Cellular Respiration in Yeast

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For: Mr. Tucker

Cellular Respiration in Yeast

Question:
How does temperature affect the cellular respiration of microorganisms?

Hypothesis:
I think that really cold temperatures will not be good for microorganisms. The same is probably true for really hot temperatures. Slightly warm temperatures are probably the best for most microorganisms.

Research:
Cellular respiration occurs within the cells of organisms. They take in glucose (sugar) and oxygen and convert this into carbon dioxide, water, and energy. This chemical reaction can be represented in the following word equation:

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon Dioxide} + \text{Water} + \text{ATP}$$

It can also be represented by the following chemical equation:

$$C_6H_{12}0_2 + O_2 \longrightarrow CO_2 + H_2O + ATP$$

ATP or Adenosine Triphosphate is the primary energy carrier in living organisms.

Variables:
Our **Independent Variable** is the temperature of the water because this is what we will be changing.
Our **Dependent Variable** will be the amount of foam (carbon dioxide) produced by the yeast.
Our **Controlled Variables** will be:

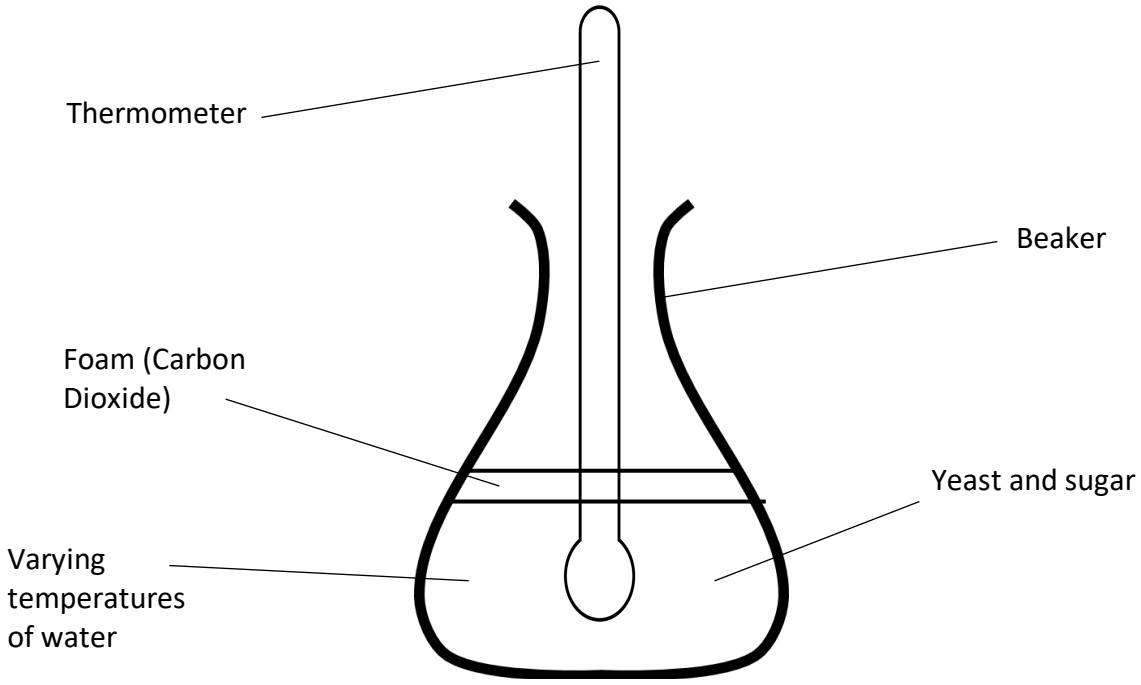
- the amount of water,
- the type of container,
- the amount of yeast,
- the amount of sugar,
- The time taken to stir the mixture, and
- the time between measurements.

Materials:

- beakers
- thermometer
- yeast
- sugar
- clock
- water

- ruler
- marker
- kettle
- fridge
- funnel

Diagram:

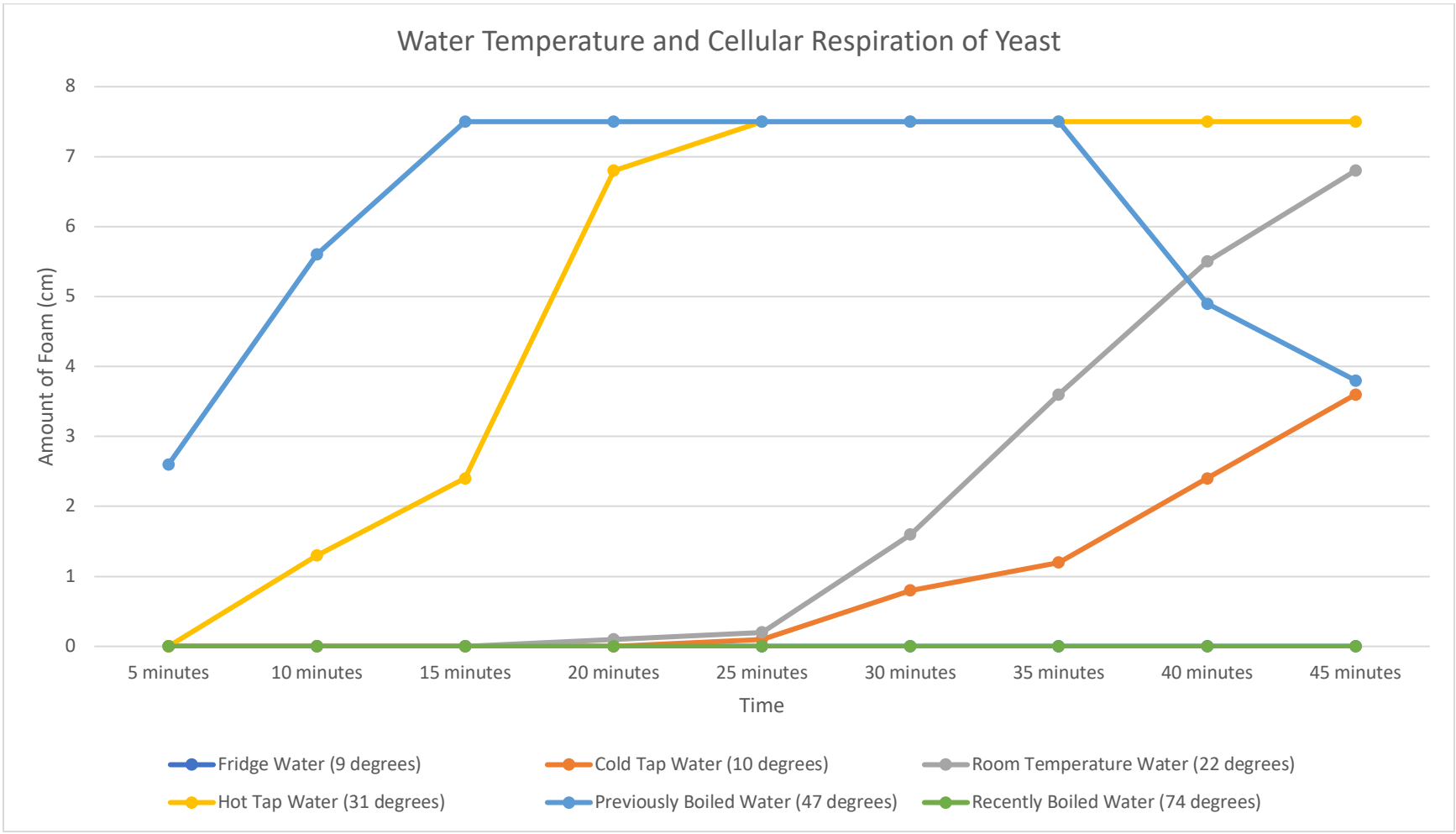


Procedures:

1. Prepare the water at 6 temperatures:
    a. Fridge water
    b. Cold tap water
    c. Room temperature water
    d. Hot Tap Water
    e. Recently boiled water
    f. Boiled water
2. Using the funnel, place 1 teaspoon of yeast and 2 teaspoons of sugar into each of beaker.
3. Pour a 100ml of water into each beaker. Vary the temperature of water in each of the beakers according to the list in step 1.
4. Stir the mixture in each beaker for 5 seconds at an even speed.
5. Measure the temperature of each beaker, record, and label.
6. In 5 minute intervals, observe the foam produced by the yeast and measure it with a ruler. Do this for 45 minutes.

Observations/Results:

Beaker	5 mins	10 mins	15 mins	20 mins	25 mins	30 mins	35 mins	40 mins	45 mins
Fridge Water (9°C)	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Getting less cloudy	Getting less cloudy	bubbles	bubbles
Cold Tap Water (10°C)	Cloudy; No foam	Cloudy; few yeast on the surface	Cloudy; several yeast on the surface	Small bubbles	1 mm foam	0.8 cm foam	1.2 cm foam	2.4 cm foam	3.6 cm foam
Room Temperature Water (22°C)	Cloudy; No foam	Cloudy; few yeast on the surface	bubbles	1 mm foam	2 mm foam	1.6 cm foam	3.6 cm foam	5.5 cm foam	6.8 cm foam
Hot Tap Water (31°C)	Yeast on the surface	1.3 cm foam	2.4 cm foam	6.8 cm foam	Overflowing; maxed at 7.55 cm	overflowing	overflowing	overflowing	overflowing
Previously Boiled Water (47°C)	2.6 cm foam	5.6 cm foam	Overflowing; maxed at 7.5 cm	Overflowing; bigger bubbles	overflowing	overflowing	Still bubbling but level of foam decreasing	Still bubbling but popping; 4.9 cm foam	Still bubbling but popping; 3.8 cm foam
Recently Boiled Water (74°C)	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam	Cloudy; No foam


Water Temperature and Cellular Respiration of Yeast
Amount of Foam (cm)
0
1
2
3
4
5
6
7
8
5 minutes
10 minutes
15 minutes
20 minutes
25 minutes
30 minutes
35 minutes
40 minutes
45 minutes
Time
Fridge Water (9 degrees)
Cold Tap Water (10 degrees)
Room Temperature Water (22 degrees)
Hot Tap Water (31 degrees)
Previously Boiled Water (47 degrees)
Recently Boiled Water (74 degrees)

Conclusion:

Our hypothesis was correct. Our results demonstrate that extreme hot and cold temperatures prevent cellular respiration. We know this because the test with 9°C and 74°C water created no foam. Meanwhile, the other tests created lots of foam. This foam is carbon dioxide (CO_2). Therefore, its abundance in these tests proves the process of cellular respiration took place.

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon Dioxide} + \text{Water} + \text{ATP}$$

$$C_6H_{12}0_2 + O_2 \longrightarrow CO_2 + H_2O + ATP$$

In our 47°C test, the foam decreased after 35 minutes. We think this does not demonstrate that cellular respiration stopped. Rather, it was simply that the bubbles were bursting. Why hypothesize that the bubbles will always begin to burst more after a period of time.

This lab is applicable to food and medical science. We know that low temperatures keep bacteria at rest. This is why we keep our fridges set below 10°C. Furthermore, medical tools will need to be sterilized through boiling in order to kill bacteria.