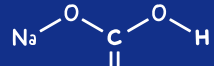
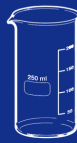


Equipment

Small beaker of full fat milk (or single cream)



Small beaker sodium carbonate solution



250cm³ beaker

Small beaker of Lipase solution



Test tube rack

Boiling tubes

Marker pen

10cm³ plastic syringes



Electric kettle

Cresol red in a dropper bottle



Stopwatch

Stirring thermometer

Aim: Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.

The effect of temperature on the rate of decay can be observed using milk. As milk decays, its pH reduces. This can be observed with an indicator called **Cresol red**.

Colour of starting solution



Solution after milk has decayed



As milk decay, lactic acid is produced.

Observing the rate of change in pH indicates the rate of decay in milk.

In this experiment, the addition of lipase and sodium carbonate means the fall in pH is due to the production of fatty acids as a result of enzyme action.

The natural process of decay is too slow for lesson time, so lipase is added to speed up to the process.

Cresol red is an indicator that is purple in alkaline solution at pH 8.8. When it drops below 7.2, Cresol red becomes yellow.



Planning your investigation

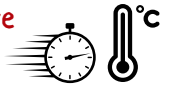
What temperature range will you investigate?

E.g. 25°C, 35°C, 45°C, 55°C, 65°C

Form a hypothesis: E.g. "As temperature increases, the rate of decay increases..."

Independent variable: temperature

Dependent variable: time taken

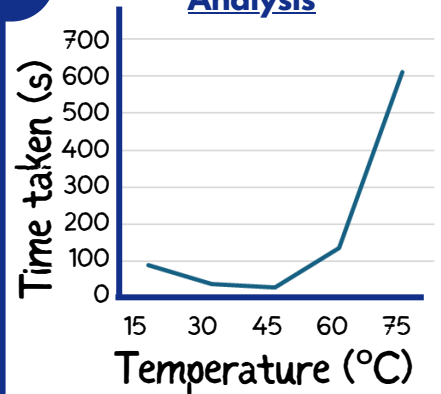


Equipment must be sterilised to kill microorganisms, so only microorganisms in milk and lipase cause results



REQUIRED PRACTICAL 10 DECAY

Analysis



What is the relationship between temperature and time taken?

Does this reflect your hypothesis?

Conclusion example:

"As the temperature is increased, the rate of decay increased as the rate of lipase action increased. For example, at 10°C it took 91 seconds to for the solution to change colour but at 45°C it was 30 seconds. However, after 45°C the rate drops rapidly because the lipase enzymes denature, so the shape permanently changes and the fat could not bind and be digested by lipase."

Method:

- 1) Label a boiling tube 'lipase'. Add 5cm³ of lipase solution.
- 2) Label a boiling tube 'milk'. Add 5 drops of Cresol red solution.
- 3) Use a plastic syringe to add 5cm³ of milk to the 'milk' tube.
- 4) Use a different syringe to add 7cm³ of sodium carbonate solution to the 'milk' boiling tube.
- 5) Place the thermometer into the 'milk' boiling tube.
- 6) Set up a water bath to the first temperature.
- 7) Put both boiling tubes into the water bath and leave them to reach to the temperature.
- 8) Use a syringe to transfer 1cm³ of lipase from the 'lipase' tube to the 'milk' tube. Immediately start the stopwatch.
- 9) Stir the contents of 'milk' boiling tube until the solution turns yellow.
- 10) Record the time taken for the colour to change to yellow, in seconds. Record in your results table.
- 11) Repeat the investigation for four more temperatures
- 12) Collect at least 2 other groups data and record them in your table.

Temperature of milk (°C)	Time taken for solution to turn yellow, in seconds			
	Your results	Class repeat 1	Class repeat 2	Mean
15	86	93	94	91
30	42	37	41	40
45	27	32	31	30
60	135	140	133	136
75	615	602	612	610

The rate of decay is the speed at which dead matter is broken down (decomposed) by decomposers.

The rate can be affected by:

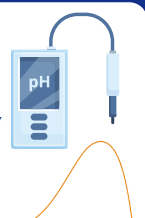
- Temperature
- Water availability
- Oxygen

Knowing the optimum conditions for rapid decay of waste organic matter is important for gardeners and farmers.



Limitation

- Difficult to recognise the end point - could use a pH meter for higher accuracy
- Cannot pinpoint optimum temperature - use 1 degree intervals to identify this



Exam Style Questions - Decay

1) A group of students wanted to investigate the effect of temperature on the time taken for different types of milk to decay.

They used the following method:

1. Measured 5cm³ of milk into six test tubes
2. Put each test tube in water baths at different temperatures
3. Measured the pH of the milk in each tube at the same time everyday for 10 days.
4. Recorded the number of days it took to reach pH 5.

a) Give one way the student could use to measure pH. (1 mark)

a) Describe how the student kept the milk constant for 10 days. (1 mark)

c) The student's teacher read through their method and told them they should have sterilised their equipment before carrying out the experiment.

Give one reason for this and describe how the students could have sterilised equipment in the school laboratory. (3 marks)

d) Give two control variables the students should use in this investigation. (2 marks)

2) a) Name two types of microorganism that cause decay. (2 marks)

b) In order to investigate the effect of temperature on the rate of decay, a group of students measured the time in days it took for the pH to reach pH 5 in milk kept at different temperatures between 5°C and 40°C

They found that the rate of decay increased as temperature increased with temperature and concluded that this can be applied to all types of animal milk.

Suggest two reasons why the student is incorrect. (2 marks)

Exam Style Questions - Decay

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a) Give one way the student could use to measure pH. (1 mark)

One mark for one of the following:

- Universal indicator (paper/solution)
- pH meter/probe

b) Describe how the student kept the milk constant for 10 days. (1 mark)

One mark:

- Water bath/incubator

c) The student's teacher read through their method and told them they should have sterilised their equipment before carrying out the experiment.

Give one reason for this and describe how the students could have sterilised equipment in the school laboratory. (3 marks)

Mark one for one of the following:

- Kill microorganisms
- Only microorganisms in milk cause results

Mark two and three for each one of the following:

- Heat
- To over 100°C)

d) Give two control variables the students should use in this investigation. (2 marks)

One mark for each of the following, up to a maximum of two marks:

- Volume of milk
- Exposure to air/oxygen
- Sterilise test tube/equipment
- Pasteurise milk
- Age of milk

2) a) Name two types of microorganism that cause decay. (2 marks)

One mark for each of the following:

- Bacteria
- Fungi (allow mould)

b) In order to investigate the effect of temperature on the rate of decay, a group of students measured the time in days it took for the pH to reach pH 5 in milk kept at different temperatures between 5°C and 40°C

They found that the rate of decay increased as temperature increased with temperature and concluded that this can be applied to all types of animal milk.

Suggest two reasons why the student is incorrect. (2 marks)

One mark for each of the following:

- Different concentration/type of fat/lipid
- Different amount of bacteria
- May have had a different pasteurisation process
- Different starting pH
- Different concentration/type of protein/carbohydrates/sugar