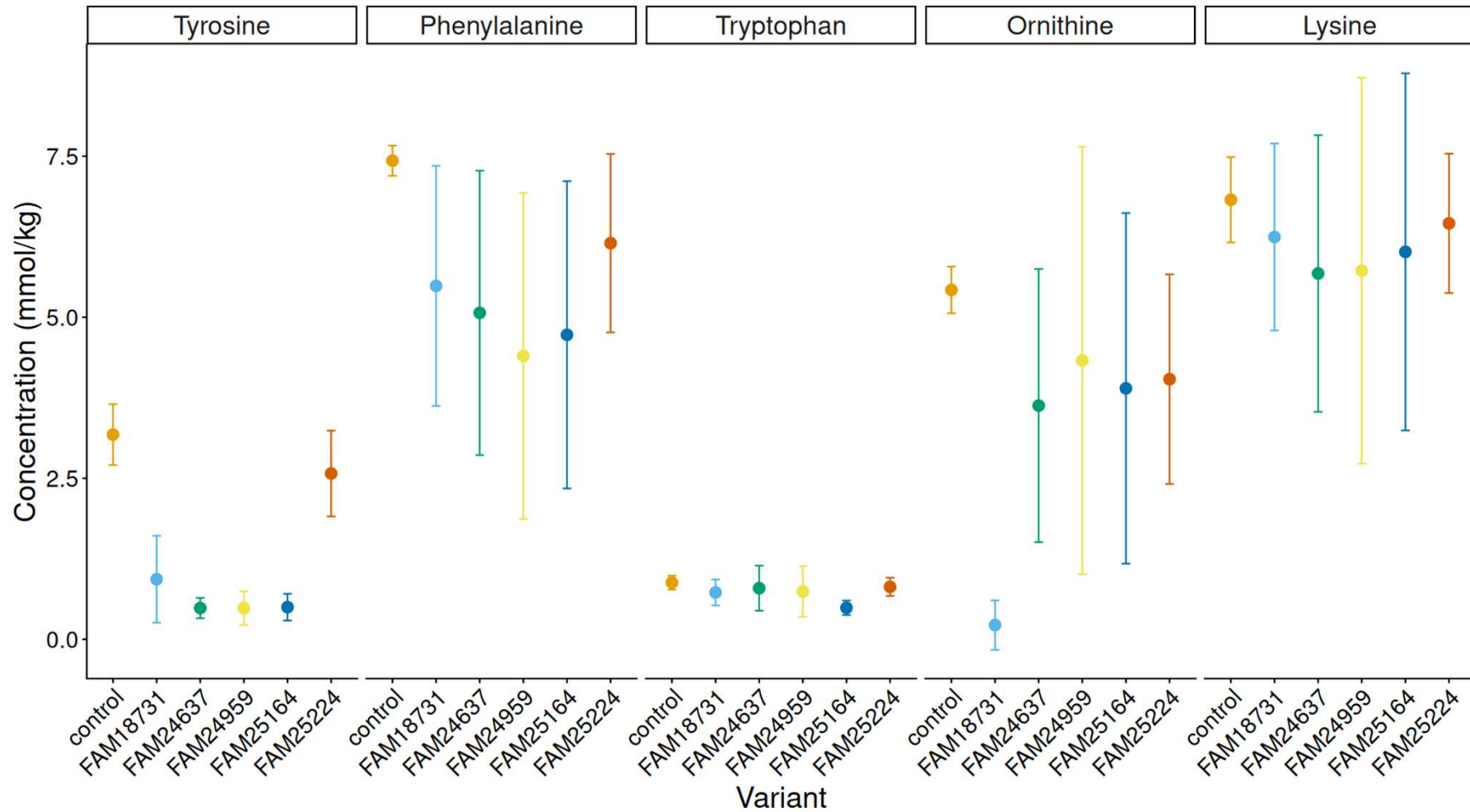


Proteolysis



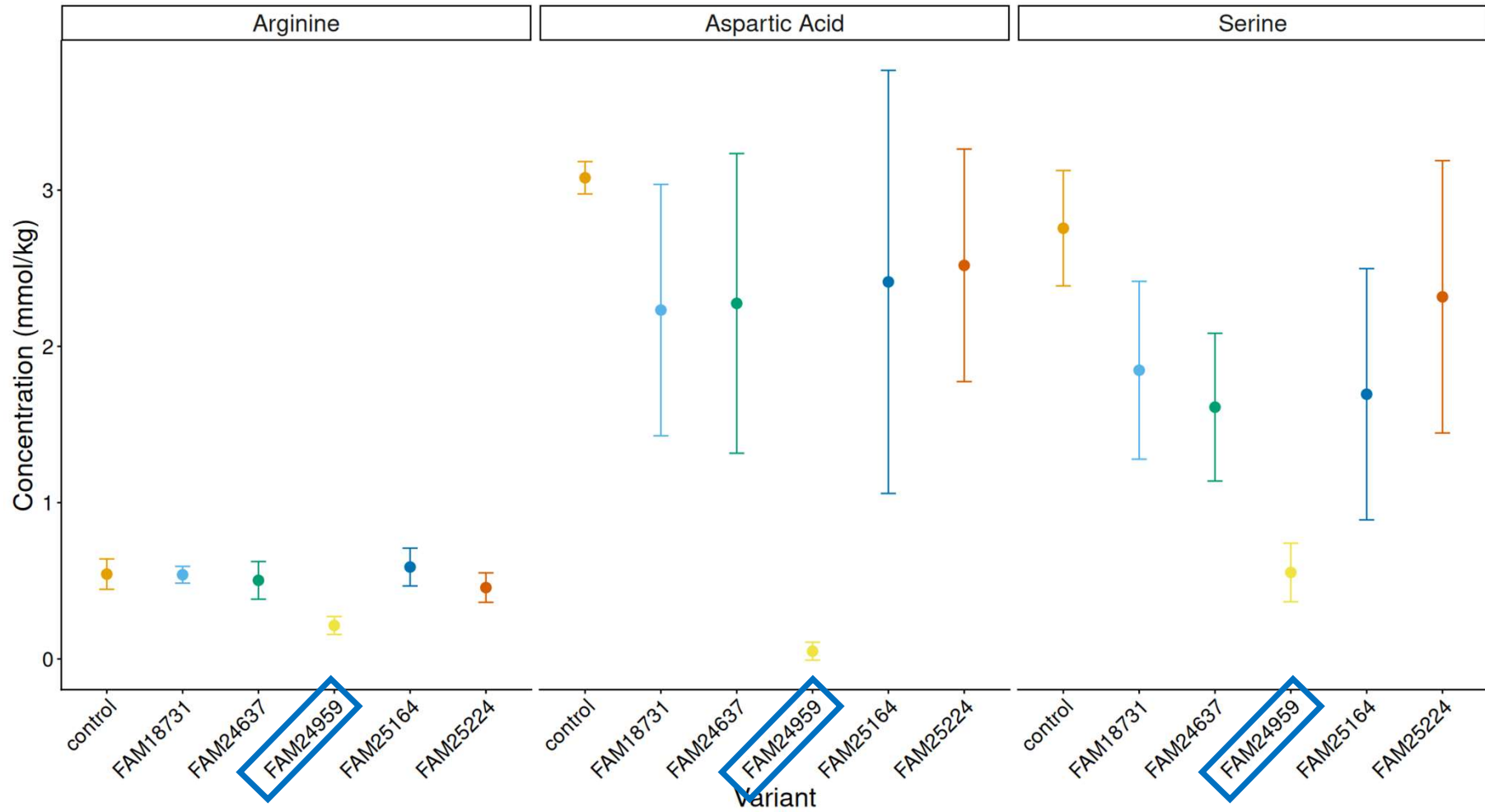


Precursors for biogenic amines (120 d)





Free amino acids of interest (120 d)





Influence on eye formation

control | FAM18731 | FAM24637 | FAM24959 | FAM25164 | FAM25224

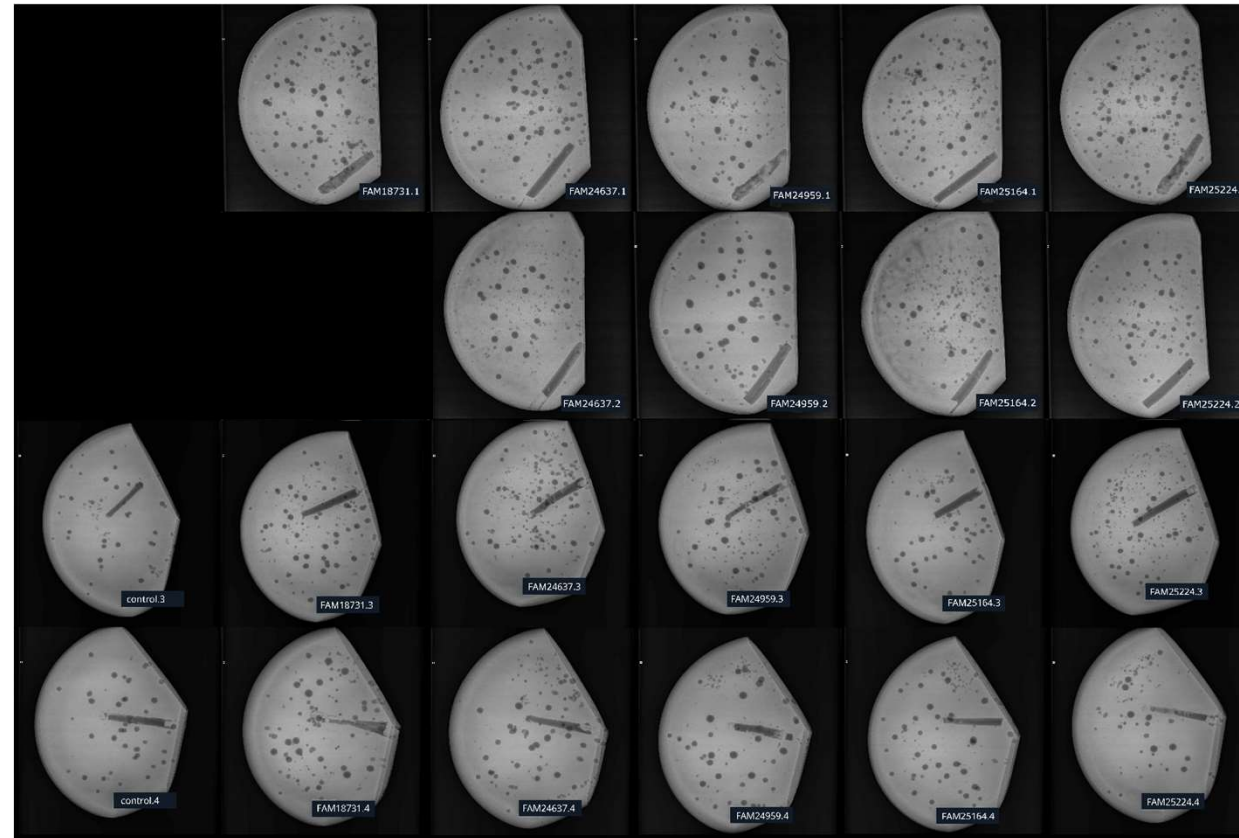
Trial

1

2

3

4



L. curvatus is an amine-forming bacteria relevant for cheesemaking

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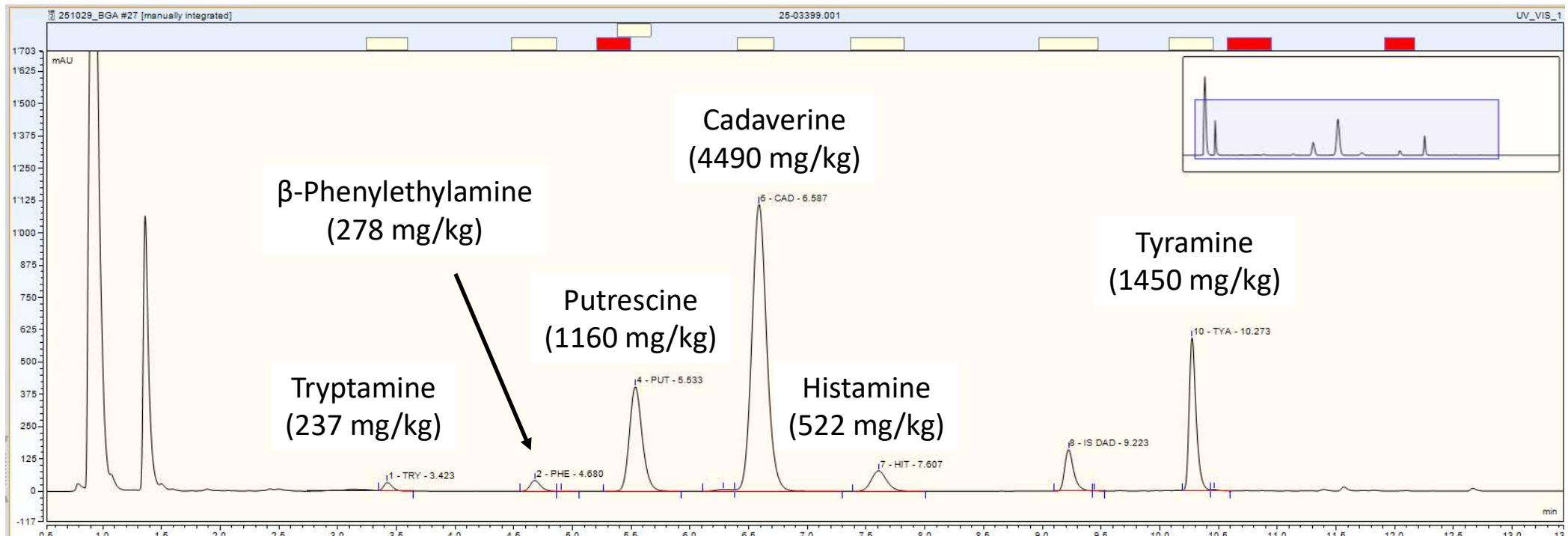


Current real-case: again bloating packages





Real-case: biogenic amines profile of a cheese send to our lab



after 3 months of ripening



Real-case: first results

- ***L. curvatus*** was isolated from the cheese surface (before cutting and packaging).
- **PCR confirmed presence on the surface (not found in the inside).**
- Isolates showed **different biogenic amine profiles** under laboratory conditions.
- Genome sequencing revealed **genetically distinct strains**.
- **Working hypothesis:** a strain mix may outperform a single strain explaining the high amounts of biogenic amines
- **High cadaverine levels suggest the presence of an additional, yet unidentified biogenic amine-producing bacterium.**
- **PCR provides a practical approach for tracing *L. curvatus*** throughout production, as no selective medium is currently available.



Acknowledgements

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Thank you for your attention.

Stefan Irmeler

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