

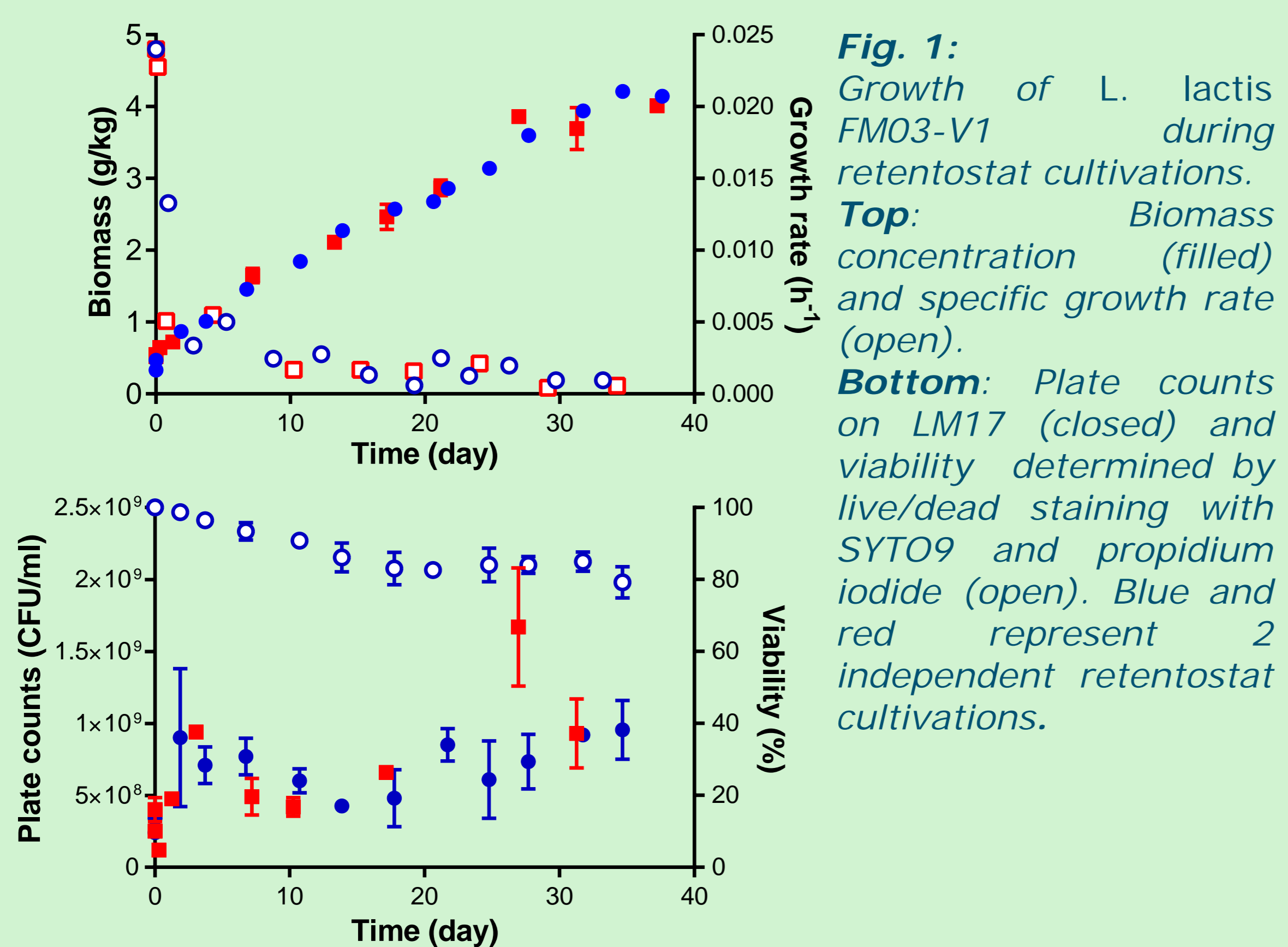
Aroma formation by lactic acid bacteria at near-zero growth rates

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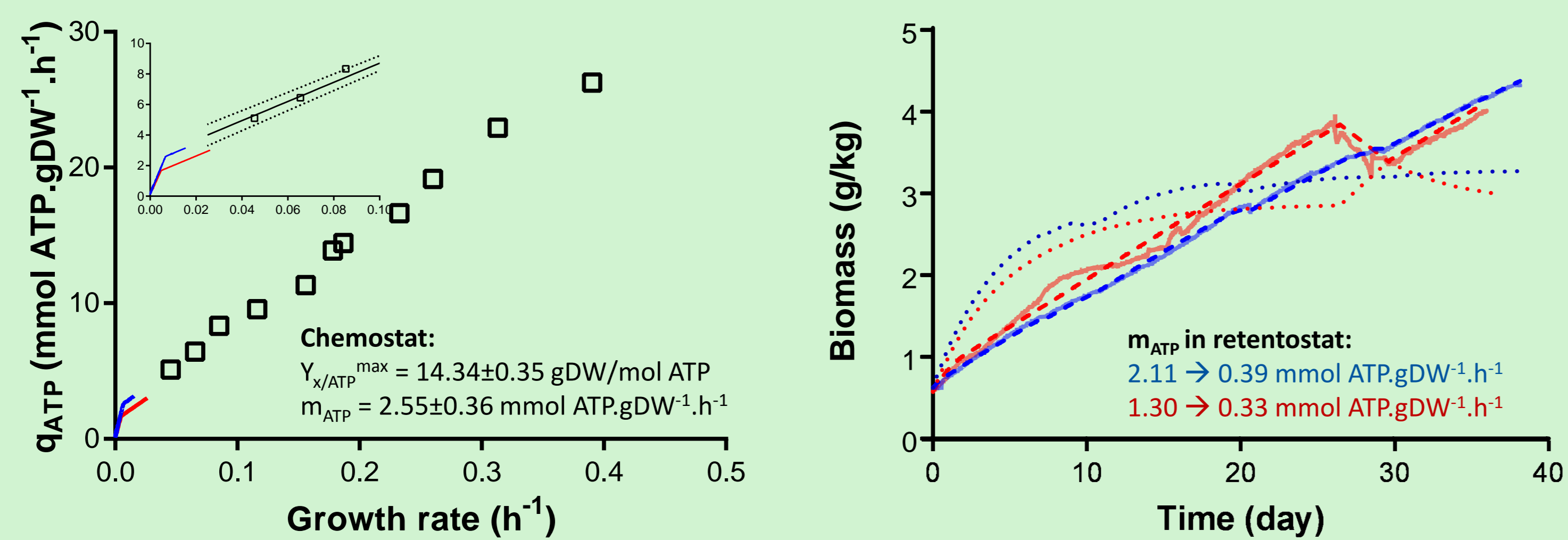
Introduction

During food fermentation processes like cheese ripening, lactic acid bacteria (LAB) encounter long periods of nutrient limitation leading to severe reduction in growth rate. Particular LAB survive these periods of slow growth while still contributing to flavour formation in the fermented product. The aim of this study was to study the quantitative physiology and aroma formation capacity of *Lactococcus lactis* at near-zero growth rates using retentostat cultivation.

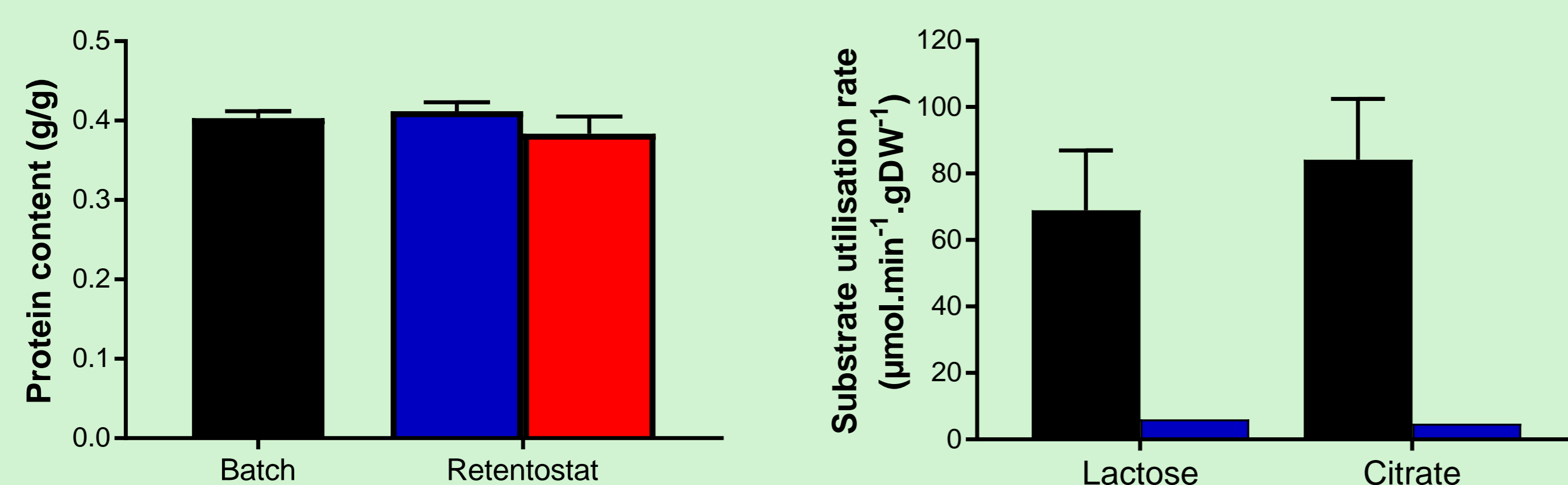
PHYSIOLOGY



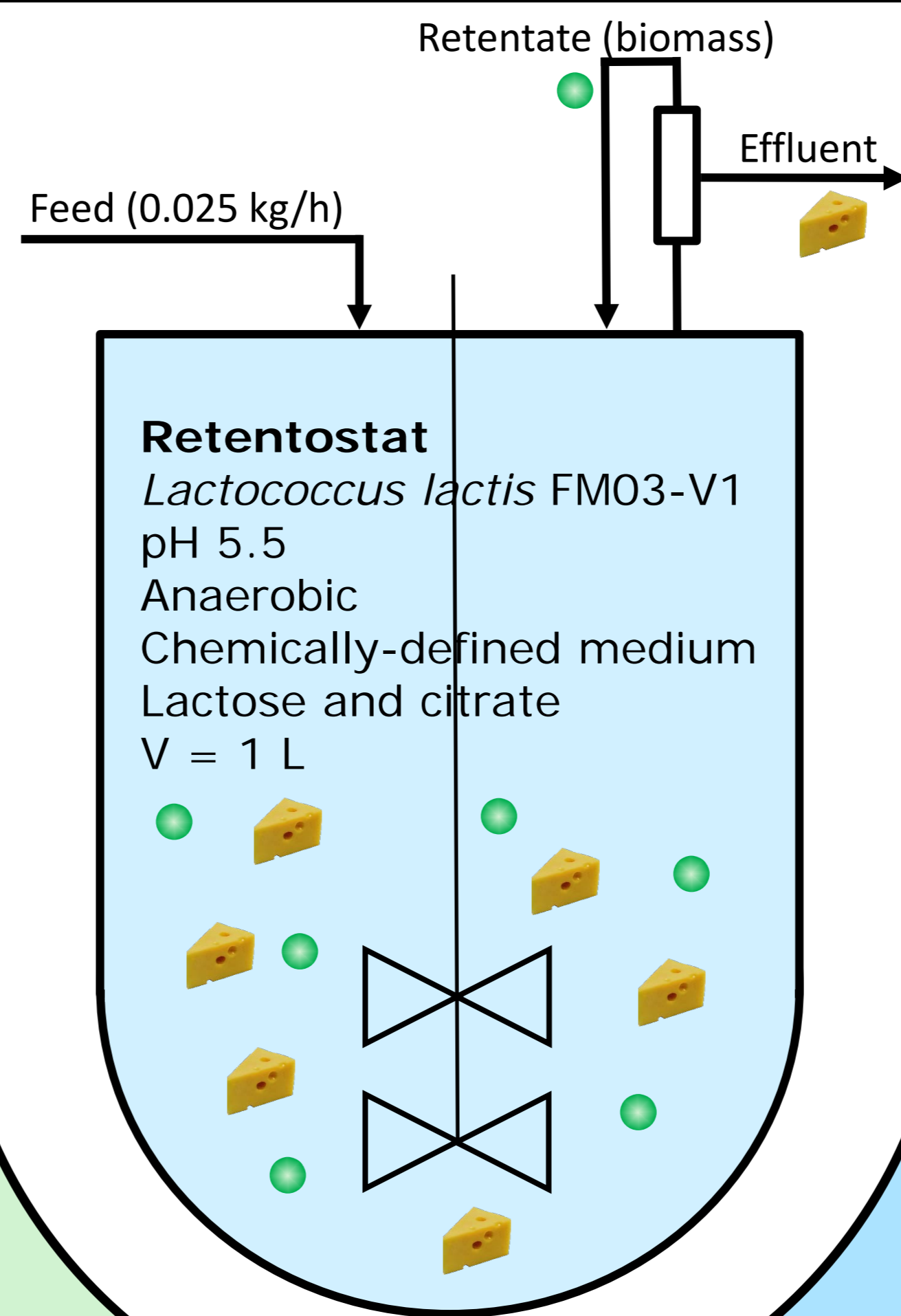
- Growth rate decreased till $<0.001\text{h}^{-1}$
 - Biomass increased 8-fold
 - Viability remained $>80\%$
 - Plate counts hardly increased
- Viable but non-culturable cells**



- Maintenance coefficient is not constant but decreased 7-fold at extremely low growth rates



- Protein content remained constant
 - Substrate utilisation capacity decreased
- More damaged proteins due to decreased protein turnover?**



AROMA

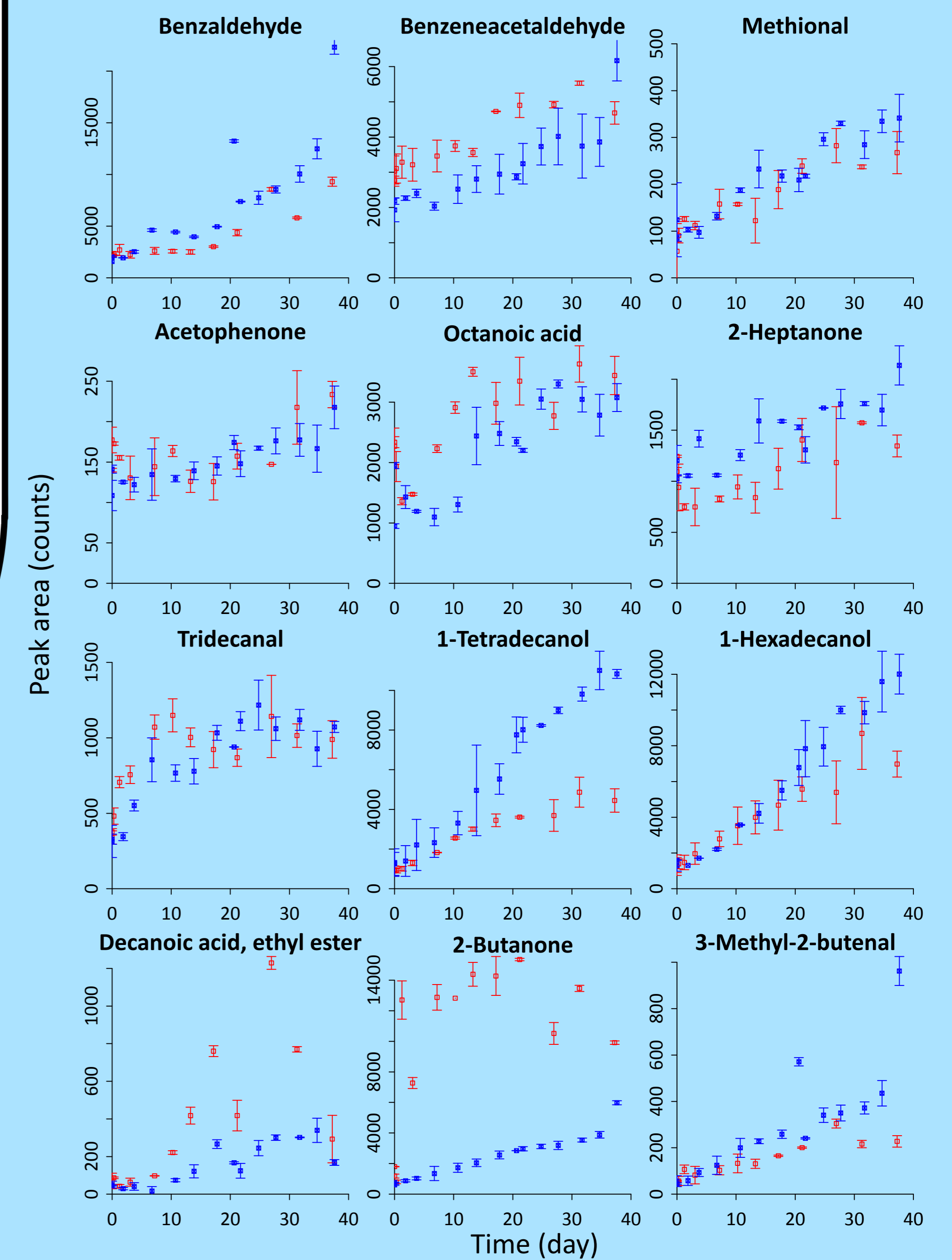
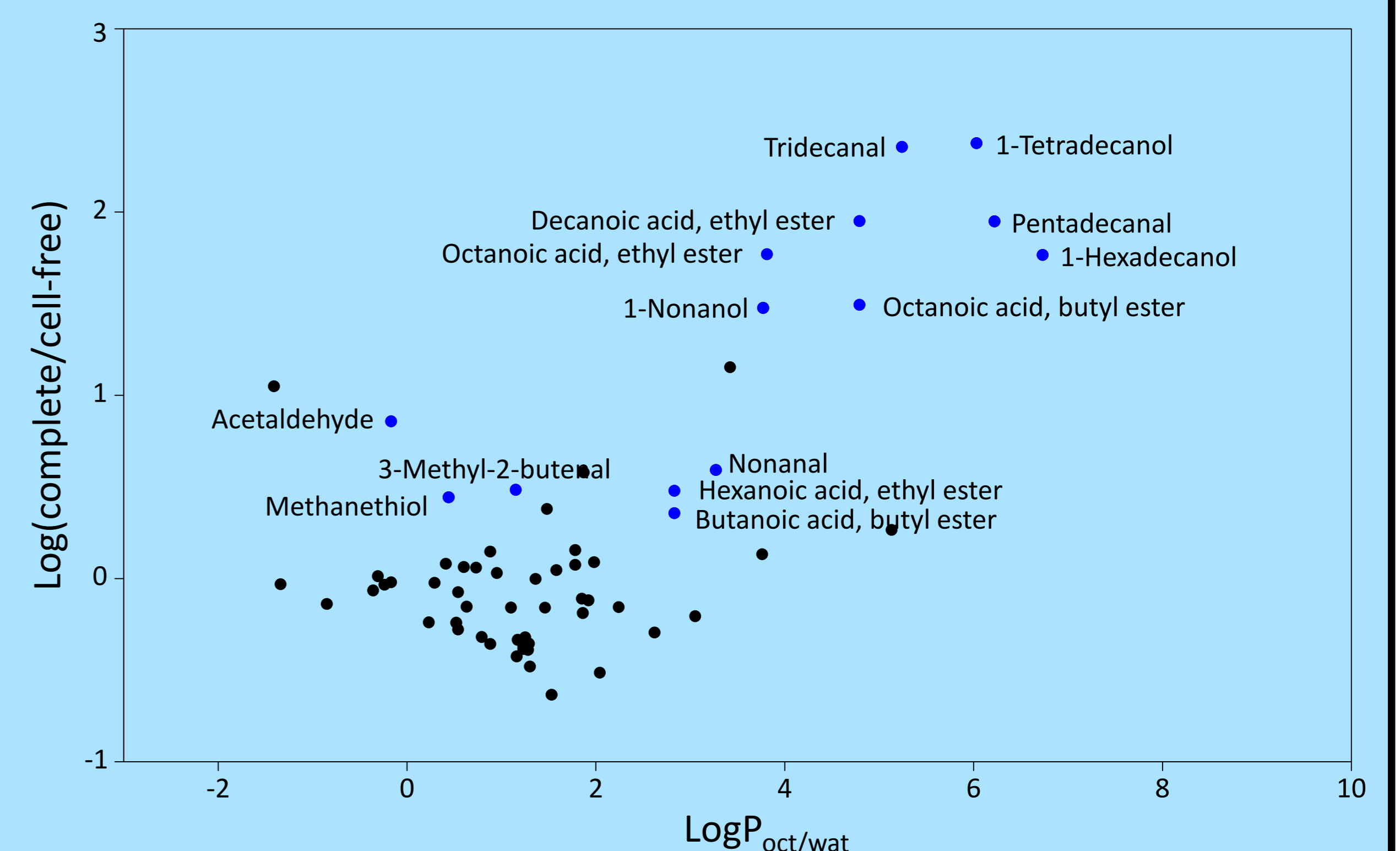


Fig. 4: Abundance of aromas that increased during retentostat cultivations. Error bars represent standard deviations of technical duplicates.

- 57 aromas produced during retentostat cultivation.
- At extremely low growth rate increase in:
 - amino acid catabolism
 - fatty acid catabolism
 - 2-butanone (acetoin metabolism)
 - 3-methyl-2-butenal (mevalonate pathway?)



- Hydrophobic compounds were mainly located in cells (i.e. in cell membrane)
 - Cells were retained and accumulated in time
- Hydrophobic compounds were retained and accumulated in time**



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