GCSE Investigation Brief

Last night Mrs Leaf made two loaves of bread, she left them rising for half an hour and found that one rose a lot more than the other.
She used the following: -

       0.5g yeast
      10cm3 water
       0.5g sucrose
      10g flour

Investigate the fact that the leaves rose to different heights.

PLAN

AIM
In this investigation, I will be trying to find out what makes dough rise at different temperatures compared to my preliminary experiment in which I used only one temperature of 40 degrees. I will also try to make my measurements more accurate by taking more care thus leaving me with more accurate and reliable results.

APPARATUS
The apparatus that I will be using for the experiment will be the following:
10 test tubes
3 beakers
1 stirring glass rod
1 measuring cylinder
3 thermometers
Stop clock
Syringe
Yeast solution
Flour.

The apparatus is similar as used in the preliminary experiment except I will be using more test tubes.
I will be using two sets of test tubes at five different temperatures of room temperature, ice, 40 degrees, 60 degrees, and 80 degrees, with the same measurement of mixture.
For example: I will use 10ml of yeast to 10grams of flour in each test tube. I will then leave each tube at different temperatures of heated water.

I will be testing the best temperature for dough to rise three times at the selected temperature so that I know my results are accurate and to make sure it is a fair test.

The experiment consists of using dough. In the experiment I will be making the dough only by using yeast + sugar solution (liquid form) and flour. I will now explain the

science behind this experiment of what makes dough rise:
The yeast (a single celled fungus) becomes throthy once mixed with water and sugar. It is then mixed with flour and kneaded, thus enabling the flour to develop enough gluten to support the carbon dioxide made by the yeast. The dough is then left in a warm place for an hour. During this time the yeast cells multiply, this is fermentation. The carbon dioxide gas produced by the yeast forms pockets that makes the dough rise by doubling its size. This process is called proving. The loaf is then heated in an oven. The heat breaks down the yeast and evaporates the alcohol that is present in the yeast. It then cooks the dough leaving a risen loaf.

Changing the temperature (condition) might determine on how fast or slow the dough will rise and how much it will rise in mm compared to its original height before heating.
If the temperature of the water is higher then the dough will rise more and faster, if the temperature were lower the results would be the opposite. The temperature effects how fast or slow the dough will rise. I will be trying to find out if this hypothesis is true or not in this experiment.

METHOD

For the experiment we were given yeast solution and flour. The yeast mixture was made up of 0.5g yeast, 10cm cubed water and 0.5g sucrose. I was to use 10g of flour to put in each of the 12 boiling tubes and 10ml of the yeast mixture to make the test fair.

We weighed out the flour to exactly 10.0g on weighing scales and measured out exactly 10 ml of the yeast mixture. Our group mixed the two ingredients in each boiling tube with a glass rod putting the same measurements of yeast and flour in each tube. Then, with a yellow pen we marked on each boiling tube the starting height of the dough in mm before putting them in the water baths, we did this so that we could measure in mm at which height the dough rose. We also put labels showing the temperature of which water bath it was to be put in.

We controlled the water baths by putting a fixed temperature on each water bath. As soon as we put two boiling tubes in each water bath we started the stop clock. We used a stop clock to make sure that we did a fair test. We left the dough to rise for 30 minutes in the water baths.

As soon as 30 minutes passed we took the boiling tubes out and with the yellow pen marked where the dough had risen. I then, with a ruler measured how much the dough rose in mm and then put the results in my results table.

Compared with my preliminary experiment, I measured the mixture and flour more accurately and carefully. I did this by putting a mm scale on each of the boiling tubes to give me more accurate results .I also took the boiling tubes out of the water baths after exactly 30 minutes, I checked the times on the stop clock. As I have taken more care in this experiment I expect to have more reliable results, which will tell me if the hypothesis is true, or not.

Data Analysis

For my data presentation I showed a variety of graphs and tables. These included the class results, class average results, my own group results, my groups average results and a line graph showing my groups average results and the class average results. I have also included my preliminary results.

I decided to do average results for my group results and the class results in case the class results and mine were not exactly accurate. I showed these results in a line graph. It showed that the dough rose at its best at 40 degrees for the class average and my groups average, the result for class average at 40 degrees was 5.6cm and for my group average was 6.8 cm. It showed that after 40 degrees the dough did not rise a lot or not at all. The line on the graph started to decrease after 40 degrees. Before 40 degrees, the line graph shows that the dough is steadily rising but not so high. My group and class average line shows that there was not much difference in the results between the classes and mine. The curve of best fit indicates that the dough slowly rises and reaches its highest height at 40degrees and then slowly stops to rise so high.

The results will not all be the same for the class and my group as all the other groups may have not measured the mixtures as accurate or took the boiling tubes out at exactly 30 minutes and nor did our group so it is not surprising when seeing the class results that all results showed different figures. This is shown in my class results table that I drew on A4 paper in the data presentation. It shows that the general pattern was the same of the line graphs that I drew out.

I also did a table and graph showing the results for the experiment my group did. It shows the results for the two boiling tubes we put in each water bath in the table and line graph. They both show the dough mixture rose best at 40 degrees. I also drew a curve of best fit to clearly show that the height rises as it gets heated till it reaches its optimum height and show the line decreases as the dough denatures (as explained below).

The graphs and tables that I have drawn out, all clearly show that the dough rose at its best at 40 degrees compared to other temperatures and their results. This shows that temperature affects the way dough rises, whither it rises at all or rises quickly at high height. But why does temperature affect in which the dough rises? It is because when we raise the temperature the particles get more energy and move around more faster therefore leading to

more collisions in a certain amount of time. The more collisions produce a reaction; in this case the reaction is making the dough rise. However the enzymes (a large protein molecule which acts as a biological catalyst) start to break down when the temperature gets too high as they stop working. This is because when the enzymes get too hot it changes shape. This then means that the substrate (glucose) no longer fits into the enzymes active site. It is said that enzyme has 'denatured'. It is when the yeast no longer consumes the glucose to produce alcohol and carbon dioxide, a process called fermentation. You can see in the graph that the line rises up to 40 degrees as it is heating up until it reaches it optimum height and temperature when the enzymes work at its best. The line then starts to go down which shows that the enzymes have started to denature so the dough does not rise any higher in height than the optimum height.

The diagram below shows the enzyme and substrate before it gets denatured, and another diagram showing the enzyme and substrate denatured:

Evaluation

I think that for this investigation, there was a good range of temperatures as we got good results that enabled me to work through this investigation and to find out at which temperature the dough rose best. I think that doing two repeats for each water bath helped in enabling me to do average results and to see whither my results were reliable by comparing the two results with each other.

However there were a few problems in doing the experiment but did not reflect the results and analysing them dramatically. The first problem that I encountered was stirring the mixture. This was because after stirring the glass rod picked up some of the dough mixture so there was not exactly 10ml of yeast mixture and 10g of flour in each boiling tube. Secondly there was the problem in measuring the exact height of the dough when using the yellow pen, as it was hard to see through the dough. Thirdly the timing was not always exact because at times we left for over 30 minutes but only slightly e.g. we left for an extra 20-30 seconds or a minute accidentally. This could have a slight effect on the results because within that 20-30 second period the dough could have rose a little bit more than it would have been at exactly 30 minutes. Those were the only problems that I encountered with in the experiment. My data does not show any errors. I know this as looking at the class average and my average on the line graph, it shows that the results are similar and there are no points that go out of proportion. However in the class results table there was one group the had negative results meaning that the height of the dough decreased after it was heated at the temperatures of 20 degrees and 80 degrees. The group had probably made mistakes in doing the experiment so that's why the results were negative compared to the other group's results.

If I were to do this experiment again I would improve on the mistakes that I have just mentioned and I would do 3trys instead of 2trys so that I am sure of my results and therefore would no that they are reliable. I would also tr y different temperature of maybe 30 degrees or/and 50 degrees as both degrees are in between the optimum temperature of 40 degrees so either might also be the optimum height and temperature for dough.