Brewery Lab & Quality Control

YEAST ESSENTIALS 2.0

ESTD 1995
WHITE LABS
PURE YEAST & FERMENTATION

Outline

- Why & how to start a QC program
- Overview of testing
- Identifying contaminants
- Putting it all together- being a real scientist ☺

Why a Quality Control Program?

-Consistent beer from batch to batch

-Predictable fermentation rates

-Consistent flavor profile

-Detection, identification, and control of brewery contaminants

-Allows you to be preventative, not reactive

Where to Start?

Budget

Time

Goals

Goals for your lab

Goals

-Yeast health & management

-Clean Brewing process

-Predictable Fermentations

-No undesirable off flavors

-Identify contaminants

What You Need to Know

-Cell counts, viability, morphology

-Meaning of clean & Forced Wort testing

-Forced Fermentations

-Forced diacetyl testing

-Media plates & Gram staining

Cell Counts/Yeast Morphology

- Knowing the concentration of cells in a slurry prior to pitching is a prerequisite for calculating the correct amount of yeast to pitch
- The yeast pitching rate has a great impact of the performance, yeast derived flavor compounds, as well as the longevity of a yeast culture
- *Bonus effect*: Visual evaluation of the yeast culture helps the brewer understand the state of the culture

Yeast Viability and Vitality

- Definition of “viability”

“Capacity of a Cell to Exhibit Life Functions”

DEAD OR ALIVE

- Definition of “vitality”

“Yeast Activity or Physiological Health” Or “Potential To Endure Stress and Still Perform”

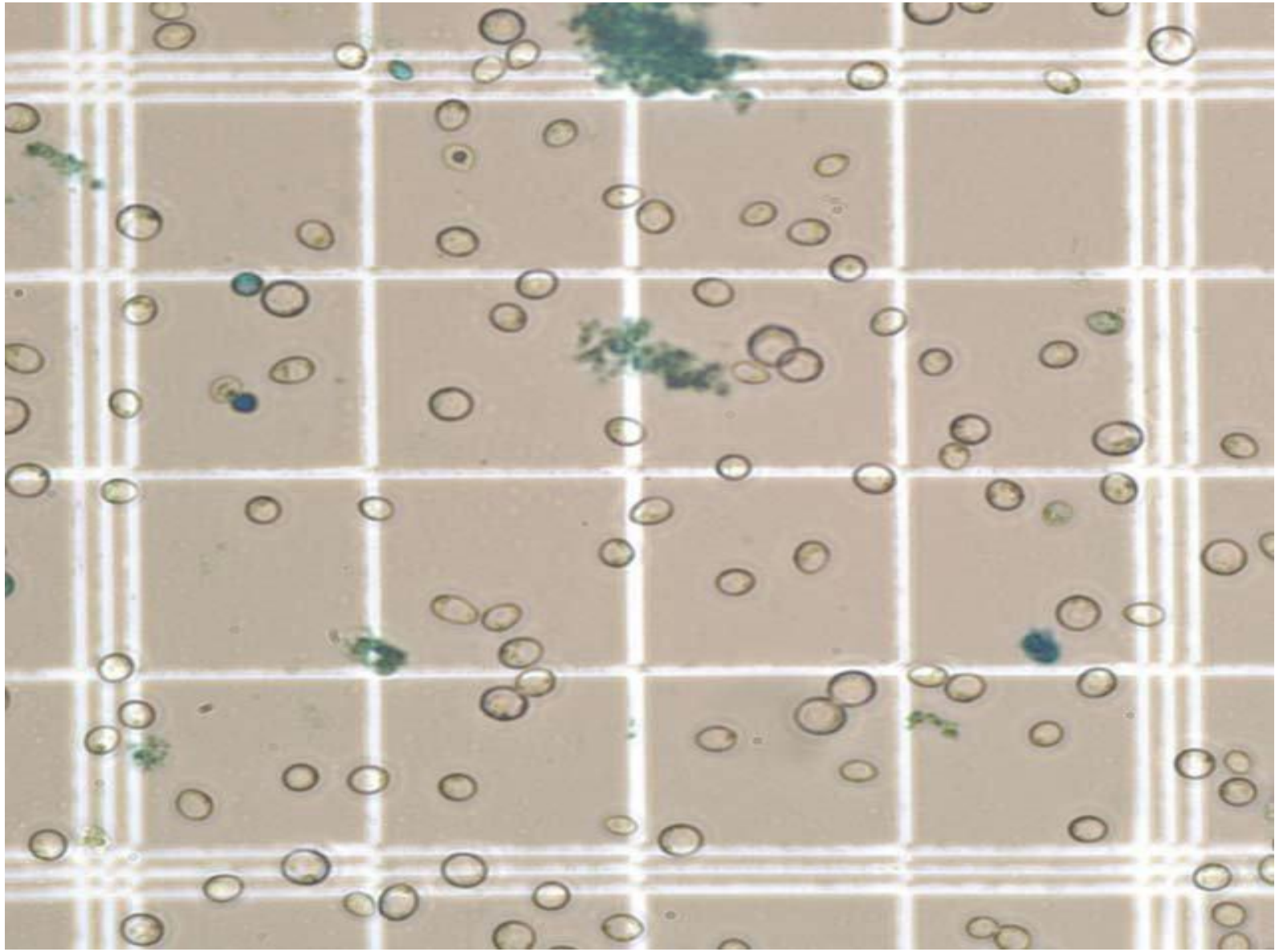
METABOLIC FITNESS

Yeast Viability Assay

Methylene Blue staining method

Pros: Quick, easy, inexpensive

Cons: can be inaccurate, great risk of human error in the dilutions



The Meaning of Clean

Definitions:

Clean – soil reduced to an acceptable level. Usually done with a combination of water and detergent

Sanitized – viable organisms reduced to an acceptable level on a clean surface.

Sterile – all organisms including spores and viruses are completely destroyed.

Cleaning & Sanitizing

"If you don't get it clean the first time, try, try again"

Frequency of cleaning
Length of exposure time to cleaning/sanitizing

- Important to have SOPs for these procedures and audit when necessary
- What works for one brewery might not work for you
- Check with your chemical manufactures to make sure you're using them correctly
- ATP meters to check for cleanliness

Forced Wort Testing

- Simple, affordable and effective way to check that the hot side of the brewing process is clean.
- After you have cooled, oxygenated, and transferred the wort, you collect a small amount prior to pitching the yeast.
- Incubate this sample, and look for evidence of contamination.

Results

- Clear wort = Beer is clean
- Cloudy wort or wort with bubbles = contamination

Duration	Result
1 day	Very dirty, clean heat exchanger and hoses. Beer will need to be dumped.
2–3 days	Major contamination. Need to clean problem, beer most likely will be affected. Do not collect yeast for re-use from this batch.
3–6 days	Mild contamination build up, clean problem. Beer may or may not be affected.
7 or more	Very clean, keep up the good work

Forced Fermentations

- You force the fermentation to the max attenuation with high temp and constant stirring

- Once the activity stops→take a specific gravity reading. This is your lowest gravity with this wort & yeast combination.

Forced Diacetyl Testing

- Forcing conversion of precursor to diacetyl with heat and oxygen
  - Mr. → water bath (140-160°F)
  - Mrs. → Room temperature

10-20 min

Cool

Smell

Results

Room Temp Beer	Heated Beer	Conclusion
Negative	Negative	No precursor present, beer is ready to go
Negative	Positive	Precursor present, beer needs more time on yeast
Positive	Positive	Beer is loaded with precursor or possibly contaminated

Contamination Detection

Use your senses:

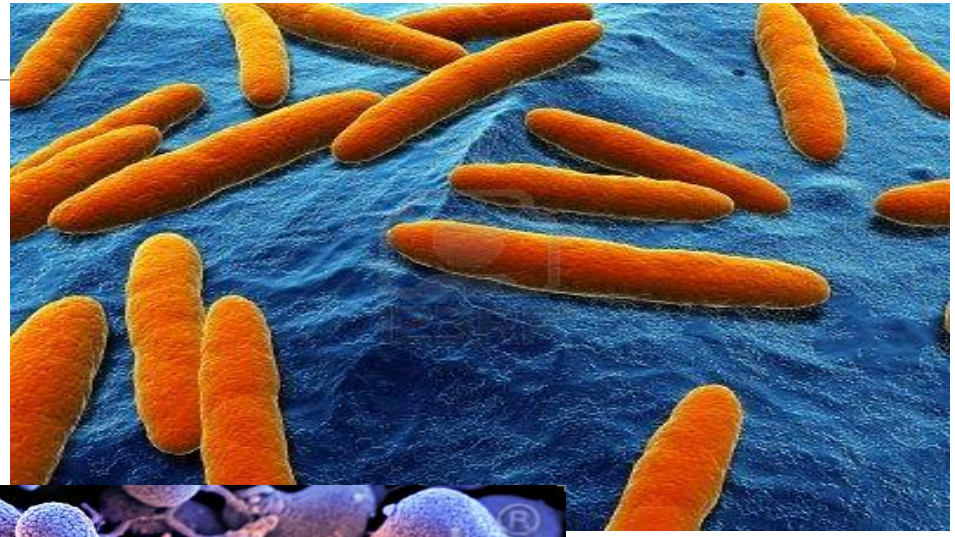
- Smell
- Taste
- Sight

Implement media into your QC program:

- Selective media plating
- Environmental plates in the brewery

The Contaminants

Acetic Acid Bacteria



Gram-negative rods

beer spoilers

Aerobic (don’t survive in the absence

Acetobacter

Gluconobacter

Contaminants

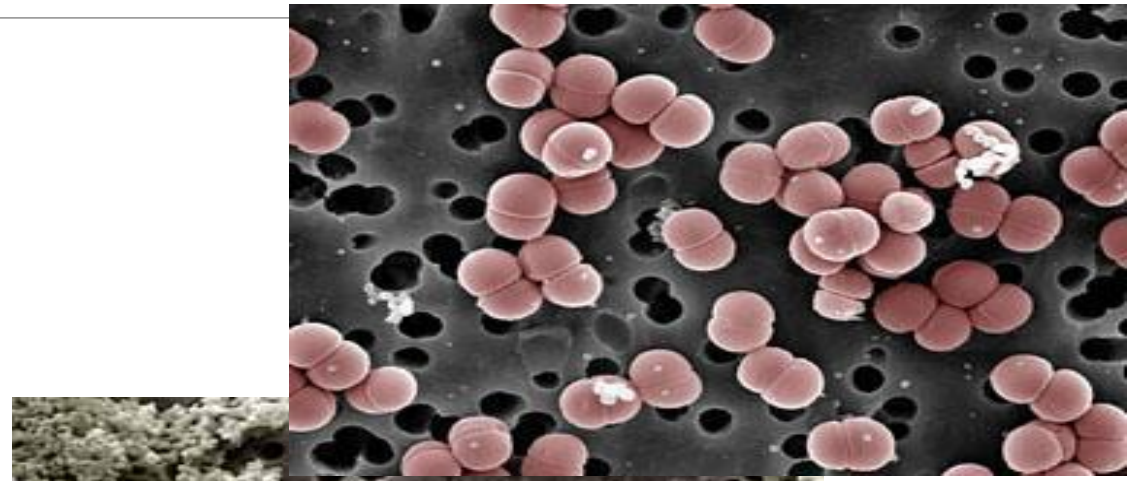
Lactic Acid Bacteria

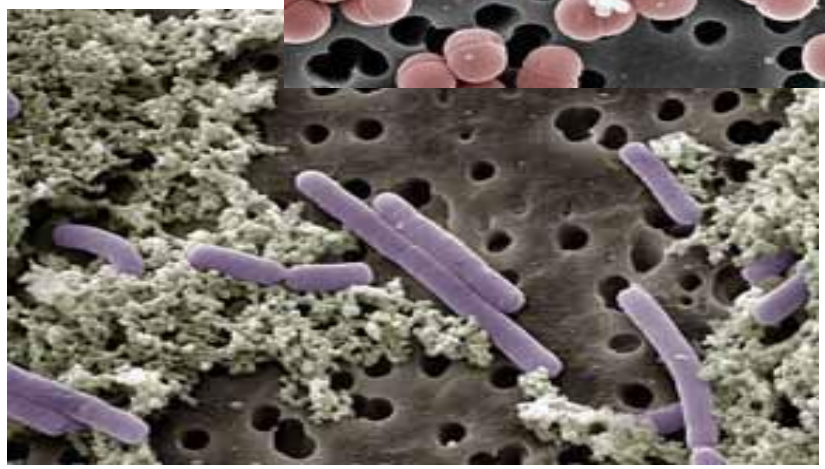
Gram-positive rods or cocci

Aerotolerant anaerobes

Temperature tolerant
(2-53°C)

Optimum temperature 30-40°C





Contaminants

Wild Yeast

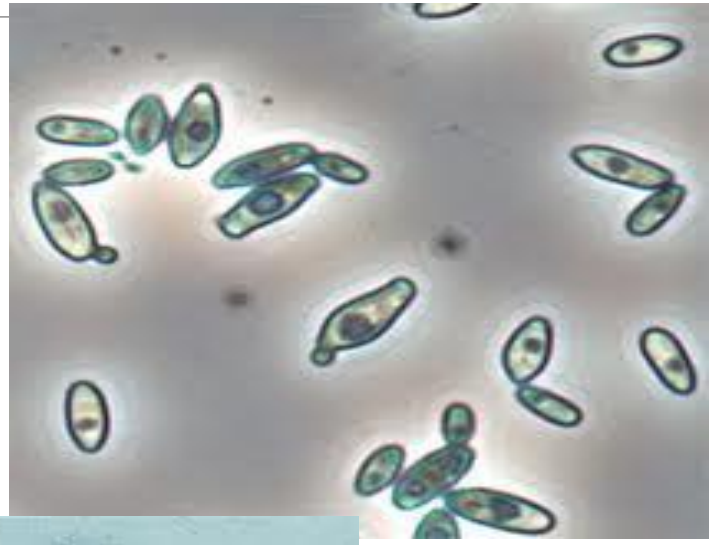
Gram-positive cocci, lemon, football, or elongated

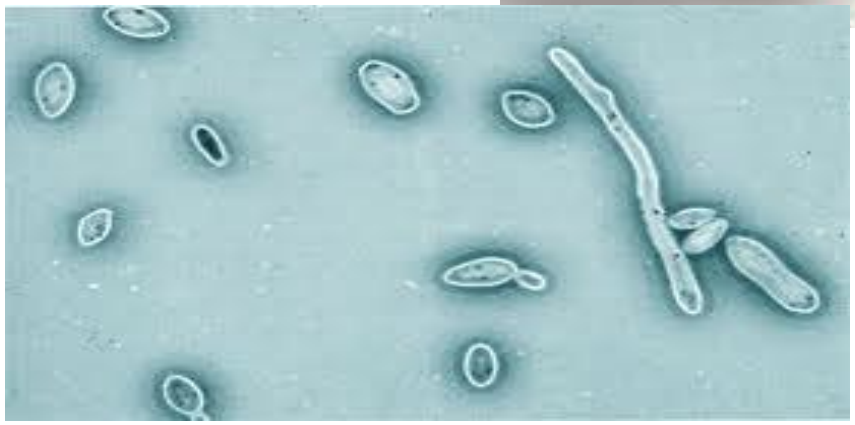
Temperature tolerant
(2-53°C)

Optimum temperature 30-40°C

Alcohol tolerant

pH tolerant (down to 3.0)





Identification

Selective or Differential Growth Media

- Growth of organisms based on environmental and metabolic conditions
- Involves specific substrates and inhibitory compounds

Wallerstein Differential Media (WLD)

Lin's Cupric Sulfate Media (LCSM)

Lin's Wild Yeast Media (LWYM)

Hsu's Lactobacillus and Pediococcus Media (HLP)

Schwartz Differential Media (SDA/ LMDA)

Identification from Plates

You'll need a microscope

Not this

Identification from Plates

- Microscopy & Gram Staining (least expensive)

  Simple, rapid, and require minimal equipment and training
- Differentiate organisms by:

  Cell morphology (shape & grouping)

  Gram-positive or negative (purple or red)

Pros: Easy, cheap, relatively quick

Cons: Requires some microbial knowledge and skills.

Identification

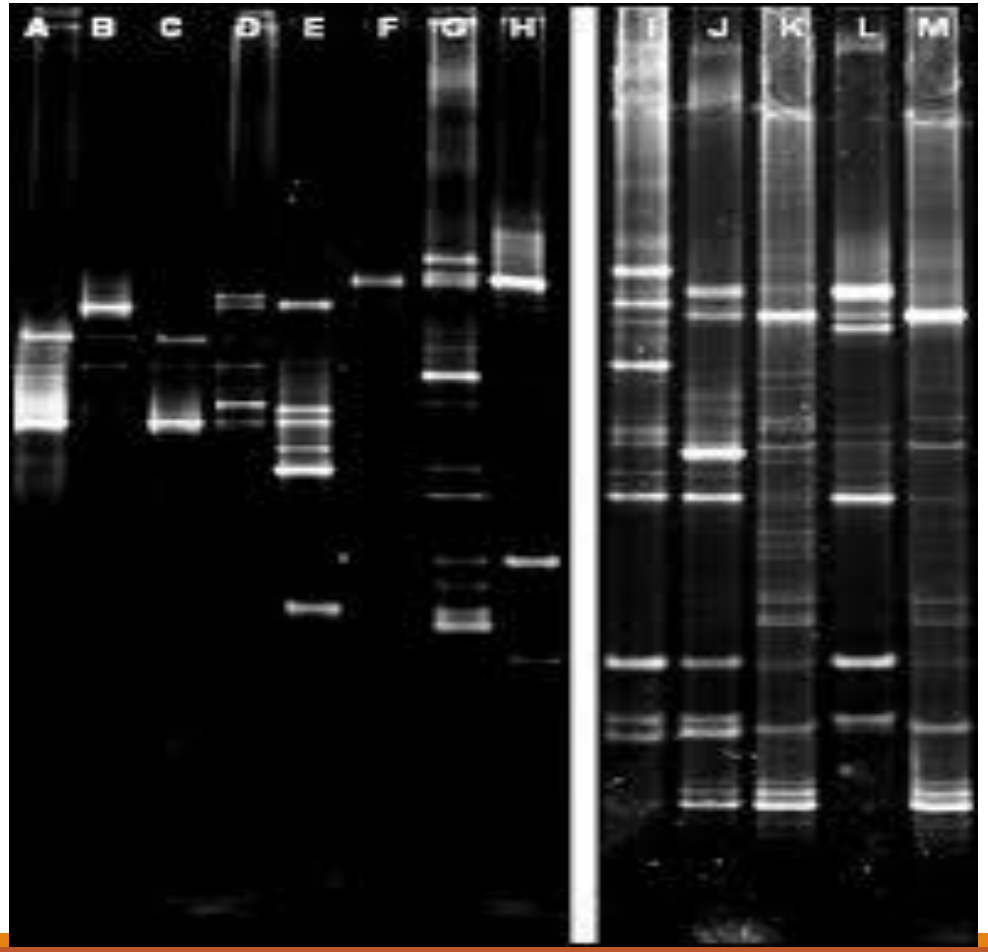
Various Tolerance Tests

- Oxygen tolerance (aerobic vs. anaerobic)
- Catalase positive or negative
- Oxidase positive or negative

Identification

Advanced Genetic Technology

- PCR, Genetic sequencing
- Results can take weeks



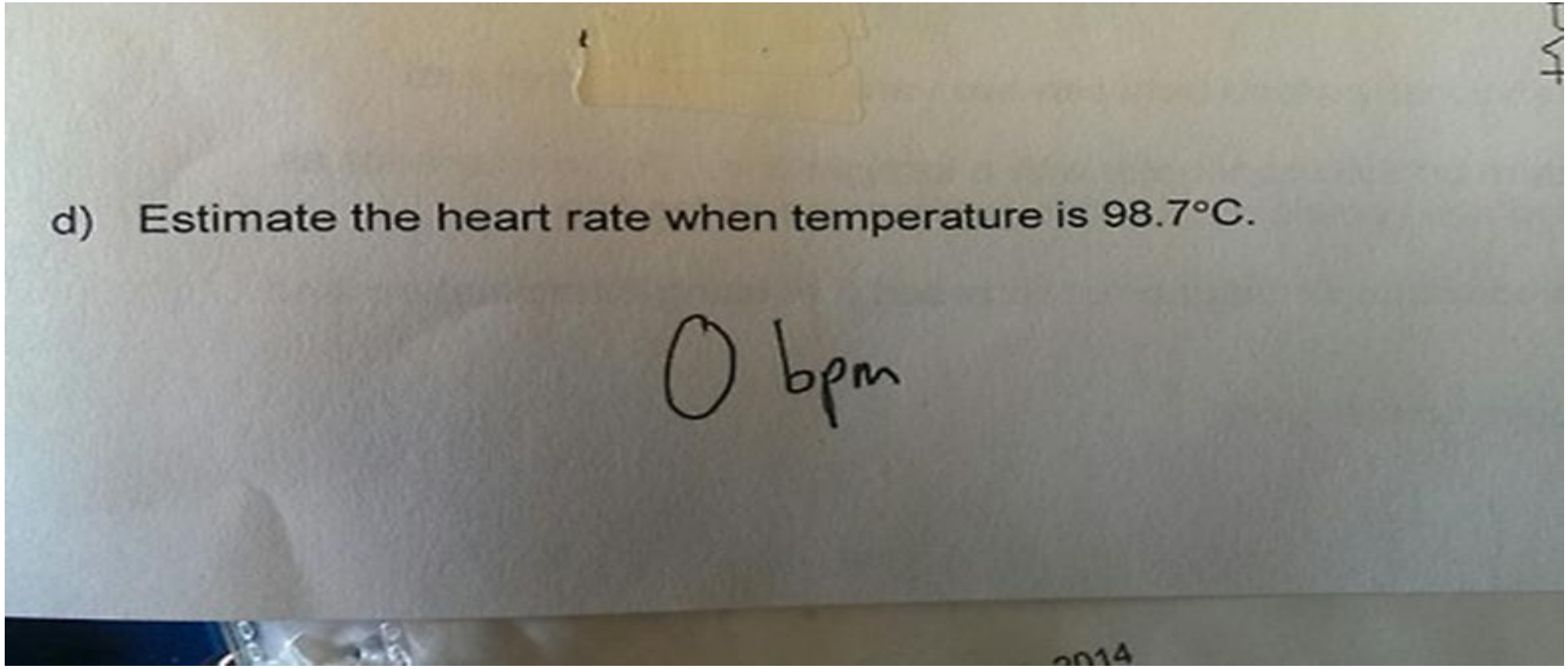
Putting it all Together

- Record keeping is key-
  - starting gravity, ending gravity over time, fermentation temperatures, pitch rates, pH readings, etc.

- Develop your testing program-
  - Set your limits
  - Set your timelines
  - Protocols

  - Communicate with your staff

Being a Real Scientist



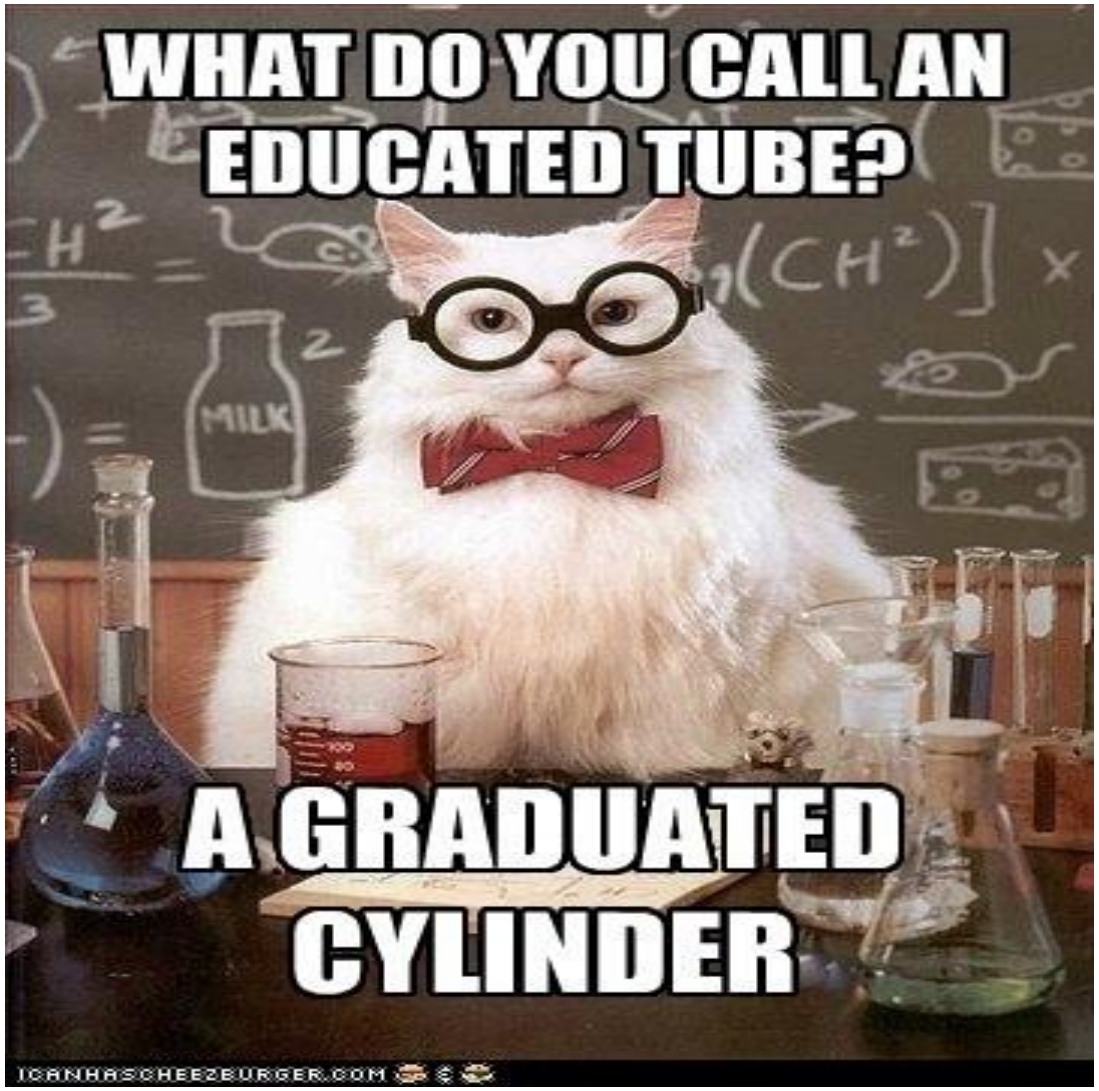
Bottom Line

Even small lab programs can benefit your end product

Start with a microscope and build from there

Have good record keeping

Be proactive, not reactive!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Thank You

Questions?