The Effect of Abiotic Factors on a Yeast Population

In this investigation, you will observe the effect of changes in abiotic factors on the growth of a yeast population. Yeast is a type of fungus and is often used in the production of bread.

Question

What are the optimal conditions for the growth of yeast?

Prediction

Predict what conditions of temperature, pH, and nutrient availability will be best for the growth of yeast.

Experimental Design

In this investigation, you will observe evidence of yeast growth under different experimental conditions. The population's cellular activity will be measured under different abiotic conditions.

Materials

- 8 large clean test tubes labelled #1–#8
- 25 mL graduated cylinder
- 3 600 mL beakers
- thermometer
- measuring spoons
- active dry yeast
- sugar
- vinegar (acid)
- ammonia solution (base)
- pH paper
- ice
- safety goggles

INQUIRY SKILLS

○ Questioning	● Conducting	● Evaluating
○ Hypothesizing	● Recording	● Synthesizing
● Predicting	● Analyzing	● Communicating
○ Planning		

Acids and bases, even weak ones, can cause irritation to skin. If any acid or base solution is spilled, clean it up immediately. If any solution falls on skin, flush it well with running water. Report any instances to your teacher.

Procedure

Part 1: The Effect of Temperature on Yeast Respiration

1. Read through the Procedure and copy the tables to record your observations in each part. Remember to give your tables a title.
2. Put on your safety goggles. Prepare three separate water baths in the 600 mL beakers: one bath at 0 °C (containing ice water), one bath at 50 °C, and one bath near 100 °C.
3. Measure 2.5 mL of yeast and 2.5 mL of sugar into three separate test tubes labelled #1, #2, and #3. Add 10 mL of room-temperature water to each of the test tubes. Place one test tube into each of the three water baths.
4. Leave the test tubes in the water baths for 15 min. Record your observations in Table 1. While you are waiting, set up Part 2 of the Investigation.

Table 1

Test tube	Temperature	Observation
#1	0 °C	
#2	50 °C	
#3	100 °C	

Part 2: The Effect of pH on Yeast Respiration

5. Measure 2.5 mL of yeast and 2.5 mL of sugar into another set of test tubes labelled #4, #5, and #6. Add 10 mL of water to test tube #4. Add 10 mL of acid solution to test tube #5. Add 10 mL of base solution to test tube #6.
6. Use the pH paper to determine the approximate pH of each solution. Place all three test tubes in the 50 °C water bath.
7. Leave the test tubes in the water baths for 15 min. Record your observations in Table 2. While you are waiting, set up Part 3 of the Investigation.

Table 2

Test tube	pH	Observation
#4		
#5		
#6		

Part 3: The Effect of Nutrient Availability on Yeast Respiration

8. Measure 2.5 mL of yeast into two test tubes labelled #7 and #8. Add 2.5 mL sugar to test tube #7. Do not add any sugar to test tube #8. Add 10 mL of room-temperature water to each test tube. Place both test tubes in the 50 °C water bath.
9. Leave the test tubes in the water baths for 15 min. Record your observations in Table 3.

Table 3

Test tube	Nutrient	Observation
#7	Sugar present	
#8	Sugar absent	

Conclusion

Complete the following items to answer the question posed at the beginning of the investigation.

Analysis

(a) What temperature was most suitable for the growth of yeast? Suggest a reason for this conclusion.

(b) What pH was the most suitable for the growth of yeast? Suggest a reason for this conclusion.

(c) What effect did the presence of sugar have on the rate of yeast growth?

Evaluation

(d) Did your observations support your prediction? Explain.

(e) Why was it important that all of the materials added to each test tube were accurately measured?

(f) Three test tubes containing water and sugar were placed in the 50 °C water bath. Did they all produce the exact same result? Explain any differences.

(g) For each of the three parts of this experiment, list the independent variable.

(h) Describe what measures were taken to ensure that each part of this experiment was controlled.

Synthesis

(i) How does this investigation show that biotic and abiotic factors are interacting?

(j) List three additional abiotic factors that you think might affect the growth rate of yeast.

(k) How can an understanding of abiotic factors assist farmers in finding the best farming techniques?

(l) Use the term "limiting factor" to summarize the observed effects of temperature, pH, and nutrient availability in this investigation.