Effect of Sugar Substitutes on Yeast

By Nathan Lucchino

Grade 9

Pittsburgh Central Catholic
Microbial Flora

• Normal populations of eukaryotic fungi, protists, and bacteria, varies between individuals
• Not much is known about the association between humans and their flora
• Effects can be mutualistic, parasitic, pathogenic, and commensal
• Normal Flora provide nutritional and digestive benefits, secrete vitamins, stimulate antibody production, and protect against pathogenic microbes
• Supplements/Foods consumed by humans might have unintended effects on these important functions of the flora
Splenda

- Artificial sweeteners used in cooking and baking measures.
- Main sweetener is sucralose
Sweet’n Low

• Low-calorie Artificial sweetener used to help lose weight.
• Main sweetener is saccharin.
Stevia in the Raw

- Zero calorie Novel sweetener used in drinks.
- Stevia leaf extract main sweetener.
Sucrose

- Also known as table sugar, used in cereals and sodas.
- A disaccharide made of glucose and fructose.
Yeast (*Saccharomyces cerevisiae*)

- Means “Sugar eating fungus.”
- Feeds on sucrose, fructose, glucose, and maltose, which it converts to cellular energy through alcoholic fermentation.
- Commonly referred to as “Baker’s Yeast”
- Most common cellular experimental model
Purpose

• To determine the effects of artificial and natural sweeteners on cell respiration in yeast.
Hypothesis

• Null- The sweeteners will not significantly alter cell respiration in yeast.
• Alternative- The sweeteners will significantly increase cell respiration in yeast.
Materials

- 125m Erlenmeyer flasks
- 12” balloons
- Red Star quick rise yeast
- Graduated cylinders
- Plastic tubs
- Stevia in the Raw
- Splenda
- Sweet’ n Low
- Test tubes
- Pipettes and pipette pumps
- Sucrose
- Scales
- Weigh boats
- Saran Wrap
- Scales
Procedure

1. Sucrose, Stevia, Sweet n’ Low, and Splenda were dissolved in sterile water at a concentration of (10%).

2. Sucrose, water, Splenda, Sweet n’ Low, and Stevia solution were added to 30 flasks in the ratios as follows:

3. 2 grams of Red Star rapid rise Cooking Yeast was added to each flask and balloons were immediately affixed to each flask.

4. The flasks were transferred to a warm (60 C) water bath.

5. After 60 minutes of incubation, each balloon was removed from the flask. (The balloon was pinched at the neck and twisted off to prevent gas leakage).
<table>
<thead>
<tr>
<th>Table 1</th>
<th>Sucrose Flask</th>
<th>Stevia in the Raw Flask x6</th>
<th>Splenda Flask x6</th>
<th>Sweet n’ Low Flask x6</th>
<th>Water Flask x6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeast</td>
<td>2g</td>
<td>2g</td>
<td>2g</td>
<td>2g</td>
<td>2g</td>
</tr>
<tr>
<td>Stock solution</td>
<td>5g</td>
<td>5g</td>
<td>5g</td>
<td>5g</td>
<td>5g</td>
</tr>
<tr>
<td>Water</td>
<td>45ml</td>
<td>45ml</td>
<td>45ml</td>
<td>45ml</td>
<td>45ml</td>
</tr>
<tr>
<td>Total</td>
<td>50ml</td>
<td>50ml</td>
<td>50ml</td>
<td>50ml</td>
<td>50ml</td>
</tr>
</tbody>
</table>
6. A plastic tub was filled with water.

7. Each graduated cylinder was filled with water to the brim and sealed with Saran wrap.

8. The cylinder was inverted and immersed into the water and the Saran wrap removed.

9. The balloon was placed into the water with the mouth placed into the cylinder.

10. The mouth was slowly released and the air was pumped into the graduated cylinder. The volume of gas was then recorded.
Sweetener Effect on Yeast Respiration (Water)

C02 Ev (mls)

<table>
<thead>
<tr>
<th>Sugar Substitute</th>
<th>Water</th>
<th>Sucrose</th>
<th>Stevia in the Raw</th>
<th>Sweet n' Low</th>
<th>Splenda</th>
</tr>
</thead>
<tbody>
<tr>
<td>C02 Ev (mls)</td>
<td>20</td>
<td>140</td>
<td>100</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

p value = $1.19 \times 10^{-12}$

Sugar Substitutes: Water, Sucrose, Stevia in the Raw, Sweet n' Low, Splenda
Sweetener effect on yeast respiration (Sucrose)

P-value $1.68 \times 10^{-12}$

Sugar Substitutes:
- Sucrose
- Splenda
- Stevia in the Raw
- Sweet n' Low
- Water
Key Questions

• Did the artificial sweeteners vary from the water sample (negative control)?

• Did the artificial sweeteners vary from the sucrose sample (positive control)?

• Dunnett’s Test
Dunnett’s Test (water sample)

<table>
<thead>
<tr>
<th>Group</th>
<th>T value</th>
<th>T crit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>18.07</td>
<td>3.48</td>
<td>Significant</td>
</tr>
<tr>
<td>Stevia in the Raw</td>
<td>12.68</td>
<td>3.48</td>
<td>Significant</td>
</tr>
<tr>
<td>Splenda</td>
<td>10.93</td>
<td>3.48</td>
<td>Significant</td>
</tr>
<tr>
<td>Sweet n’ Low</td>
<td>14.66</td>
<td>3.48</td>
<td>Significant</td>
</tr>
</tbody>
</table>
## Dunnett’s Test (sucrose sample)

<table>
<thead>
<tr>
<th>Group</th>
<th>T-value</th>
<th>Tcrit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>17.79</td>
<td>3.48</td>
<td>Significant</td>
</tr>
<tr>
<td>Splenda</td>
<td>7.11</td>
<td>3.48</td>
<td>Significant</td>
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<tr>
<td>Stevia in the Raw</td>
<td>5.4</td>
<td>3.48</td>
<td>Significant</td>
</tr>
<tr>
<td>Sweet n’ Low</td>
<td>3.47</td>
<td>3.48</td>
<td>Not Significant</td>
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</table>
Conclusion

• Reject null hypothesis- sugar and sugar substitutes significantly affected yeast respiration rate

• Also, the artificial sweeteners were less effective at promoting yeast respiration than sucrose.
Limitations and Extensions

• Wider balloons could be purchased to prevent ripping while attaching to the flasks
• The synchronizing of the flasks was not perfect
• Using different substitutes of sugar or a different yeast than the one(s) used
• Only cell respiration was tested, (growth curve, survivorship curve)
Works Cited

• www.Familydoctor.org
• www.todaysdietitian.com
• www.webmd.com/food-recipes/features/best-sugar-substitutes
• www.Redstaryeast.com