Wine Yeast Biofilms and Quorum Sensing

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Aim: To study wine yeast biofilm formation, regulation and the impact on winemaking

Wine yeast can form biofilms with unique mat structures

Σ1278b (commonly used laboratory strain for filamentation and biofilm studies) and 3 commonly used commercial wine yeast strains were grown on a 90 mm petri dish filled with YPD + 0.3% agar (nutrient-rich medium) for 13 days at 25°C. All strains spread along the surface forming a thin biofilm.

Some cells within low nitrogen biofilms invade the medium

Σ1278b
L2056
AWRI796
EC1118

Yeast cells were grown on a minimal nutrient and nitrogen poor medium (SLAD) + 0.3% agar. (A) Some cells invaded into the agar (black arrows). Images were taken from the underside of the agar plate. (B) Cells on the agar surface were rinsed off with water to examine the invading cells. Filamentous cells were observed (white arrows) in the magnified view.

Signalling molecules influence the amount of invasive growth

AWRI796 grown on SLAD, SLAD with the addition of 0.05% ethanol and SLAD with 0.05% ethanol, 50 µM tryptophol and 50 µM 2-phenylethanol. While ethanol enhanced filamentous invasive growth on low-agar SLAD, the effect was suppressed by the addition of aromatic alcohols (known yeast quorum sensing molecules).

RNA-seq transcriptome analysis of surface vs invasively growing wine yeast supports the current theory that invasively growing cells are foraging for nutrients

RNA was extracted from surface and invasively growing cells of AWRI796 to compare gene expression profiles using next generation sequencing (RNA-seq) technology. The majority of genes involved in the processes shown (left) had increased expression in invasively growing cells compared to the non-invasive cells.

Conclusion

Nutrient availability and the presence of signalling molecules influence yeast strategies for colonisation and survival. This may have an impact on wine microbial profiles and their metabolism, thus would likely influence wine aroma and flavour.