Burning Off Kilojoules

Introduction

Food energy is measured in Calories (C) each of which equals one kilocalories (kcal), and each kilocalories is equivalent to 4.18 kJ of heat energy. Most food product labels list the energy content in Calories. The gross energy value of a food can be determined by actually burning the food and measuring the chemical energy produced. The food energy is converted to heat energy.

The heat of combustion can act as a rough guide to the caloric value of certain foods since the food when eaten produces at least as much heat in the body as it does when it burns. The purpose of this lab is to measure and compare the heat of combustion of several different kinds of nuts.

Objectives

To determine the heat of combustion per gram of various kinds of nuts.
To compare the heat of combustion values with the accepted caloric food values of the nuts.

Procedure

Record mass of nut.
Place ("stick") the massed nut on the sharp end of a straightened paper clip. Place the other end of the paper clip in a cork, (see diagram ...)
Mount the cork in a clamp on the ring-stand.
Place exactly 100 g of water in a tin contained. Suspend the can from the ring clamp stand, adjusting the height so that it is directly above the cork and the nut mounting.
Record the temperature of the water in the can.
Light the nut with a match. Allow it to burn completely.
Record the highest temperature reached by the water.

Data Collection

Record you data in a suitable table.

Processing the Data

1. Record the change in temperature of the water.
2. Calculate the heat of combustion for the nut. Express your answer in kJ per gram.
3. Calculate the energy value of the nut in kilocalories.
4. Use diet tables to research the caloric food values of the nut used by you and compare your values to these accepted values.
5. Account for any inaccuracy in your results by listing experimental factors which could introduce errors into your work.
6. Do you think that the body extracts the available energy from such foods as nuts in a more or less efficient manner than the one demonstrated in this experiment? Explain.
7. The heat of combustion of octane, which is one of the major constituents of gasoline, is 5500 kJ mol^{-1}, or 48 kJ g^{-1}. The density of octane is 0.70 g cm^{-3}.

a) Assume that Ms. Pall's car requires 10.0 L of octane to travel 100 km. How many kilojoules of energy are used?
b) How many Brazil nuts would be required to release the same amount of energy? (Assume the average nut has a mass of 2.5 g.)