

Yeast Investigations

Name

Introduction

Microorganisms include bacteria, fungi and viruses. Viruses can only grow and reproduce inside other living cells and so are not possible to work on in a school laboratory. In this practical you are going to work on a fungus. Yeasts are tiny egg shaped single celled fungi which can only be seen with a microscope. They are so small that 1 gram of yeast contains 20,000,000,000 (twenty billion) cells! The species of yeast which you are going to use is called *Saccharomyces cerevisiae* which means ‘sugar eating brewer’ and it is an easy and safe microorganism to work with.

Yeast cells use a variety of sugar molecules to obtain energy. This process which is called fermentation produces two useful products, carbon dioxide and ethanol. In bread baking the yeast ferments sugars available from the flour and added sugar. The carbon dioxide gas cannot escape but the elastic and stretchable dough inflates as the bread ‘rises’. The alcohol vapourises during baking. In brewing the sugar is provided by fruit with added sugar or by the natural breakdown of starch into sugar in barley grain as it germinates. The alcohol remains in solution to form the wine or beer and the carbon dioxide escapes from the solution

Some of the following statements are true and some are false. In the box write T or F. For each false statement give the correct version.

| | |
|---|--|
| 1. <i>Saccharomyces cerevisiae</i> is a species of fungus | |
| 2. <i>Saccharomyces cerevisiae</i> is dangerous to work with | |
| 3. Yeasts can only use one type of sugar, sucrose, for energy | |
| 4. The products of fermentation are alcohol, sugar and carbon dioxide | |
| 5. In wine making there is enough sugar in the fruit to supply the yeast | |
| 6. The oxygen produced by the yeast makes the bread rise. | |

Yeast Investigations Worksheet

Name :

In this practical you are going to carry out investigations with yeast. When you mix fast action bread yeast with a sugar solution it starts fermenting and it produces a foam on the surface of the sugar solution. This can be done in a boiling tube. The depth of the foam can be used as a measure of how actively the yeast is fermenting.

The production of the foam is too slow at room temperature but yeast, like other microorganisms is killed by high temperatures.

1. 3g of dry fast action yeast (about ½ teaspoon) added to 30 ml sucrose solution (made by dissolving 10 g of sucrose in 100 ml of warm water) gives a reasonable depth of foam after 15 minutes. This can be used as a control. What is a control and why is it useful?

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2. How are you going to keep the tubes at a temperature of about 40 °C ?

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3. How are you going to label the tubes so you know which is which?

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4. **Plan** your investigation. Choose one of the following – circle it.

- (i) How is yeast activity affected by the type of sugar it is given?
- (ii) How is yeast activity affected by household products such as detergent, toothpaste, fizzy drinks, mouthwash etc.?
- (iii) Can yeast ferment sweeteners (e.g saccharin) as well as sugars?

- (iv) Other.....

You are going to measure the activity of the yeast by measuring the depth of the foam in the tube at a fixed time after adding the yeast to the sugar solution

5. What variable or factor are you going to **vary** or change? How are you going to change it?

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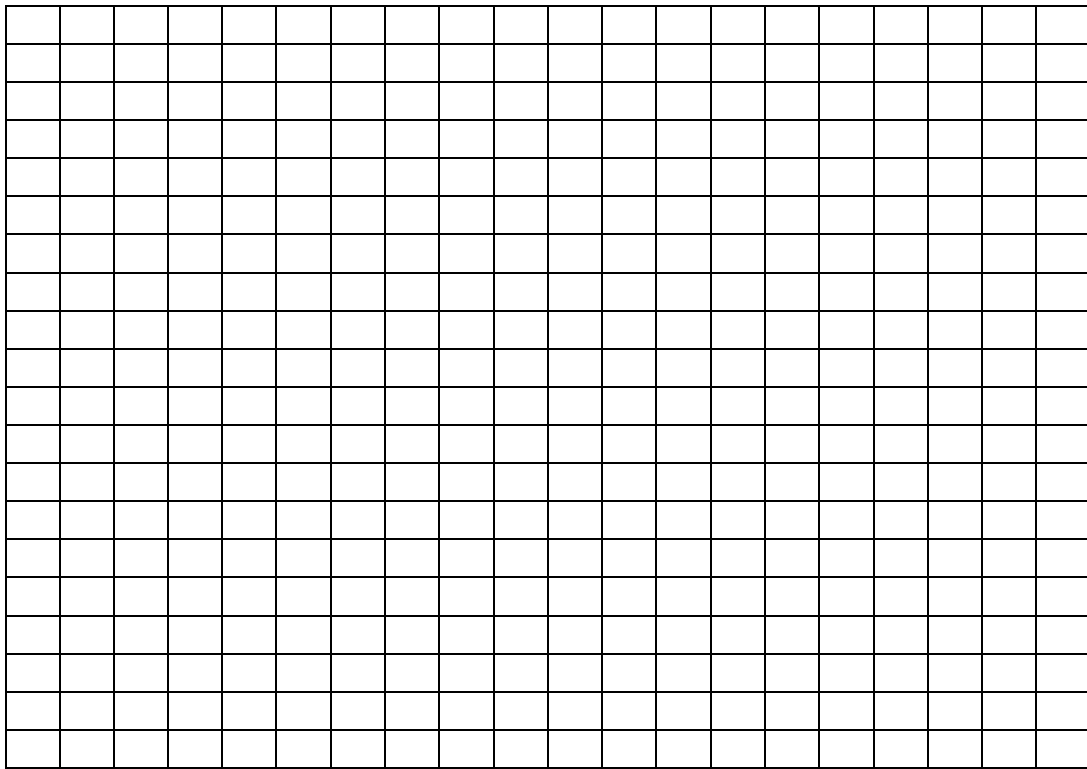
6. What other variables are going to affect the depth of foam in the tube? How are you going to keep these variables the same to make it a fair experiment? (Give precise details of what you are going to do.)

| Variable | How are you going to keep it constant? |
|---------------------------------|--|
| Amount of yeast | |
| Temperature | |
| Amount of sugar solution | |
| Concentration of sugar solution | |
| | |

7. Carry out your investigation as planned . Record your **results** in the table below.

| Tube number | Variable which was changed = | Depth of the foam after minutes |
|-------------|---------------------------------------|--|
| | | |
| | | |
| | | |
| | | |
| | | |

8. Draw a **bar chart** of your results. What you varied deliberately should be on the horizontal x axis and what you measured – the depth of the foam - should be on the vertical y axis.



9. What **conclusions** can you draw from your results?

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10. **Evaluation** Are the results what you expected? If not what do you think is happening? Were you wrong in how you thought yeast would react to the variable you changed? Or is there another variable which you did not think of or did not keep the same which is affecting the results?

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11. If you were doing this investigation again what improvements could you make?

.....

Yeast Investigations

Teacher's information sheet

There are many bacteria and fungi which you can get from suppliers which do all sorts of wonderful things but in my research for this module write it for a busy teacher whose TY science is just one part of a busy weeks preparation and teaching. The time and trouble and forethought required to order these microorganisms and the subculturing and care they require when they arrive so they are ready for the practical is for the specialist and enthusiast – and they are probably doing it already! There is also the safety aspect which all teachers are becoming more aware of. I therefore decided to stick to yeast – a really ‘safe to handle’ microorganism – and this practical uses fast action bread yeast which is obtainable in any supermarket.

If you are used to the yeast/hydrogen peroxide experiment in L.C. biology this foam production is much slower- but less messy! Different brands of fast action yeast may need different concentrations of sugar to get a reasonable amount of foam in 15 mins.

I do not let TY students near my ‘good’ balance so it is fine to get them to measure out the yeast in a way they can devise e.g. up to a mark on the end of a wooden splint and then recognise this as a source of error at the end.

Risk Assessment:

Risk:

Cuts from glassware

All work with microorganisms

Minimised by:

Handle with care

Wash hands after the practical

Apparatus and chemicals required:

For a class of 24

1. 3 packets of Fast Action bread yeast. This would give a sachet for each pair.
2. Sucrose – ordinary table sugar
3. Boiling tubes – each group will need at least 4
4. Beakers to use as water baths
5. Access to hot water (or cold water could be heated using the bunsen)

Involve students in the planning and bringing in the requirements below for their chosen investigation

6. A variety of sugars e.g. glucose (available from chemist), fructose, lactose.
7. A variety of household substances to use e.g. detergent, toothpaste, mouthwash, fizzy drinks etc
8. Saccharin, canderel and any other artificial sweeteners e.g. Seven up (contains sugar) and diet seven up (which contains aspartame)

Advance preparation:

1. Photocopy the introduction and worksheets – per student/ per pair of students.
2. Purchase the yeast and the sucrose.
3. If you separate the introduction and planning from the investigation then it gives students that very important opportunity to take ownership of what they are doing and get involved in bringing in the necessary bits and pieces – and as long as you have the sucrose and yeast you can supply the inevitable ones who don’t!

Suggested answers:

Introduction:

1. True.
2. False Saccharomyces cerevisiae is safe to work with.
3. False Yeast can use many types of sugar for energy
4. False The products of fermentation of sugar by yeast are alcohol and carbon dioxide
5. False Sugar is added to the fruit in wine making
6. False The carbon dioxide produced by the yeast makes the bread rise

Worksheet:

1. Control is a 'normal' situation which is useful for comparison
2. Put into a water bath or a beaker with warm water in it topped up every now and again.
3. The tubes must be labelled in a way which does not wash off in the water bath e.g. permanent marker / sticky labels.
4. Choice of project
5.
 - (i) type of sugar - sucrose, glucose, fructose etc
 - (ii) a few drops of different household products (detergent, toothpaste, fizzy drinks, mouth wash) will be added to each tube
 - (iii) use sugar / sweetener
 - (iv)
- 6.

| Variable | How are you going to keep it constant? |
|-----------------------------|--|
| Amount of yeast | Use the same amount of yeast in each tube |
| Temperature | All tubes in the same water bath / beaker |
| Amount of sugar solution | Use the same volume of sugar solution in each tube |
| Concentration of sugar soln | Use the same concentration of sugar solution |

7. Table of their results
8. Bar chart of their results
9. Conclusions based on their own graph which may or may not be what they(or you!) expected.
10. Other variables which may explain results
 - (i) Equal masses dissolved are not equal in terms of numbers of molecules of sugar available to the yeast because the molecules are of different masses.
 - (ii) Are the different substances having a biological effect on the yeast of a physical effect on the foam formation?
 - (iii) Some sweeteners are sugar based but have less sugar so yeast can use them. Others such as aspartame have no sugar and cannot be used at all.
11. Their own ideas for controlling other variables better / ideas for future experiments to clarify results.