

# Traditional beers as a source of new yeast biodiversity

Presented by  
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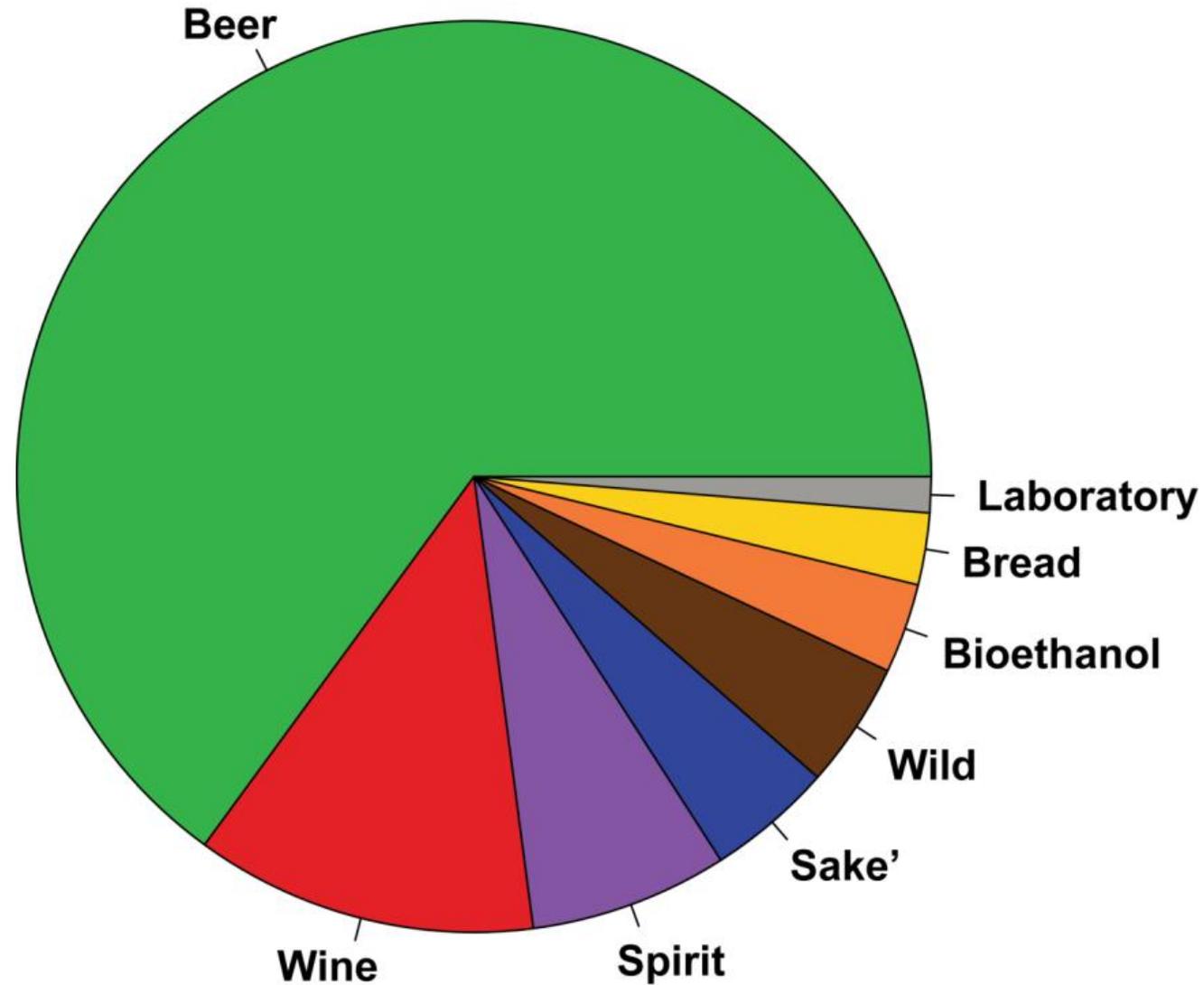


# Different fermented products, different industrial yeasts



(RECENTLY FEATURED WINES)

# Collection of > 1000 industrial yeasts and wild isolates



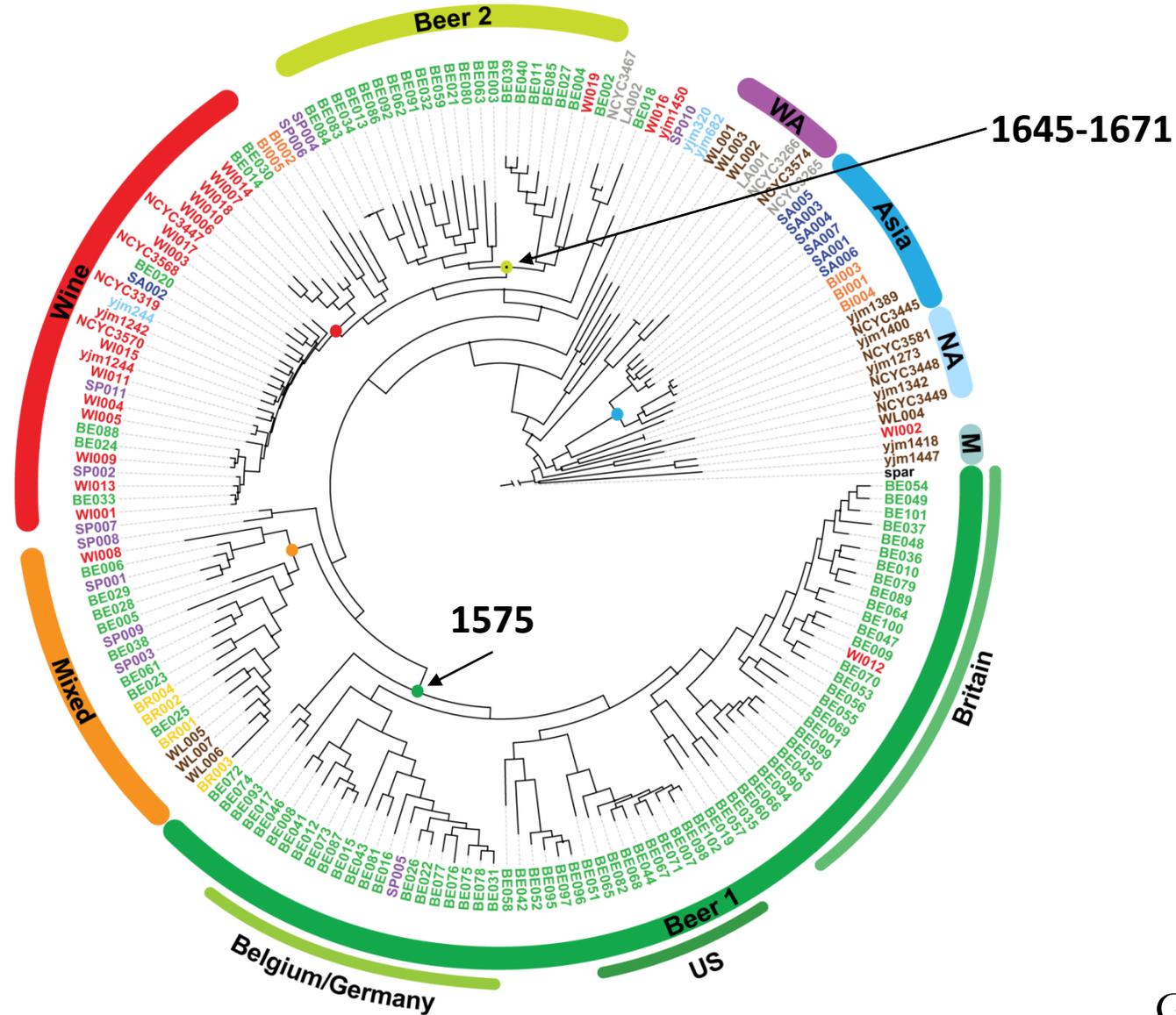
# The family tree of industrial yeasts

## Origin

- Beer
- Wine
- Spirits
- Saké
- Wild
- Bio-ethanol
- Bread
- Laboratory
- Clinical
- S.paradoxus*

## Lineage

- Beer 1
- Britain
- US
- Belgium/Germany
- North America (NA)
- Mixed
- Wine
- Beer 2
- West Africa (WA)
- Asia
- Malaysia (M)



# Decline of farmhouse brewing in the 19<sup>th</sup> Century

Gallone et al., 2016

- Industrialization



# Decline of farmhouse brewing in the 19<sup>th</sup> Century

Gallone et al., 2016

- Industrialization
- Improvements in transportation



# Notable exception

The Norwegian  
farmhouse beer yeast  
**Kveik**



# Kveik unique reported characteristics

- Kveik maintained via backslopping



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- Kveik maintained via backslopping
- **High temperature fermentation**



# Kveik unique reported characteristics

- Kveik maintained via backslopping
- High temperature tolerance
- **Desiccation tolerance**



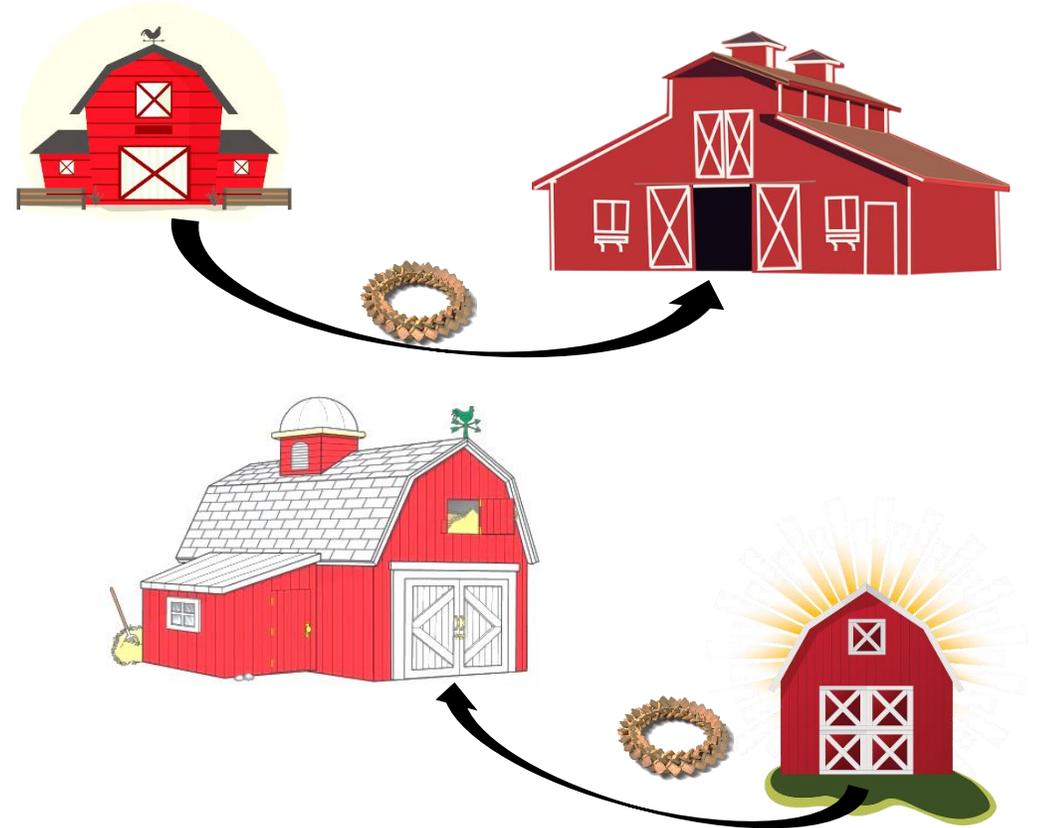
# Kveik unique reported characteristics

- Kveik maintained via backslopping
- High temperature tolerance
- Desiccation tolerance
- High gravity fermentation



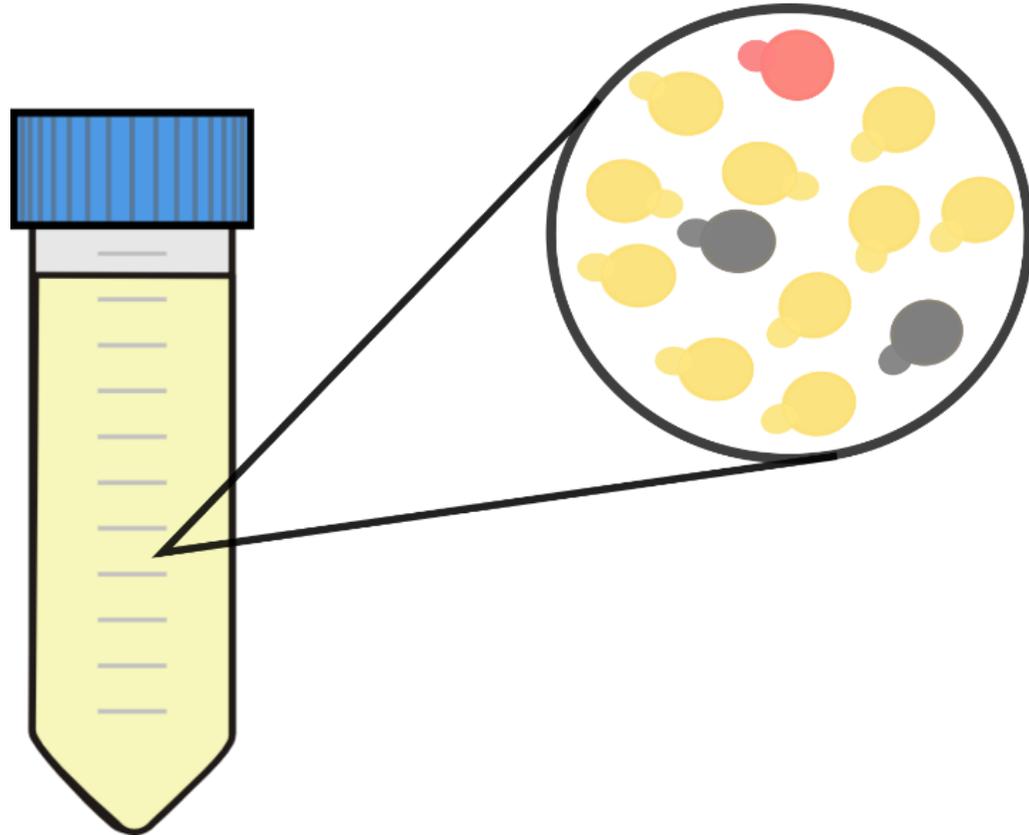
# Kveik unique reported characteristics

- Kveik maintained via backslopping
- High temperature tolerance
- Desiccation tolerance
- High gravity fermentation
- Culture of kveik yeast sharing



# How we get better yeasts?

- Exploring untapped natural biodiversity - Farmhouse yeasts





# Kveik cultures geographical origin

- 26 Cultures

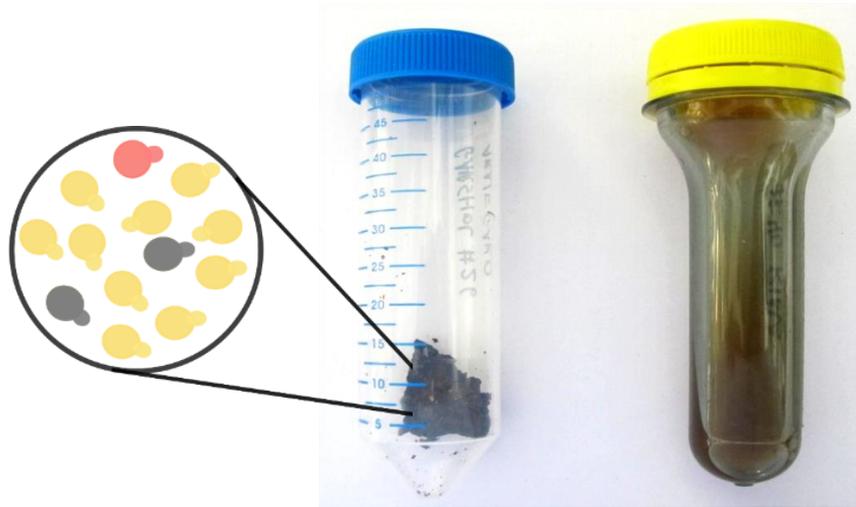


Lars Garshol

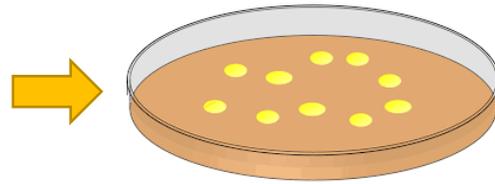
## Other farmhouse yeast cultures from

- Russia
- Lithuania
- Latvia

# From Kveik culture to single strain



Kveik culture



Growing yeasts



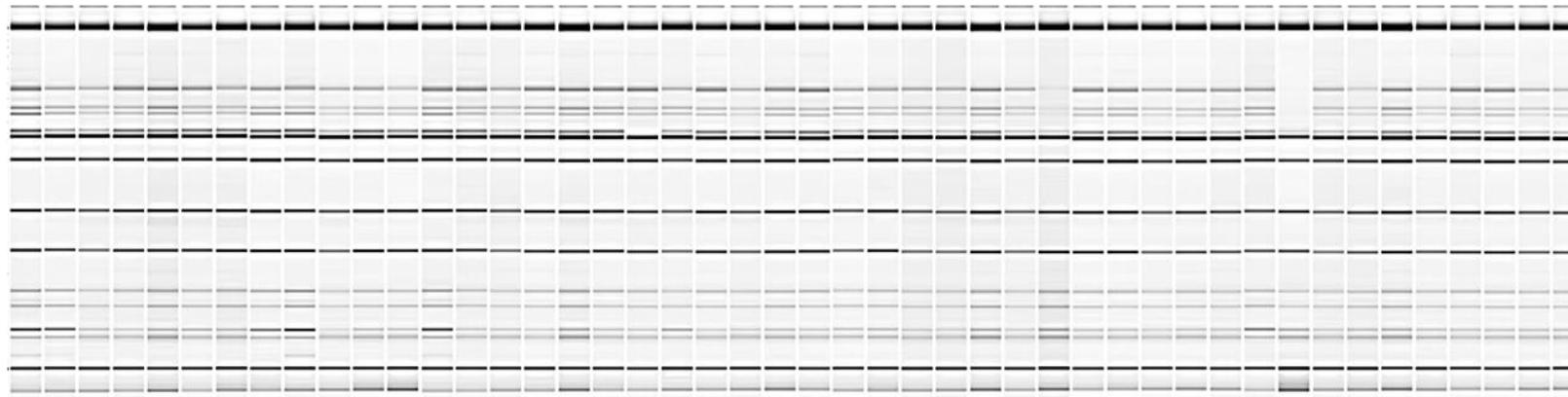
DNA extraction  
& analysis  
(~1300 variants)



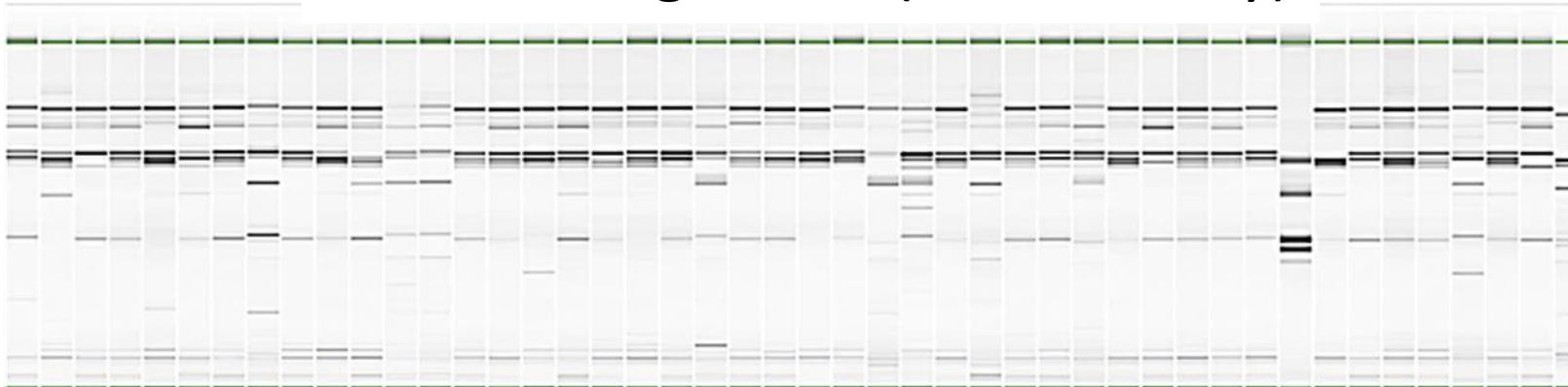
Identifying yeast species  
(186 strains)

# Farmhouse yeast cultures vary in their complexity

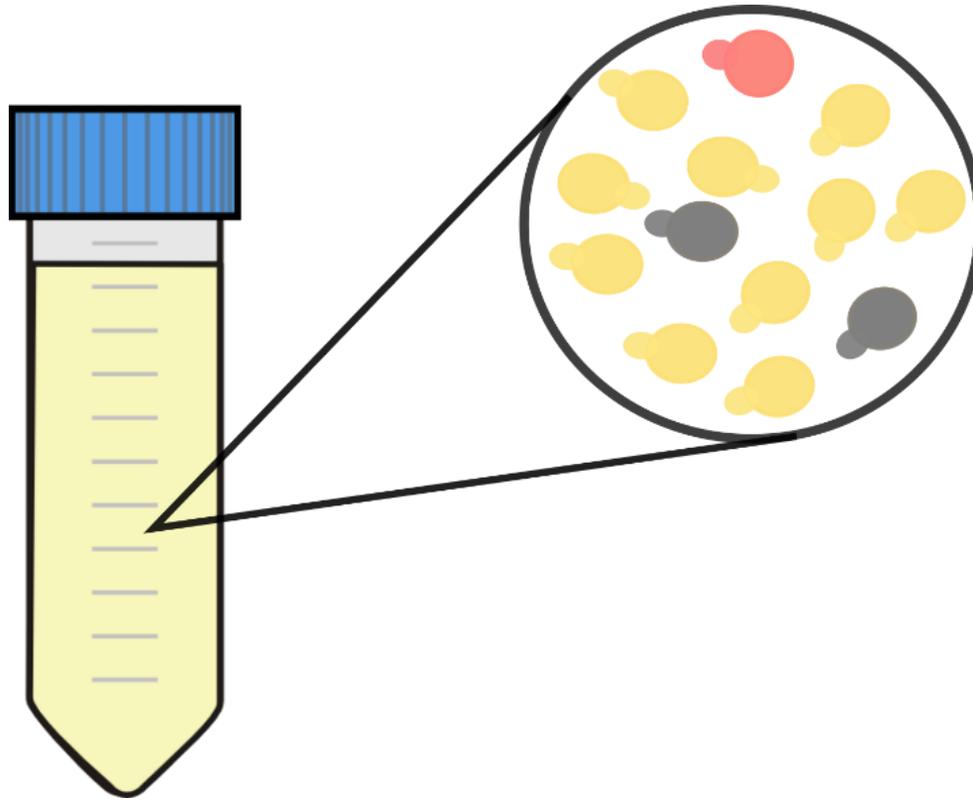
Selected strains =4      Kveik 'Opshaug' (Southern Norway)



Selected strains =13      Kveik 'Ebbegarden' (mid Norway)



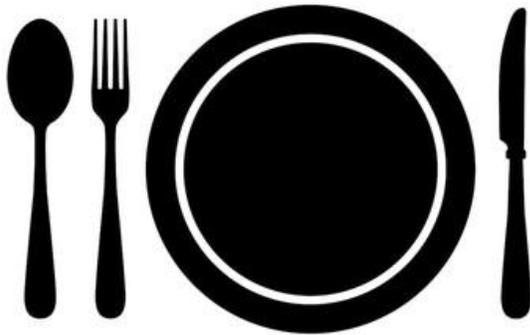
All isolated strains were *S. cerevisiae* except one hybrid  
*S. cerevisiae* + *S. uvarum*



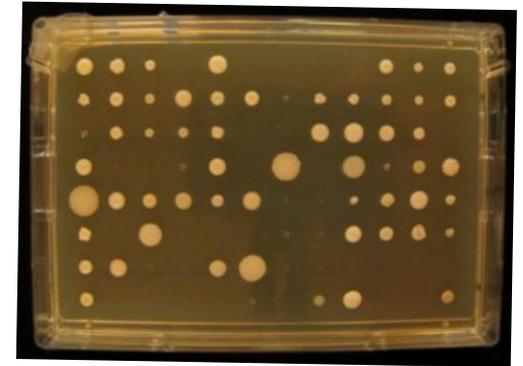
## Fermentation performance



## Nutrient utilization



## Stress tolerance



## Aroma production

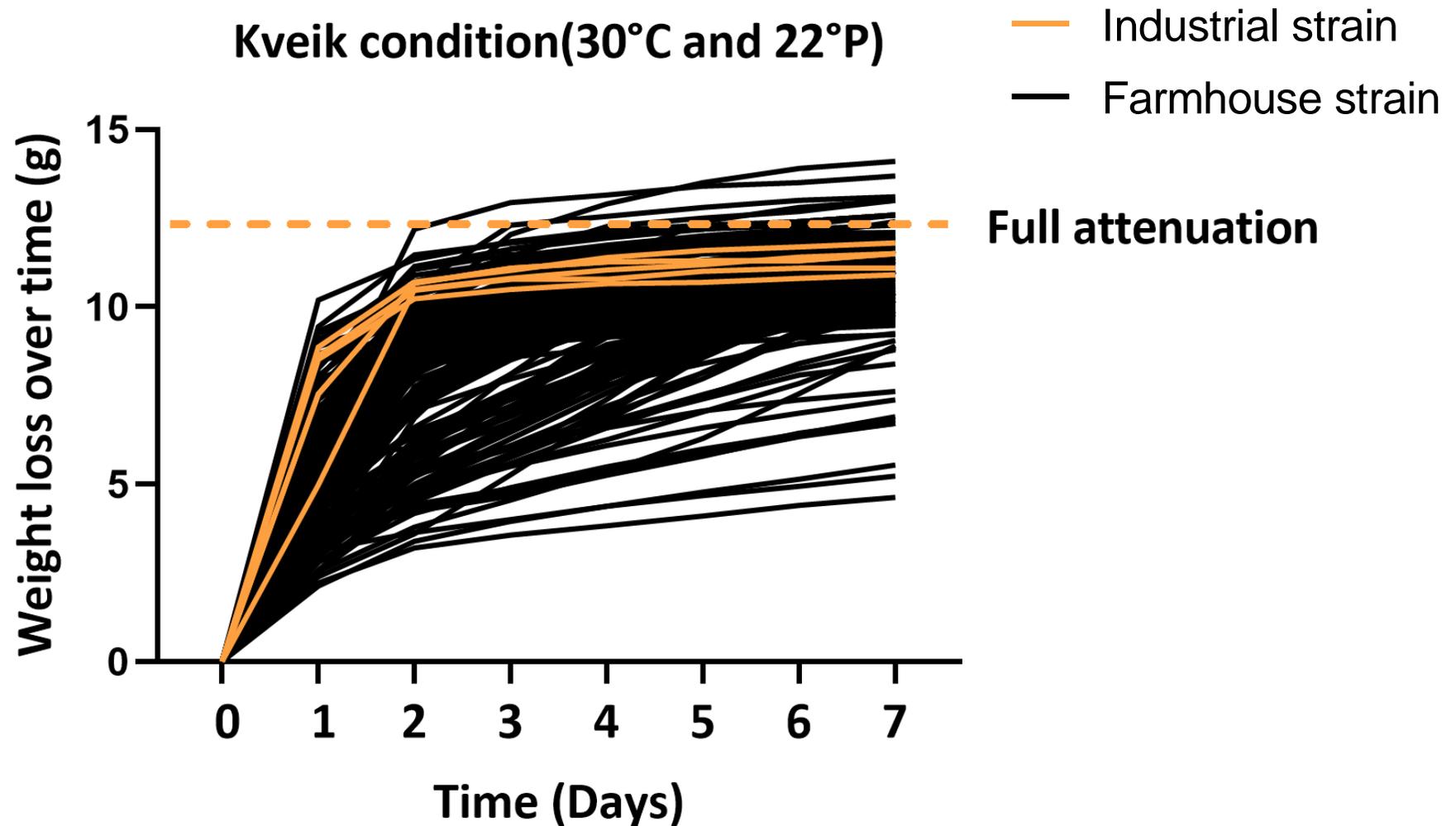
# Fermentation conditions

**Number of strains:** 186 Kveik strains + 6 industrial strains

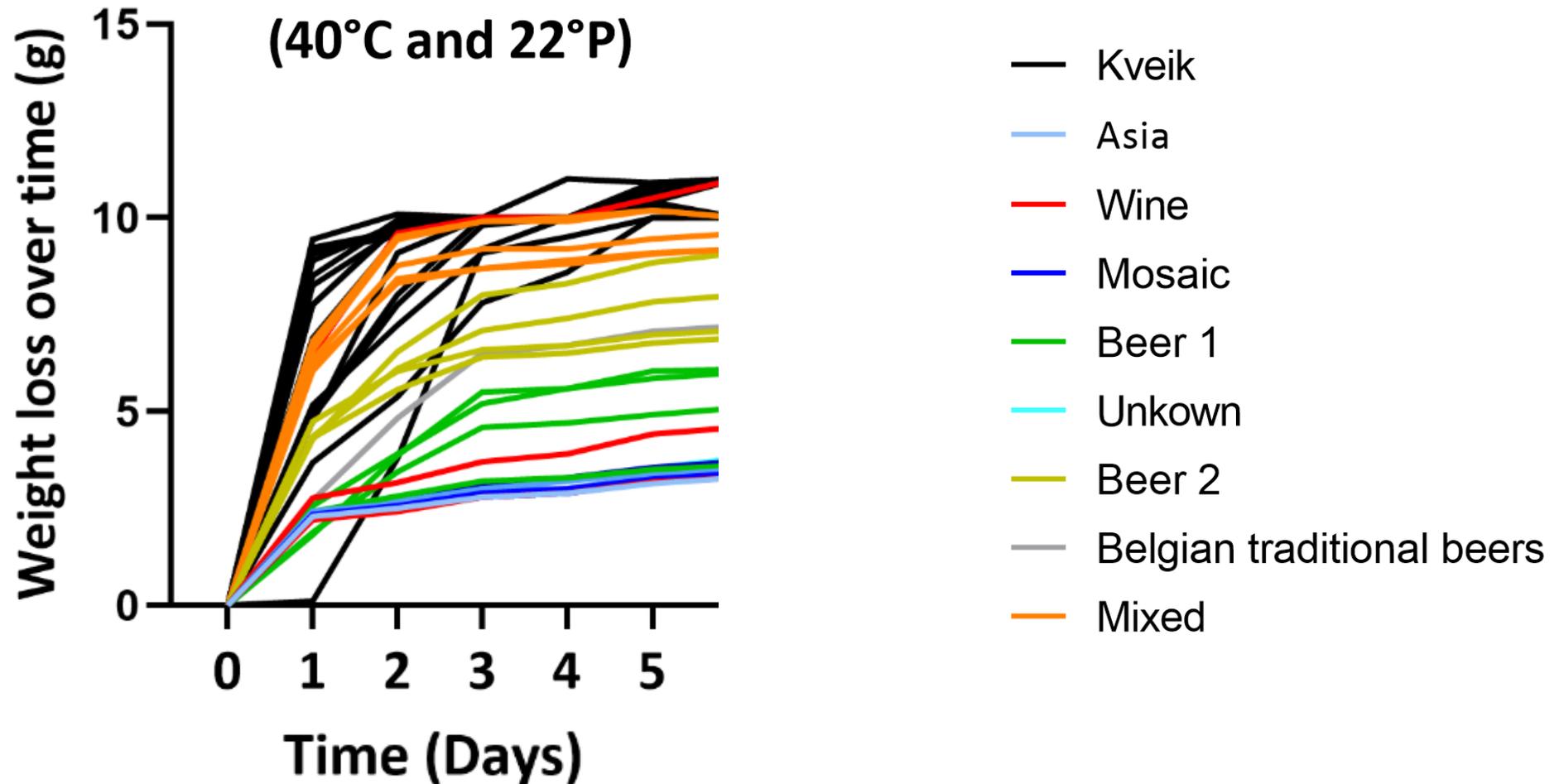
**Fermentation conditions:** 30°C and 22°Plato (gravity)



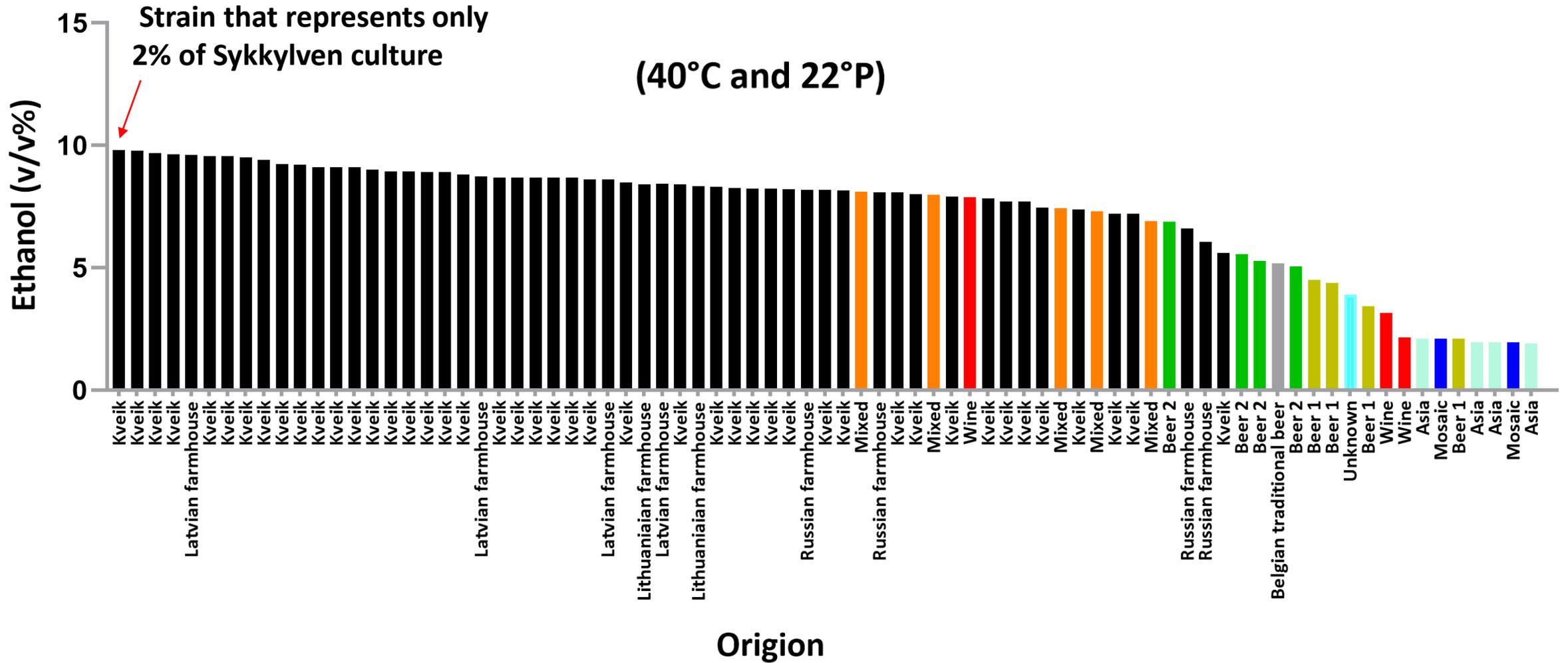
# Farmhouse yeasts vary in their fermentation speed



# Farmhouse yeasts fermentation performance at high temperature



# Farmhouse yeasts fermentation performance at high temperature



# Farmhouse beer aroma analysis



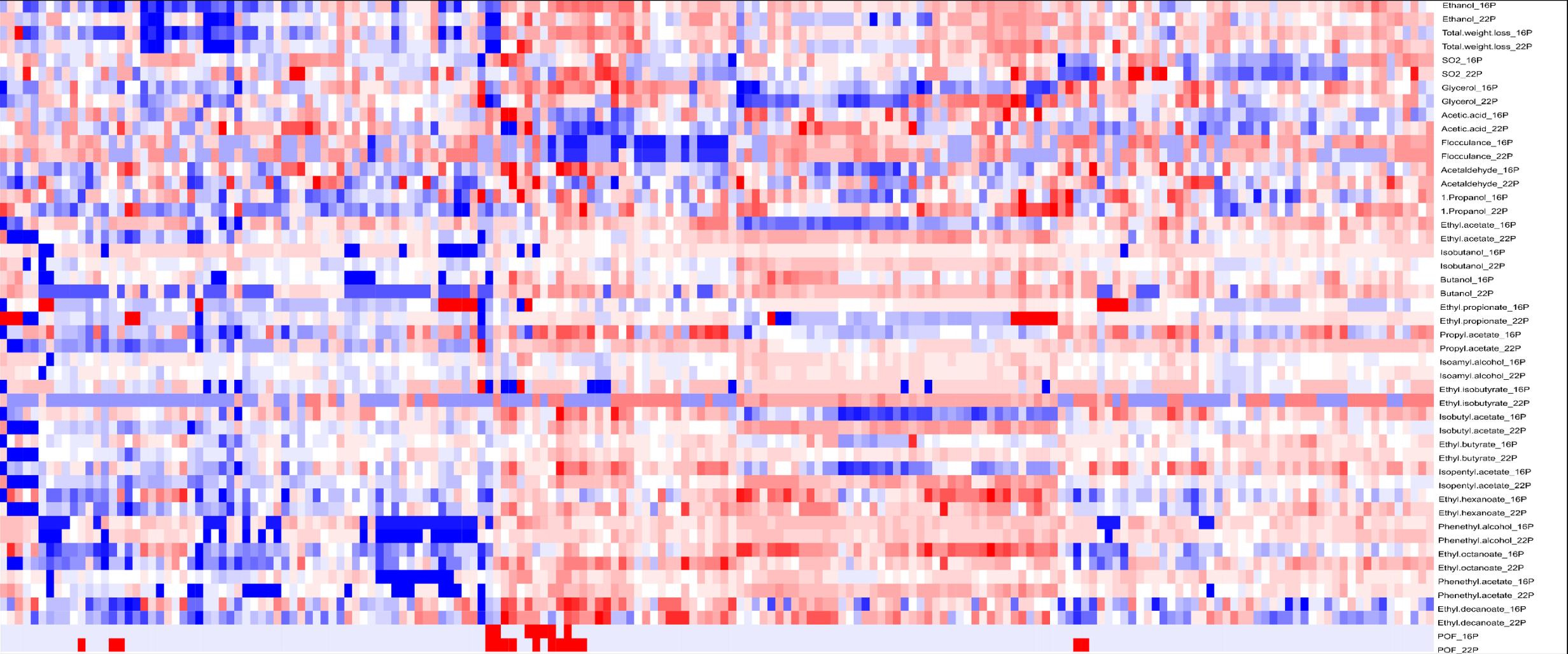
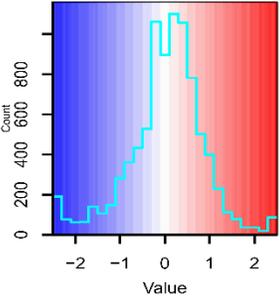
Sensorial



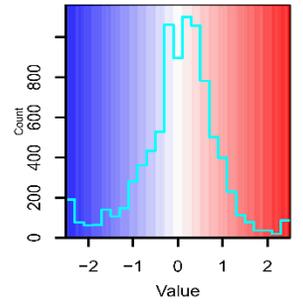
Chemical



# Farmhouse yeasts show high diversity in their aroma production

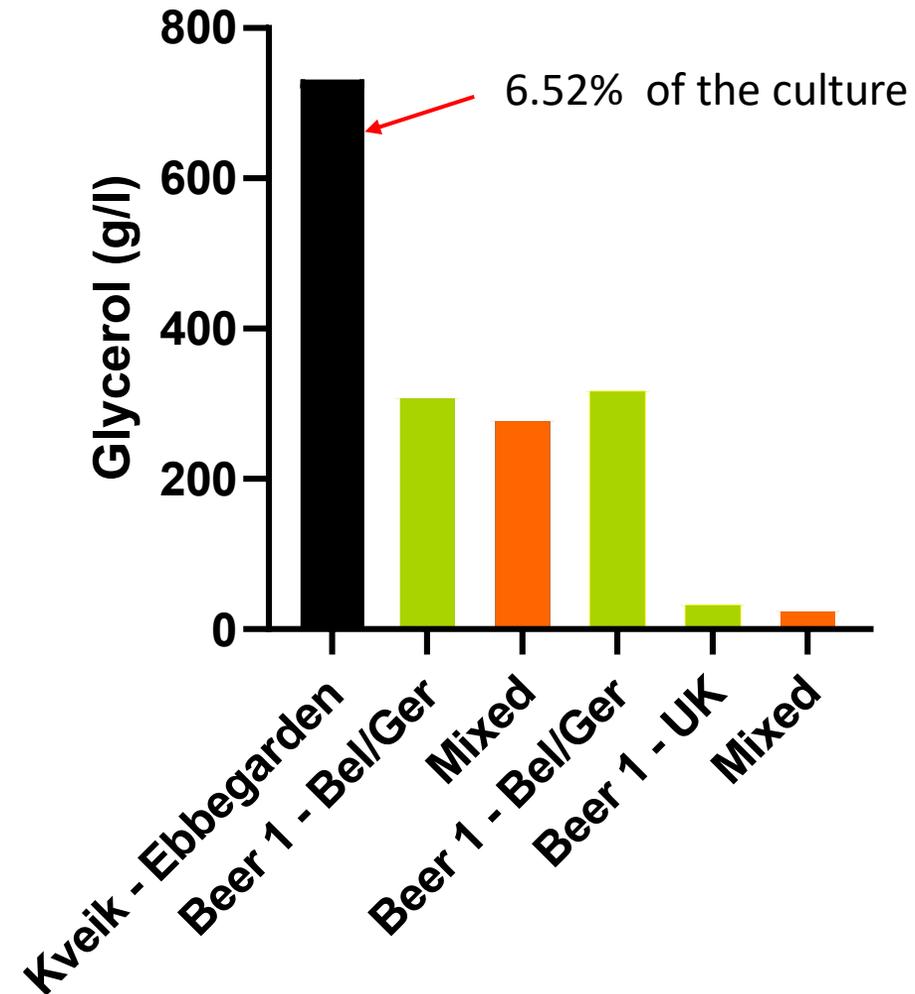


# The majority of the kveik yeasts are POF-

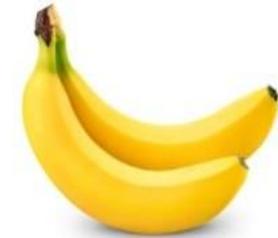
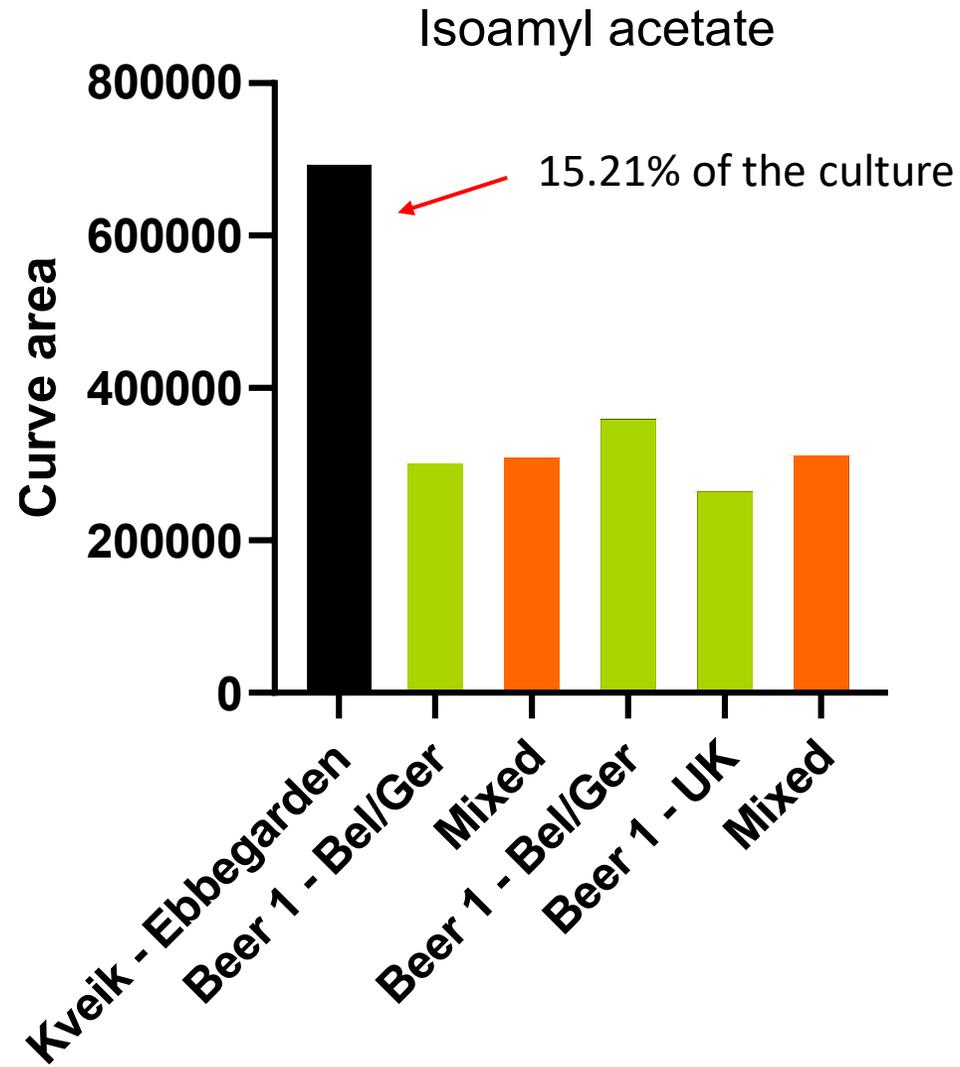


# Strains with unique characteristics

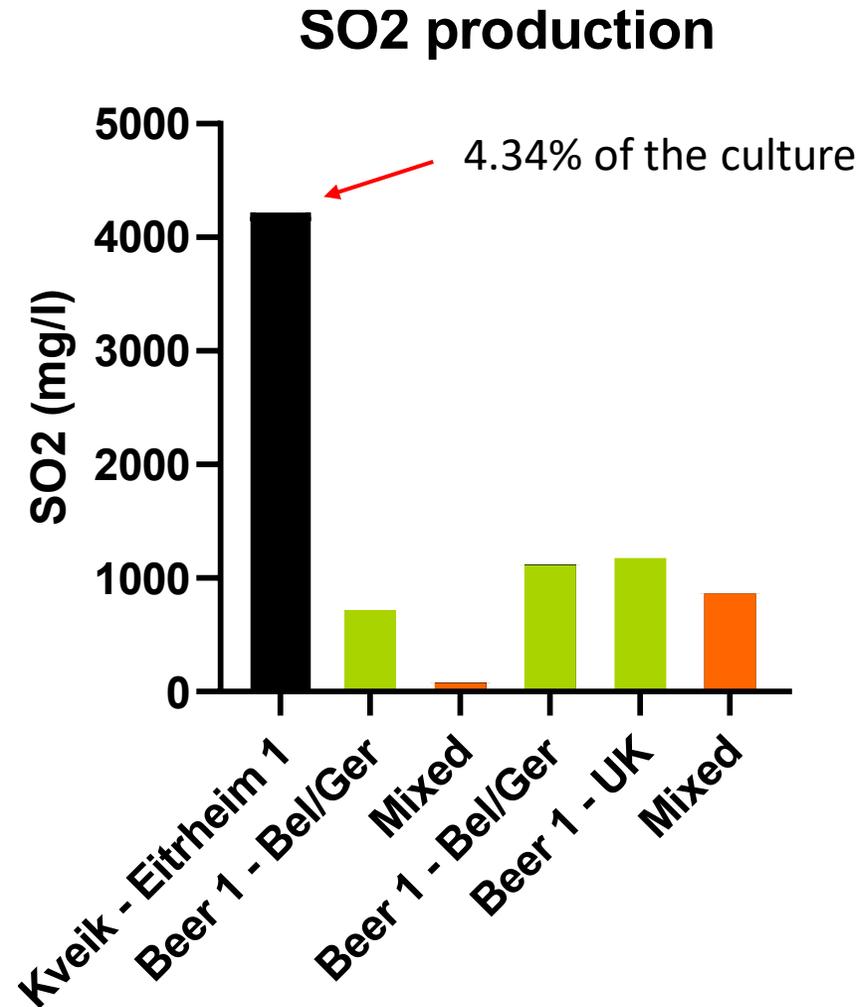
## Glycerol production



# Strains with unique characteristics



# Strains with unique characteristics



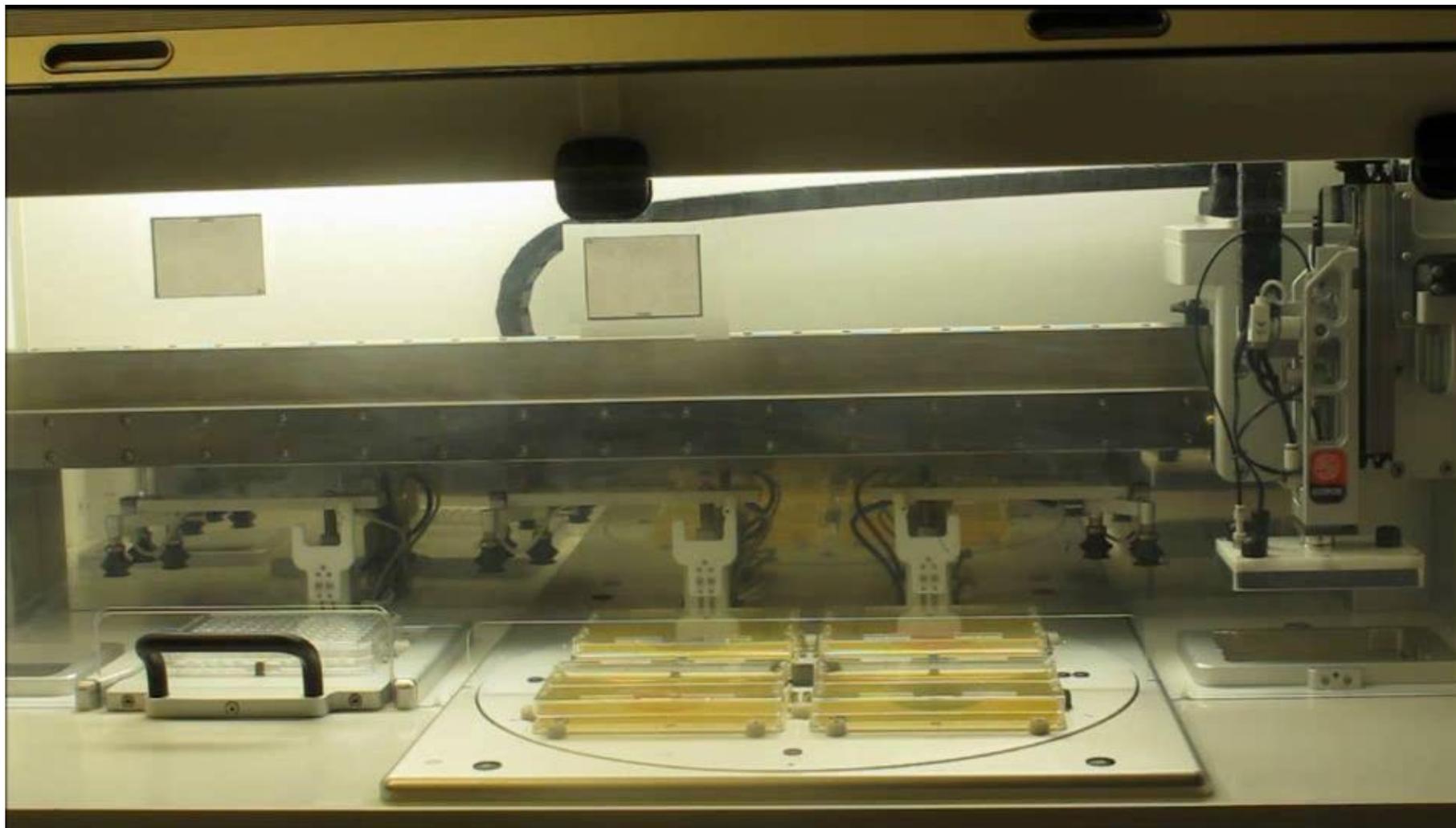
# Stress tolerance



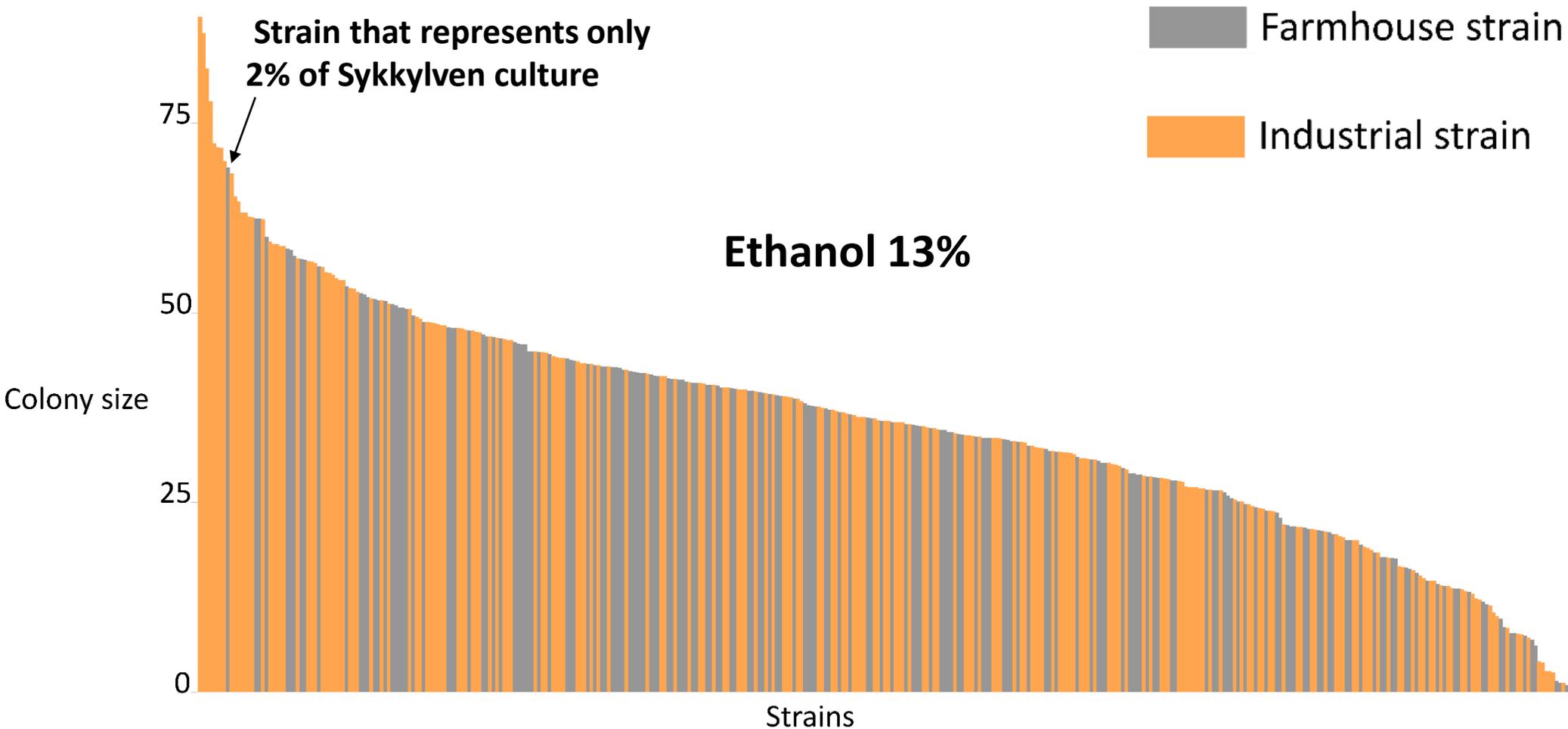
Ethanol tolerance



# High-throughput screening



# Farmhouse yeasts have wide diversity of ethanol tolerance



# Summary

- Farmhouse yeasts have high diversity
- 95% of the farmhouse yeast are POF- (domestication signature)
- The high diversity of the farmhouse yeasts is a great source of new strains that can be used in industrial applications

