

Viability, vitality and overall brewing fitness of yeast

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Presentation outline

1. Issues regarding yeast management
2. Maintaining culture purity
3. Defining and measuring “brewing fitness”
4. Maintaining brewing fitness

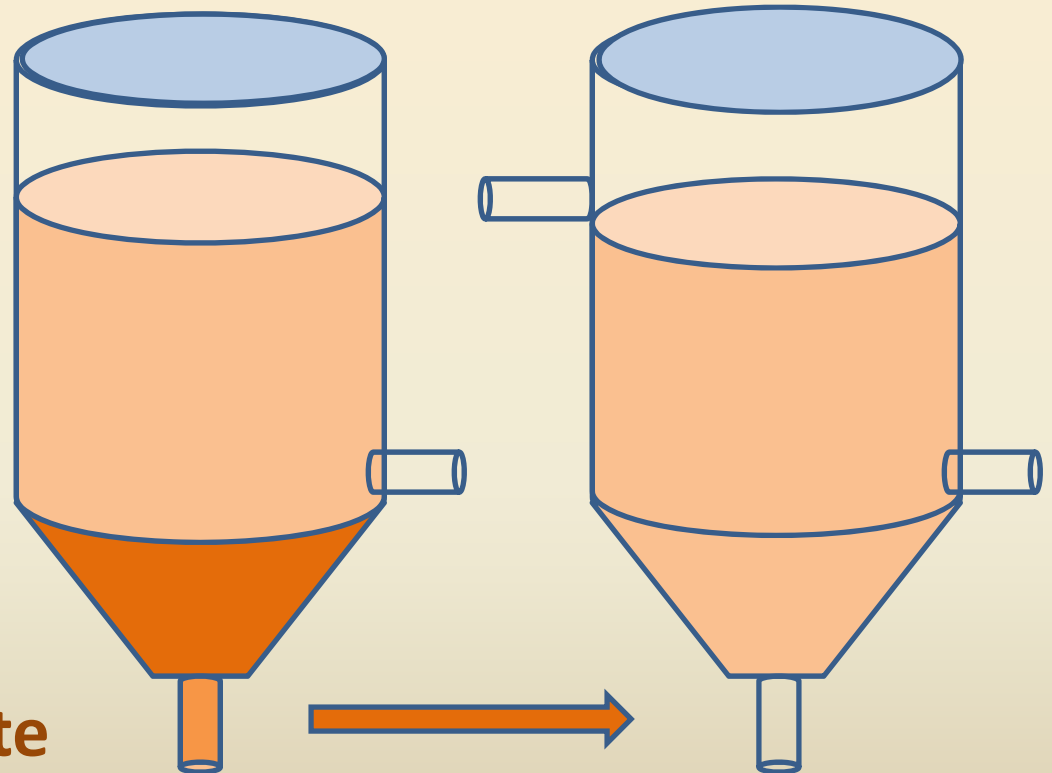
Issues in yeast management

From batch to batch:

1. Maintaining culture purity
2. Maintaining culture viability & vitality



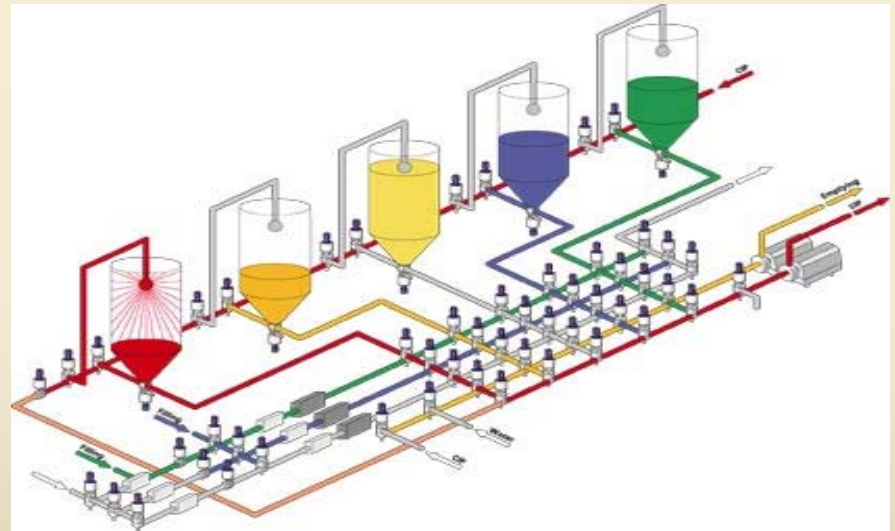
Optimal (re-)pitching rate



Maintaining culture purity

Preventing contamination through good brewing practice:

1. Implement SOPs to ensure proper cleaning & sanitation of vessels, pumps, pipes and hoses



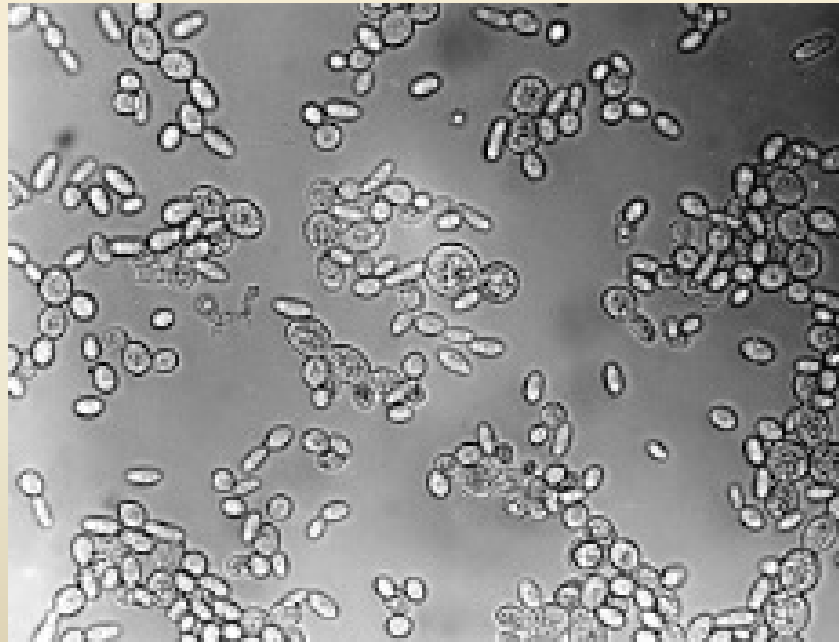
Maintaining culture purity

2. Implement a preventative maintenance schedule to ensure aseptic transfers and sanitary operation of key equipment such as pumps & heat exchangers



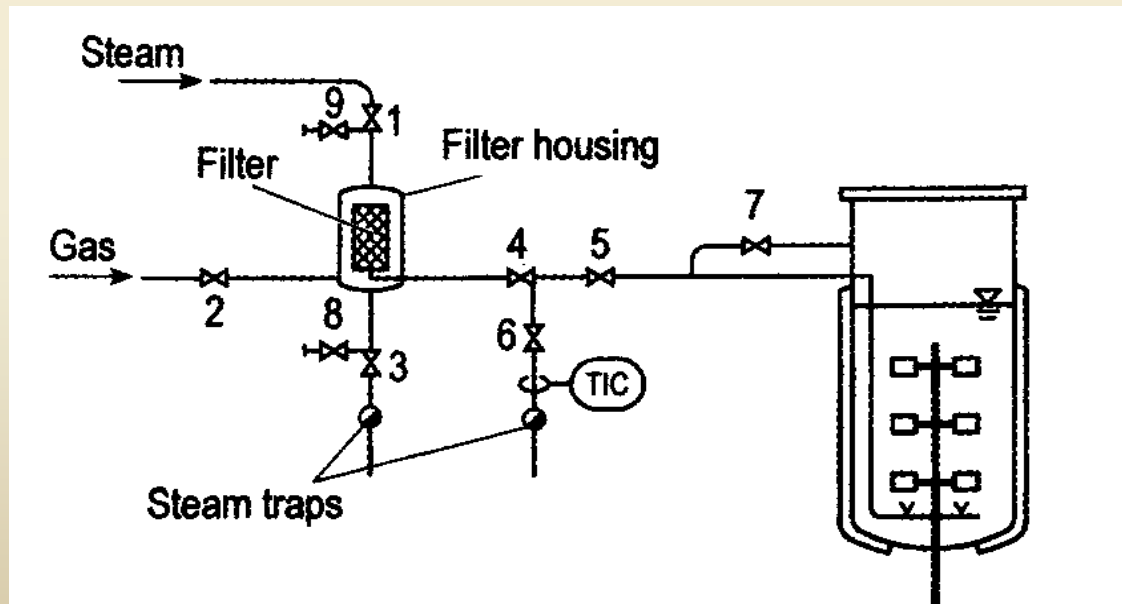
Maintaining culture purity

3. Evaluate culture purity and vitality before re-pitching and take corrective action if needed



Maintaining culture purity

4. For first batches, verify purity of seed culture and propagate using an aseptic vessel aerated with sterile air or oxygen



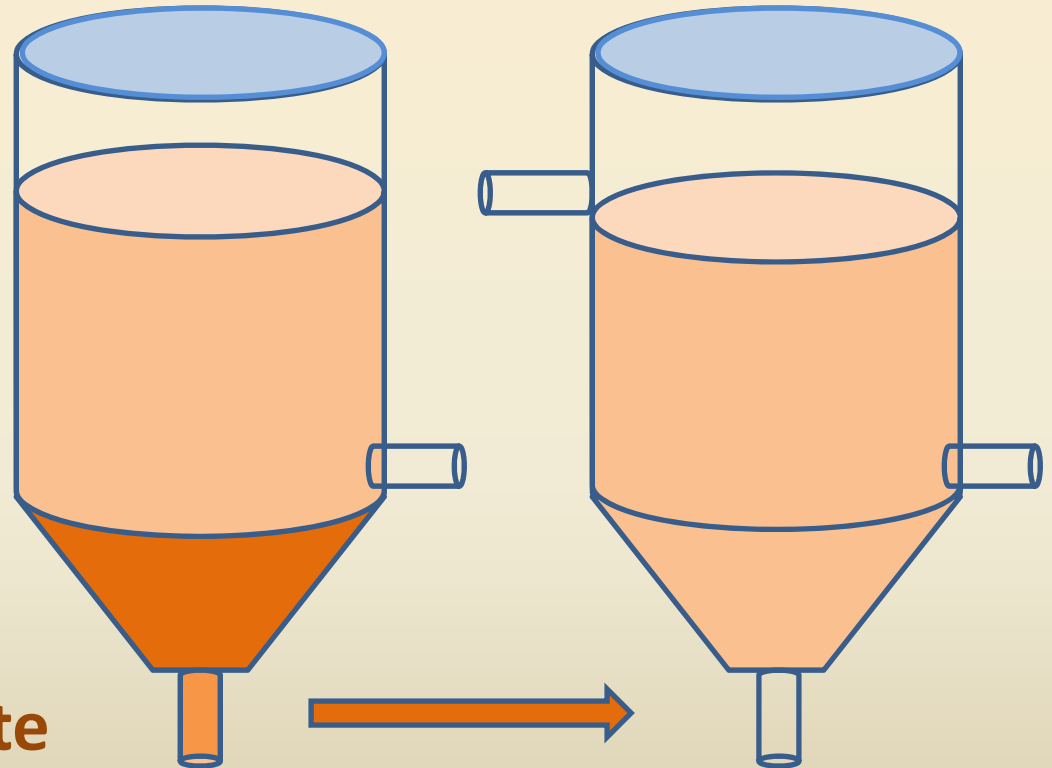
Issues in yeast management

From batch to batch:

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Optimal (re-)pitching rate



What's in a definition?

Viable: a cell capable of growth and reproduction under favorable conditions

VS

Vital: a cell demonstrating a strong and active metabolism



Viable cells in a dormant, damaged or injured state may be considered as non-vital.

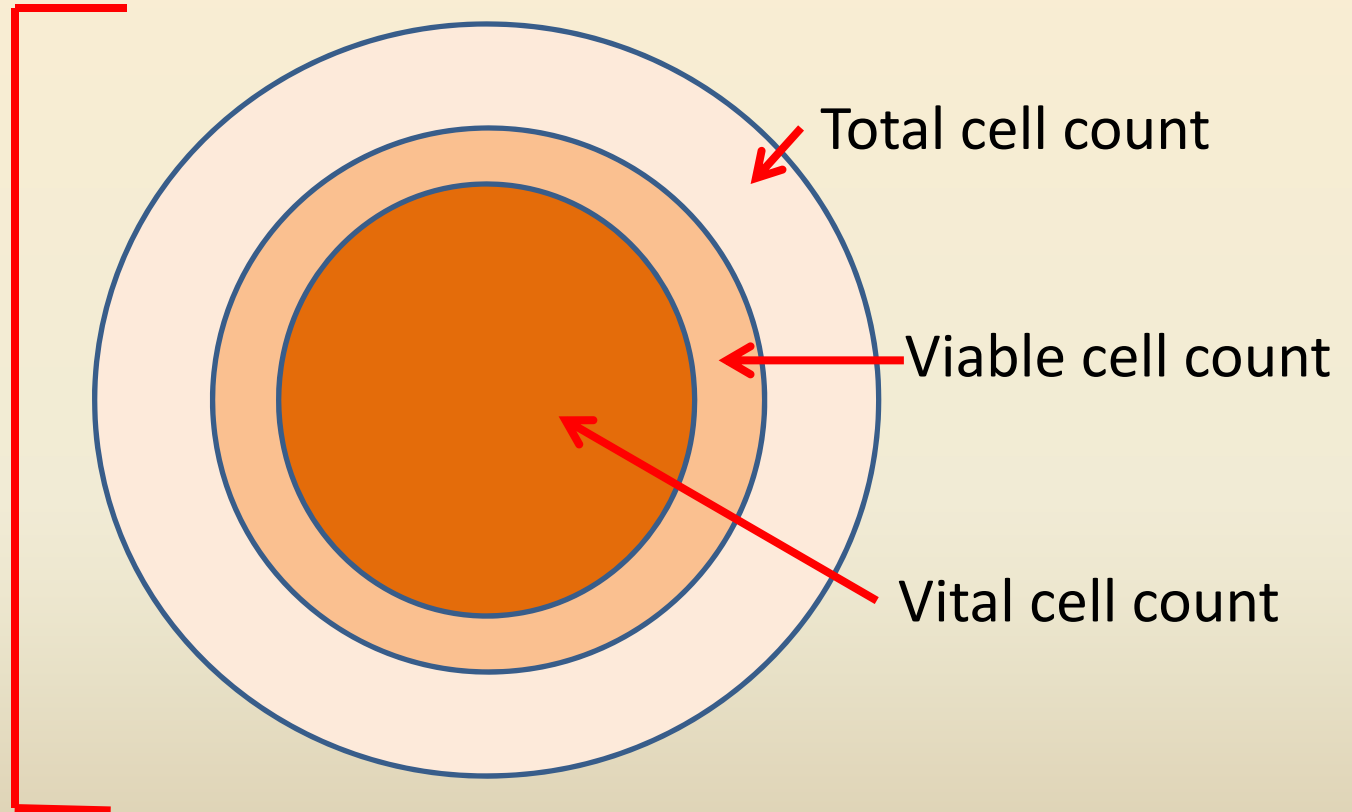
Overall brewing fitness

A definition that applies to a population of yeast:

A sufficient **number of viable cells** with a **level of vitality** that results in the fermentation of the brewing wort in a timely manner to achieve a product with consistent quality.

Measuring brewing fitness

Brewing
fitness of a
population



Measuring brewing fitness

Each method provides somewhat different information

Manual methods

Light absorbance – VIS spectro (total count)

Staining and light microscopy (total + vital count)

Plating on semi-solid nutrient agar (viable count)

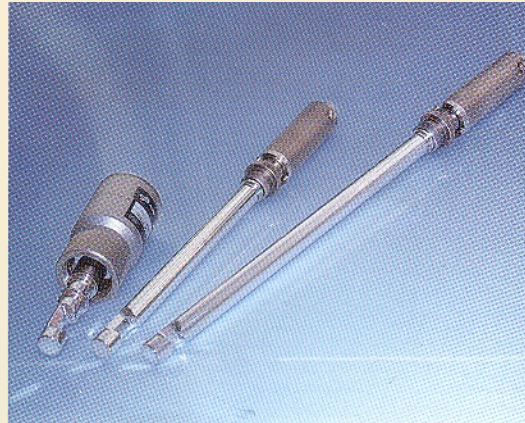
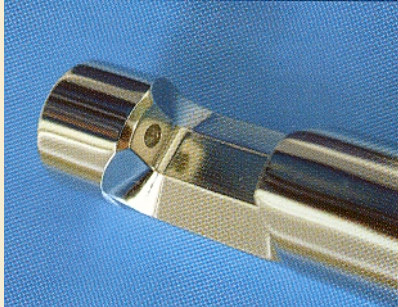
Automated methods

Light absorbance – IR probe (total count)

Staining & image analysis (total + vital count)

Capacitance probe (vital count)

Light absorbance

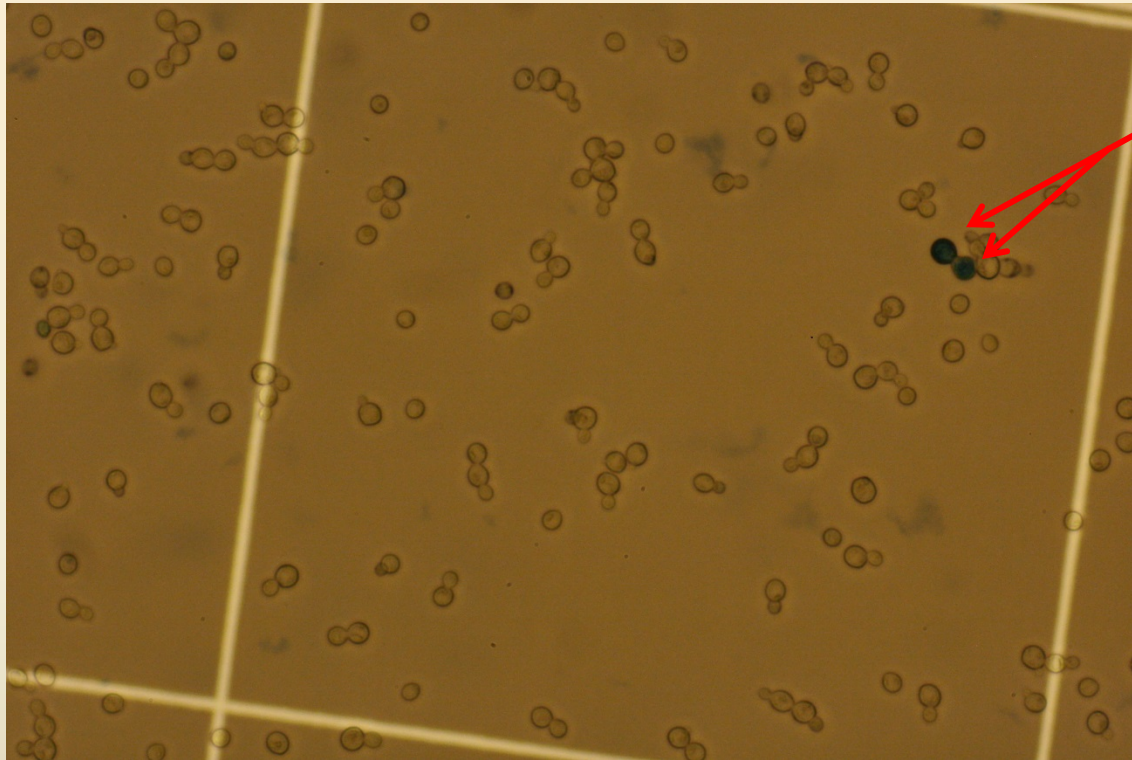


The on-line OPTEK turbidity probes use the principle of Near-Infrared (NIR) absorbance to measure cell concentration.

Off-line spectrophotometers require a calibration curve of absorbance units (AU) vs cell number and cannot differentiate live from dead cells.



Staining & light microscopy



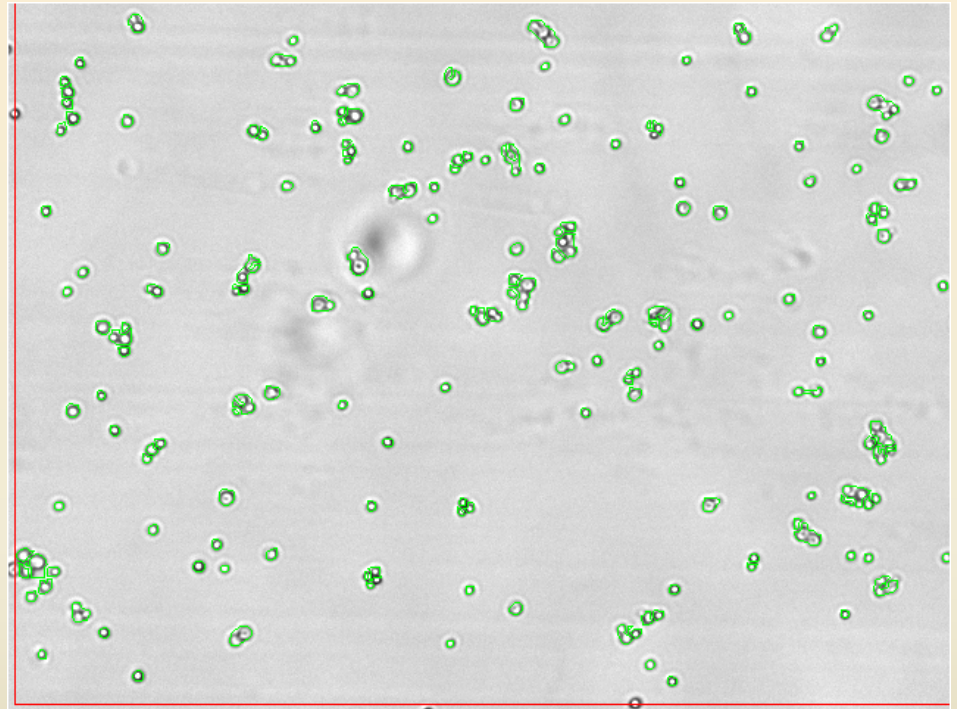
Dead cells

Yeast population stained with methylene blue and mounted on a hemocytometer grid for enumeration under a light microscope

Staining & image analysis

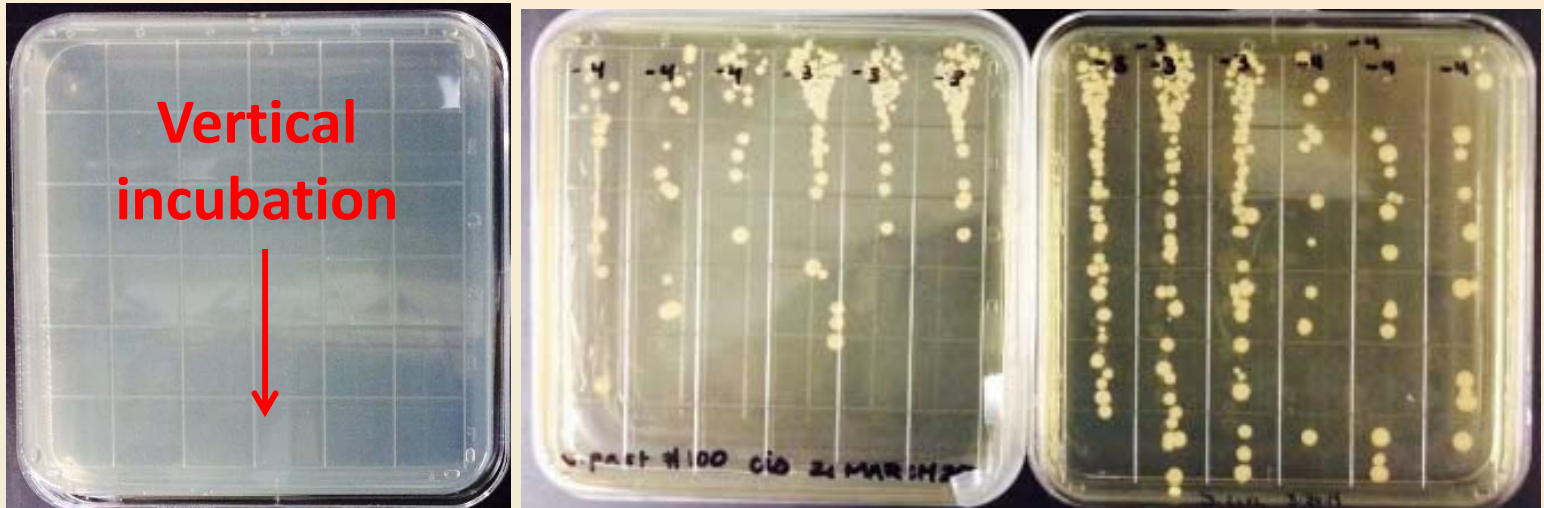


Nexcelom Bioscience
Cellometer (CEV-2520) with
additional Fluorescence optics
module VB-595-502.



Identification of cells based on
shape & size

Plate counting on nutrient agar



A measured volume of cell suspension with a known dilution factor is introduced at the beginning of each “lane”.

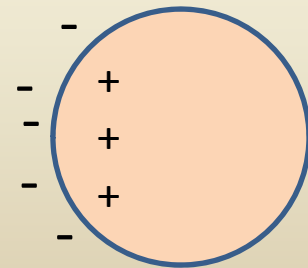
After 24-48 hours , the viable cell count is calculated based on the specific dilution factor and on the assumption that each colony was formed from an individual cell.

Population capacitance

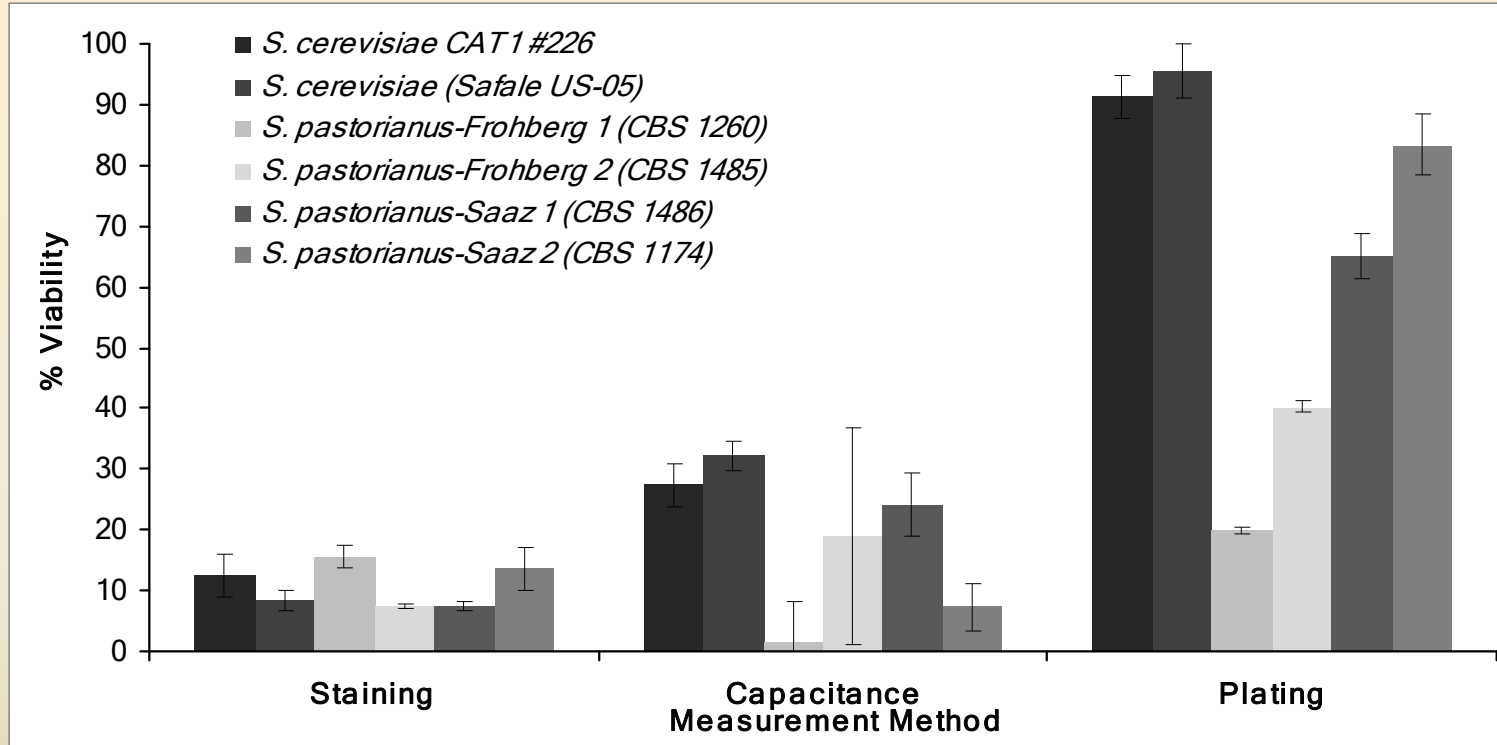


After correcting for solution conductivity, the capacitance of the population is proportional to the total number of viable/vital cells and their surface area/volume ratio.

Damaged or dead cells do not contribute to capacitance due to leaky membranes.

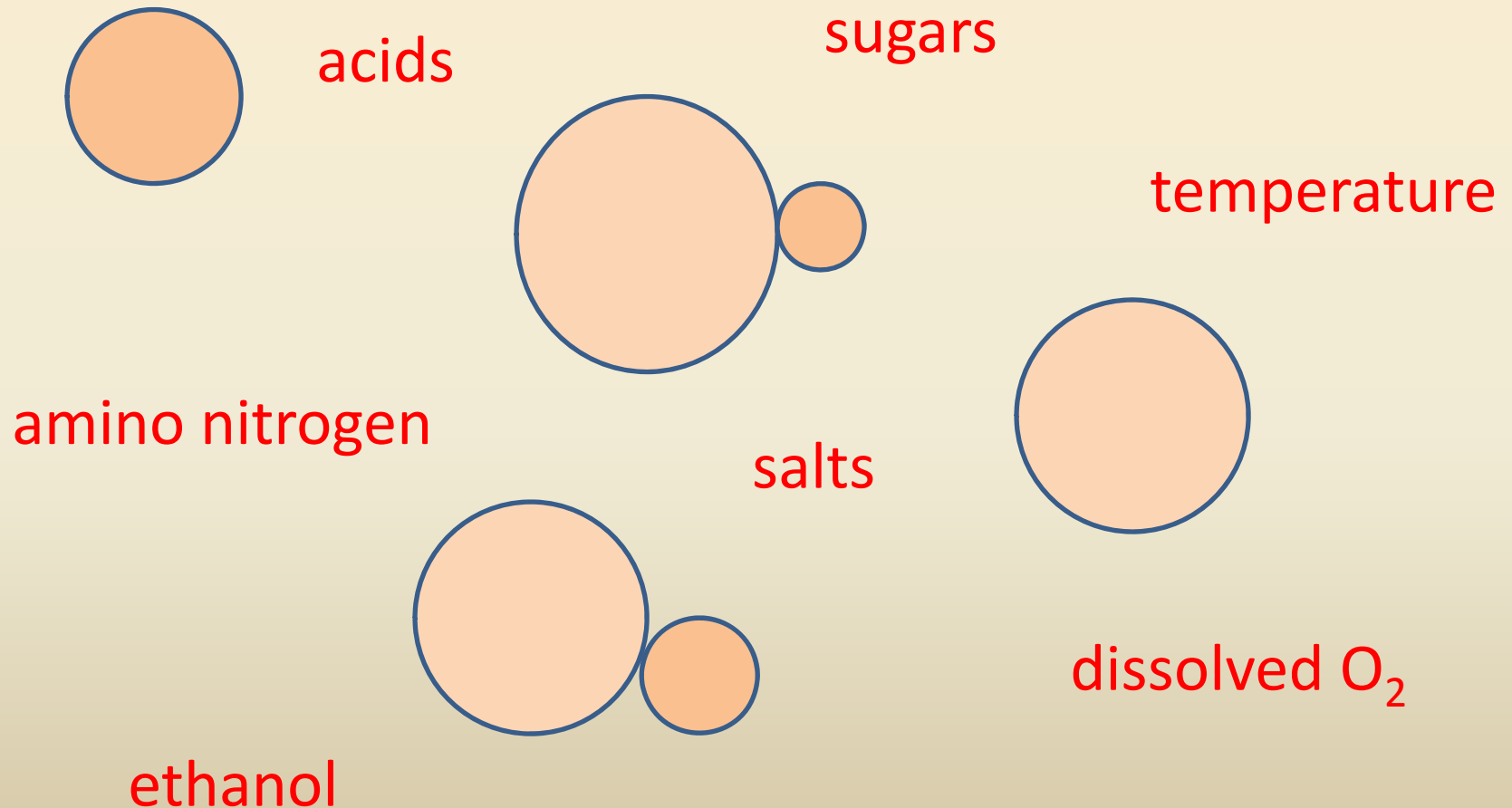


Different method = different info



Effects of dehydration and rehydration on various lager yeast

Cells & their environment: helpful or stressful



Maintaining brewing fitness

Keeping the yeast population healthy with a balanced environment:

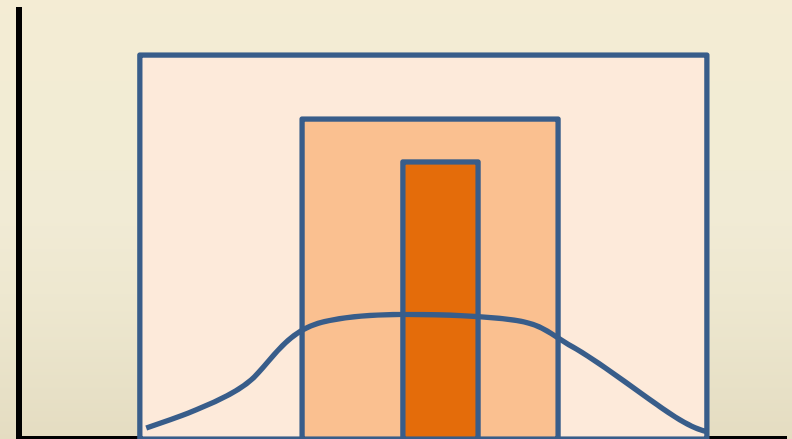
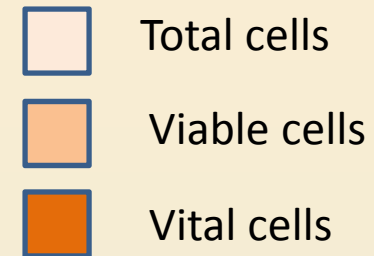
1. Provide a balanced nutritional environment
2. Provide adequate exposure to dissolved oxygen
3. Avoid environmental shocks
4. Avoid long periods of storage
5. Maintain culture homogeneity

Environment impacts the brewing fitness

Low level of brewing fitness:

Cells are poorly adapted, damaged or in an unfavorable environment to maintain viability & vitality

A broad distribution of cells within the population:



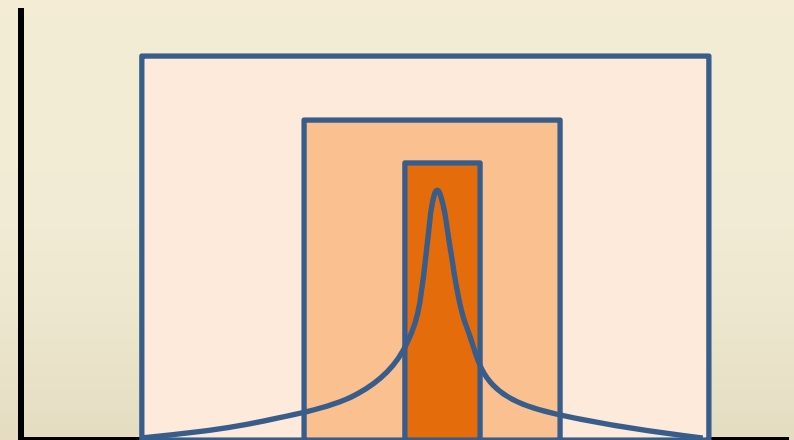
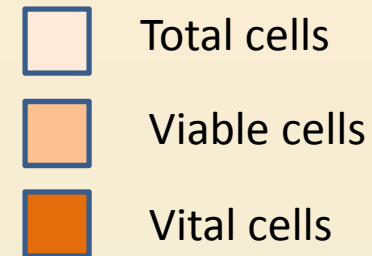
Example: 50% viability, 20% vitality

Environment impacts the brewing fitness

High level of brewing fitness:

Cells are well adapted, metabolically active and in a favorable environment to maintain viability & vitality

Narrowing the distribution within the population:

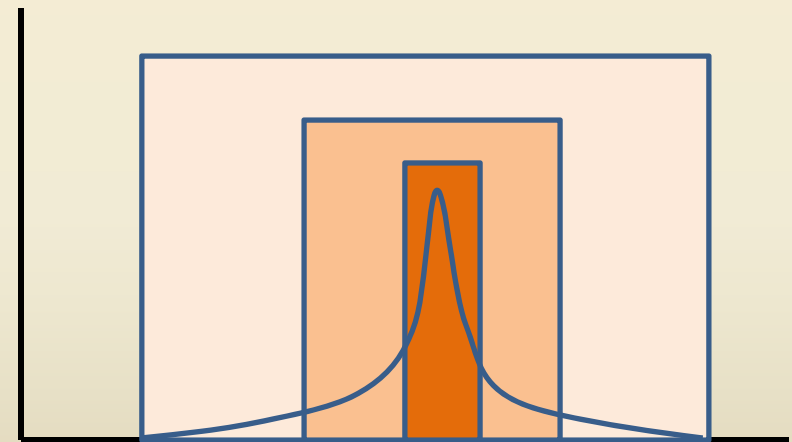
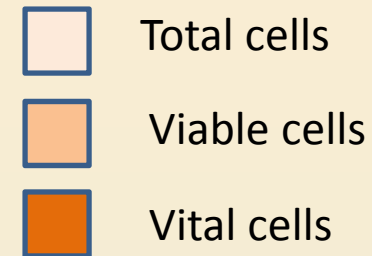


Example: 95% viability, 85% vitality

Uniformity within the population

Advantages:

1. Accurate assessment of pitching rate
2. Predictable fermentation performance
3. Consistent product quality
4. Resistance to contamination



Example: 95% viability, 85% vitality

Summary

1. Yeast management should focus on maintaining culture purity and brewing fitness to ensure an effective (re-) pitching strategy.
2. Brewing fitness of a yeast population reflects the relative fractions of both the viable and vital cells.
3. Measuring and controlling brewing fitness in the population can be accomplished through a variety of analytical techniques and by ensuring the environmental conditions are suitable for your culture.

In conclusion



*Thank you
for your
attention!*

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