Combustion of food transcript

Food calorimeters are used to measure the energy stored in a food sample, and the energy released by burning the food depends on the combination of nutrients in the sample.

This video will show you how to use a simple food calorimeter in a virtual laboratory to measure the energy in different foods. You will be able to determine the number of calories per gram in a food sample by measuring the heat transferred to a fixed volume of water when burning the food in a combustion chamber under an oxygen atmosphere.

On the bench you have all the equipment and chemicals needed for this experiment.

The food calorimeter consists of:

* a borosilicate glass water jacket that surrounds the combustion chamber
* a copper spiral tube connected to the combustion chamber through which the products of combustion will be drawn out, allowing heat to be transferred to the water
* a metallic base that forms the floor of the combustion chamber with a moveable support for the crucible – and here you can see the crucible with its food sample in place, a couple of pillars that support the ignitor coil and an inlet for the oxygen supply
* a metallic lid covering the water jacket
* and a wire stirrer to homogenize the temperature of the water.

Other pieces of equipment available are:

* a temperature probe that is fitted through the lid of the water jacket
* a low voltage power supply to heat the ignitor coil
* an oxygen supply
* a water jet vacuum pump connected to a water tap to draw the gases out of the combustion chamber
* a measuring cylinder
* and a balance, also called scales.

Once you start the experiment, you will be able to choose a food sample using a drop-down menu. For the purposes of this demonstration, we will select a coconut peanut.

Your first task is to weigh the crucible containing your selected food. This initial mass should be recorded in your laboratory notebook.

The crucible containing the food is then placed onto the moveable support on the base of the calorimeter.

Next, you will move the empty glass water jacket onto the base of the calorimeter, forming the combustion chamber around your food sample. Note that the manual stirrer is already inside the glass vessel.

The glass vessel is now filled with one litre of water.

Once the water is transferred, the application will complete some steps of the food calorimeter assembly for you. The lid is placed on the water jacket and the oxygen source and water jet vacuum pump are connected to the inlet and outlet of the combustion chamber.

Next, you will fit the temperature probe through the lid of the glass vessel by turning on the temperature display. At this point, you will take a temperature reading of the water before the start of the experiment. Remember to stir the water to ensure a uniform temperature throughout the glass vessel and record the initial temperature value in your laboratory notebook.

Now, you are ready to open the tap to start the water jet vacuum pump. This ensures the suction of the gases out of the chamber. After this, it is now safe to open the regulator valve of the oxygen cylinder.

Clicking on the crucible support handle will move the food closer to the ignitor coil.

When you turn on the low voltage power supply, electric current will flow through the igniter coil. At this point, a video will start playing showing the combustion of your selected food.

When the coil gets hot, it ignites the food and the oxygen flowing inside the combustion chamber ensures the food continues burning. The gases produced by the combustion of the food pass through the copper spiral tube and heat the water inside the glass vessel.

The application will turn off the power supply for you as soon as the food sample starts burning. And the crucible will also be moved back to its original position. While the video is playing, the calorimeter is in lockdown mode, and you cannot change any settings.

Immediately after the flame extinguishes and the video finishes, you will stir the water and record the final temperature of the water after the combustion of your selected food.

You can now close the oxygen supply and the water jet vacuum pump. The application will dismantle the calorimeter for you when you switch off the temperature display.

It is very likely that the food sample will not burn to completion, so it is important to record the combined weight of any non-burned food and the crucible.

The energy of the food can then be worked out from the change in water temperature and the change in the mass of the food.

At any time during an experiment, you can start a new run by selecting ‘Reset trial’. This will change the initial masses of the food samples and refresh the water, so it is important that you weigh your sample again and record the temperature of the new water.

Deviations from the protocol that could introduce experimental errors and issues around laboratory safety, will trigger an alert advising you on how to continue the experiment.