

Fantastic Yeasts and Where to Find Them

Stephen Bux, Eli Anhder, Andrew Coulup

Medical Laboratory Science

Mentor: John Rasmussen, Ph D.



Abstract

Yeasts are one of the most ubiquitous organisms found on the planet. They are used extensively in industry and are associated with clinical infections. The aim of this study was to determine growth characteristics of six different yeast strains on a variety of carbon sources. The yeast strains were grown on yeast nitrogen base agar plates containing 2% dextrose, sucrose, maltose, lactose, raffinose, and galactose. Plate growth experiments were carried out in aerobic and anaerobic conditions. All yeasts displayed a positive growth on all carbon sources in both aerobic and anaerobic conditions except lactose, which displayed no growth in either condition. These six yeasts were also cultured in liquid yeast nitrogen base culture with 4% dextrose, lactose, raffinose, and sucrose. The lactose cultures for all yeasts did not produce growth and all other carbon sources had positive growth. Lactose is a gal(β1→4)glu disaccharide. Yeasts do not have a β-galactosidase enzyme and are unable to process lactose. The inability to utilize lactose causes the yeast cells to starve and die.

YEAST TESTED:

- ☐ IA07 (1)
- ☐ IB56 (2)
- ☐ *Saflager 34/70* (3)
- ☐ *Brettanomyces clausenii* (4)
- ☐ *Candida albicans* (5)
- ☐ *Fleishman's Active Dry* (6)

CARBON SOURCES TESTED:

- ☐ Galactose
- ☐ Dextrose
- ☐ Sucrose
- ☐ Lactose
- ☐ Raffinose
- ☐ Maltose
- ☐ Sucrose



Figure 1: Aerobic and Anaerobic Testing on 2% solid agar

Materials and Methods

- Each of the 6 yeasts were plated on agar plates containing Yeast Nitrogen Base (YNB) and 2% of galactose, dextrose, sucrose, maltose, lactose or raffinose.
- The plating was done in duplicate for growth in aerobic and anaerobic conditions.
- Plates were incubated at room temperature for 14 days.
- Growth was visually measured by examining the plates for the presence of colonies, and results were recorded. (See Fig. 1, Tables 1 and 2)
- The 6 yeasts were then inoculated in 4 test tubes each that contained YNB liquid media and a 4% solution of either dextrose, sucrose, lactose, or raffinose.
- Each yeast was also inoculated in a fifth test tube that only contained the YNB media and would serve as a negative control for the experiment.
- Tubes were incubated at room temperature for 14 days.
- Growth in each test tube was visually measured based on turbidity, and results were recorded. (See Fig. 2 and Table 3)

DISCUSSION

- Primary testing using yeast nitrogen base solid agar plates containing 2% sugar grown in both aerobic and anaerobic environments produce growth on each plate, barring Lactose
- Secondary testing using liquid yeast nitrogen base culture with 4% sugar grown in aerobic conditions demonstrated positive growth in every tube except for the media containing lactose.
- Yeasts do not have a β-galactosidase enzyme to break the gal(β1→4)glu bond contained in lactose and are unable to utilize lactose as an energy source.
- Further testing required to quantify how much, if any, of the lactose media the yeasts can use without having the β-galactosidase enzyme.
- Raffinose contains gal(α1→6)glu and glu(β1→2)fru bonds and could support yeast growth.
- Further studies should be performed to determine if yeast species do not contain any copies of β-galactosidase or simply a lactamase enzyme.

TABLE 1 Growth of Yeast on 2% Sugar Solid YNB Media Under Aerobic Conditions

| Yeast (#) | Galactose | Dextrose | Sucrose | Lactose | Raffinose | Maltose |
|------------------------------------|-----------|----------|---------|---------|-----------|---------|
| IA07 (1) | + | + | + | - | + | + |
| IB56 (2) | + | + | + | - | + | + |
| <i>Saflager 34/70</i> (3) | + | + | + | - | + | + |
| <i>Brettanomyces clausenii</i> (4) | + | + | + | - | + | + |
| <i>Candida albicans</i> (5) | + | + | + | - | + | + |
| <i>Fleishman's</i> (6) | + | + | + | - | + | + |

Note: (+) positive for growth, (-) negative for growth

TABLE 2 Growth of Yeast on 2% Sugar Solid YNB Media Under Anaerobic Conditions

| Yeast (#) | Galactose | Dextrose | Sucrose | Lactose | Raffinose | Maltose |
|------------------------------------|-----------|----------|---------|---------|-----------|---------|
| IA07 (1) | + | + | + | - | + | + |
| IB56 (2) | + | + | + | - | + | + |
| <i>Saflager 34/70</i> (3) | + | + | + | - | + | + |
| <i>Brettanomyces clausenii</i> (4) | + | + | + | - | + | + |
| <i>Candida albicans</i> (5) | + | + | + | - | + | + |
| <i>Fleishman's</i> (6) | + | + | + | - | + | + |

Note: (+) positive for growth, (-) negative for growth

TABLE 3 Growth of Yeast in 4% Sugar YNB Liquid Media

| Yeast | Carbonless | Dextrose | Sucrose | Lactose | Raffinose |
|--------------------------------|------------|----------|---------|---------|-----------|
| IA07 | - | + | + | - | + |
| IB56 | - | + | + | - | + |
| <i>Saflager 34/70</i> | - | + | + | - | + |
| <i>Brettanomyces clausenii</i> | - | + | + | - | + |
| <i>Candida albicans</i> | - | + | + | - | + |
| <i>Fleishman's</i> | - | + | + | - | + |

Note: (+) positive for growth, (-) negative for growth

Conclusion

- The aim of this research was to determine the ability of various yeast strains to utilize different carbon sources. This was completed by using six different carbohydrates with varying glycosidic bonds in aerobic and anaerobic conditions on solid media. Lactose was the only carbohydrate that was non-utilizable in both conditions. This result was repeated when using liquid media. It was determined that the absence of a β-galactosidase in yeasts led to the no-growth phenotype that was observed. Since lactose contains a sole β-glycosidic bond, yeast strains are unable to survive on this carbon source.