

Investigation of the energy content of foods

Introduction

Different foods have different energy contents. The energy content of a food can be released when you set it alight. When you hold a burning food underneath a known volume of water, the temperature increase can be measured. A simple calculation can then be used to estimate the amount of energy stored within the food.

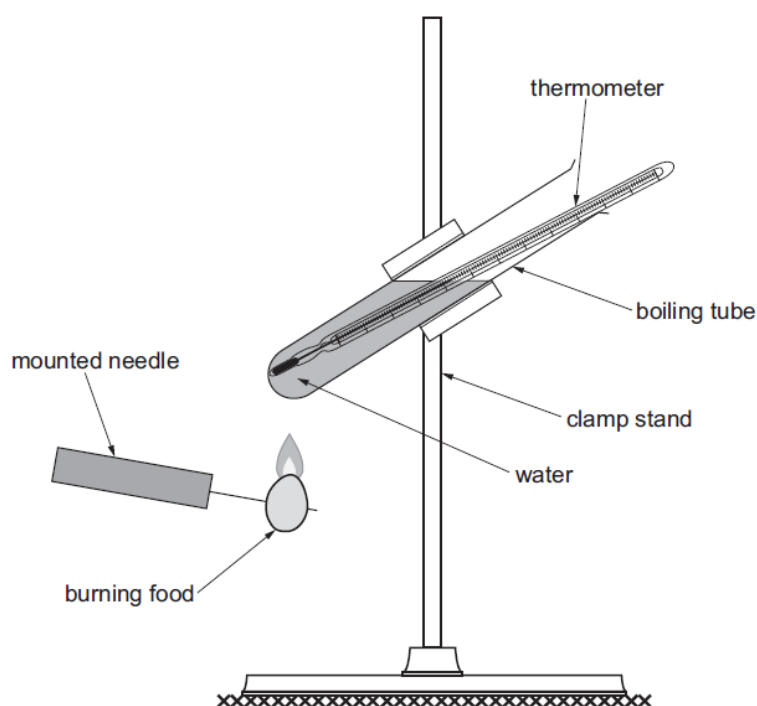
Apparatus

25 cm³ measuring cylinder
boiling tube
clamp stand, clamp and boss
thermometer
Bunsen burner
heat proof mat
mounted needle
samples of foods

Access to:

electronic balance ± 0.1 g

Diagram of Apparatus



Method

1. Measure 20 cm³ of water into a boiling tube.
2. Clamp the boiling tube to the clamp stand.
3. Record the temperature of the water using a thermometer.
4. Choose a piece of food and record its mass.
5. Place food onto a mounted needle.
6. Hold the food in the Bunsen burner flame, until it catches alight.
7. As soon as the food is alight, hold it under the boiling tube of water. Keep the flame directly underneath the tube.
8. Hold the food in this position until it has burnt completely. If the flame goes out, but the food is not completely burnt, quickly light it again using the Bunsen burner and hold it directly underneath the boiling tube.
9. When the food has burned completely, and the flame has gone out, immediately record the temperature of the water.
10. Repeat steps 1-9 for other foods.

Analysis

1. Calculate the increase in temperature each time.
2. Calculate the energy released from each food using the formula:

$$\text{Energy released from food per gram (J)} = \frac{\text{mass of water (g)} \times \text{temperature increase (}^{\circ}\text{C)} \times 4.2}{\text{mass of food sample (g)}}$$

3. Compare your results with the theoretical value on the food packet.
4. Evaluate your method and suggest how it could be improved.

Risk Assessment

Hazard	Risk	Control measure
Fumes produced from burning foods or foods alone can cause allergic reactions	Risk of allergic reactions (skin rashes/breathing difficulties) or anaphylactic shock.	Do not use nuts as the food source. Maintain good ventilation of the laboratory. Be prepared to administer first aid.
Bunsen burner can cause burns. Burning food can cause burns.	Risk of burns, especially to the skin.	Handle the equipment with care. Wear safety goggles. Tie long hair back.

Teacher/Technician notes

4.2 J / kg °C is the value for the specific heat capacity of water. 1 cm³ of water has a mass of 1 g.

A good range of data can be obtained from comparing the energy values of different crisps, e.g. wotsits, monster munch etc.

The method as stated does not include repeats, but students should be encouraged to carry out an appropriate number, if time allows.

This experiment can be used to compare the energy values quoted on food packaging with the data obtained from the experiment. Students can repeat results to determine repeatability and share results between pupil groups to determine reproducibility of data. This experiment is effective at evaluating the effectiveness of a method. Students can explain why the data obtained from the experiment is significantly different to the energy values quoted on food packaging. The idea of random and systematic errors can be explored.

Students should design their own table, but a suggested table format is shown below.

Type of food	Mass of food (g)	Temperature at start (°C)	Temperature at end (°C)	Temperature increase (°C)	Energy released per gram (J)

Working scientifically skills covered

1. **Development of scientific thinking**

Explain every day and technological applications of science: evaluate associated personal, social, economic and environmental implications and make decisions based on the evaluation of evidence and arguments

2. **Experimental skills and strategies**

Make and record observations and measurements using a range of apparatus and methods.

Evaluate methods and suggest possible improvements and further investigations.

3. **Analysis and Evaluation**

Carrying out and representing mathematical analysis

Evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.

4. **Scientific vocabulary, quantities, units, symbols and nomenclature**

Use SI units and IUOAC chemical nomenclature unless inappropriate