

Calorimetry – Energy value of potatoes

Name _____

Date _____

Research Question: How does the energy content in lipids and carbohydrates differ?

Energy content is the amount of heat produced by the burning of a small sample of a substance and heating water with the heat given off, and is measured in joules per gram (J/g).

You can determine energy content by burning a known mass of food and capturing the heat released to a known mass of water in a calorimeter. If you measure the initial and final temperatures, the energy released can be calculated using the equation

$Q = \Delta t * m * c$, where

Q = heat energy absorbed (in J),

Δt = change in temperature (in °C),

m = mass (in g), and

c = specific heat capacity (4.185 J/g°C for water).

Q/g of food burned gives the energy content per gram.

MATERIALS

Dried potato slices + potato crisps

Forceps

Stand + clamp

Boiling tube or metal can to contain the water to act as a calorimeter

Thermometer (0-100°C ±0.25°C)

Graduated cylinder (50 ml ±0.5 ml)

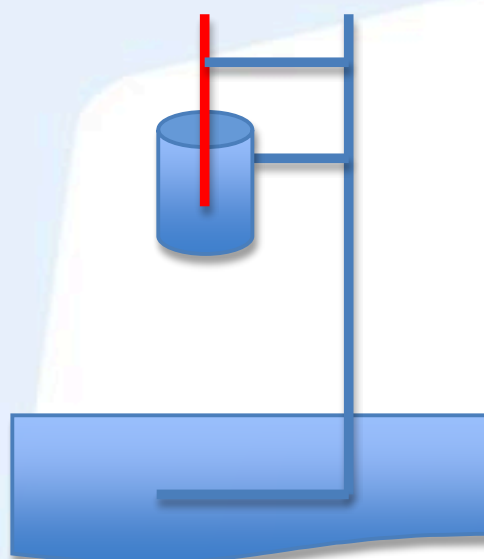
Bunsen burner + matches

Balance (0-200 g ±0.01g)

A sheet of aluminium foil



METHOD



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CAUTION: Do not eat or drink in the laboratory. Be careful with Bunsen burners and matches.

Be prepared to record all of your RAW data in your own data table. Each student will collect his or her own raw data and class data may be collated later.

We will use dried potatoes and potato crisps (cooked in oil).

1. Get a sample of slice of dried potato and a potato crisp.
2. Record the initial masses of the food samples.
3. Spread a sheet of aluminium foil under the calorimeter to catch any pieces of food and to reflect the heat upwards. See the demonstration setup.
4. Measure a known volume of water and place in the calorimeter.
5. Use a clamp to hold the container high enough so that you can hold the burning food underneath.
6. Stir and measure the initial temperature of the water.
7. Use a clamp to suspend the thermometer in the water. The thermometer should not touch the bottom of the container.
8. Light the Bunsen burner but keep the burner away from the calorimeter set up.
9. Using a pair of forceps, hold the potato in the Bunsen burner just until the potato ignites.
10. Quickly, move the burning potato under the calorimeter and hold there until the burning stops.
11. Stir the water and record the highest temperature.
12. Determine the final mass of the food sample.
13. Repeat the procedure for a second food sample.
14. When you are finished, clean up your area correctly. Don't throw away the aluminium foil.

PROCESSING THE DATA

Calculate changes that occur from your raw data recordings.

Determine the heat energy gained by the water (in J). Use the equation.

Calculate the energy content (in J/g) of each food sample.

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Share data with other groups.

CONCLUSION

1. Which of the potato slices had the greatest energy content? Suggest a reason why.
2. How could you show the amount of energy that comes only from the oil that crisps were cooked in?
3. How could you show that the water only gained energy from the burning food and not the surroundings?
4. Compare class average values to published values, citing your sources correctly. Use www.bibme.org. You will need to convert from Calories to Kilojoules – use the converter in the dashboard- select energy / calories to joules.
5. Are these values similar? If not, why not?

Nutrition Facts	
Serving Size	
1 potato large (3" to 4-1/4" dia) (299.0 g)	
Amount Per Serving	
Calories 278	Calories from Fat 3
% Daily Value*	
Total Fat 0.4g	1%
Saturated Fat 0.1g	1%
Polyunsaturated Fat 0.2g	
Monounsaturated Fat 0.0g	
Cholesterol 0mg	0%
Sodium 30mg	1%
Total Carbohydrates 63.2g	21%
Dietary Fiber 6.6g	26%
Sugars 3.5g	
Protein 7.5g	
Vitamin A 1%	Vitamin C 48%
Calcium 4%	Iron 18%
* Based on a 2000 calorie diet	

EVALUATION

What are the sources of errors in your method of data collection?

¹ "Calories in Potato, Baked, Flesh And Skin." *Calorie Counter Database - Free Online Diet Program*. New York Times, n.d. Web. 15 Sept. 2010. <<http://caloriecount.about.com/calories-potato-baked-flesh-skin-i11674>>.

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How can you improve your method of data collection?



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Teacher notes:

Alternatives set ups

1. For method 6-7, Use a data logger with temperature probes. Label the data collection appropriately.
2. For conclusion 3, One temp probe in the calorimeter, a 2nd probe in a blank calorimeter in the vicinity to record change of water temperature due to surroundings. The rise in temperature of the blank is subtracted from the temperature change of the calorimeter.

