Using Calorimetry as an Experimental Means to Compare the Energy Content of Two Foods

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Author Note

The data included in this laboratory is the result of the very hard and careful work of Mrs. Emily Morales. Our lab team conducted the experiment, but due to the constraints of time and laboratory space, our results were not as robust as we desired.

Abstract

This will be the last thing you guys write – I will go over this in class.

Using Calorimetry as an Experimental Means to Compare the Energy Content of Two Foods

This is where the body of your paper begins, or the introduction. Note that the title of your paper appears at the top of your introduction even though other sections begin with headings like “Method”, “Results” and so on. The rest of the text in this template provides hints about properly generating the parts of your APA-formatted paper. Notice that there is no extra spacing between the paragraphs or sections.

The major components of your paper (abstract, body, references, etc.) each begin on a new page. These components begin with centered headings at the top of the first page. (You can see how major components of text get divided in this freely available sample document: http://www.apastyle.org/manual/related/sample-experiment-paper-1.pdf ). Some papers have multiple studies in them so the body could have multiple sections and subsections within it.

Sections can have subsections with headings. For example, a Method section might have Participants, Materials, and Procedure subsections if there are enough details to explain to warrant such headings. The sixth edition of the APA manual, unlike earlier editions, tells you to bold some headings. Below are examples.

# **Methods**

Our experimental protocol required the use of the *Eisco Calorimetry Laboratory Kit*, along with a few other components as listed below.

**Materials**

Erlenmeyer flask (125 mL capacity)

Cylindrical metal stand

Metal suspension plate

Cork-and-nail sample holding assembly

Rubber stopper

Matches or a lighter

Thermometer or temperature probe

Triple-beam balance (0.01 g resolution)

Two food samples (peanut, crouton)

**Procedure**

With goggles on and the workspace protected from being burned, we obtained the initial mass of the cork-and-clip food holder and the crouton, and recorded in Table 1(b), to the nearest 0.01 grams. We then recorded the mass of the empty Erlenmeyer flask (d). After pouring in 125 mL of room-temperature water we reweighed the flask and entered its mass in (e).

**Setting up the apparatus**. We inserted the thermometer into the rubber stopper, and placed it on the top of the flask, making sure the probe was submerged into the water, but not touching the glass. We set up the apparatus according to Figure 2; by inserting the flask through the metal plate, turning it by 90 degrees so the metal clamp on the flask rested on the plate, and then placed the plate on top of the aluminum tube. We then affixed the food sample to the cork-and-nail holder securely.

**Running the experiment.** Before burning any food, we obtained the initial temperature of the water and recorded it in Table 1(f). Using a match, we then set the crouton on fire and slipped it under the flask, fanning the opening of the aluminum tube in order to provide enough oxygen for the burn. We carefully monitored the temperature increase and once the crouton was burned out completely, we waited to see if the temperature would rise any further, then recorded the highest temperature in Table 1(g).

We then weighed the burnt crouton and holder, in order to determine the actual mass of food burned, and recorded this in Table 1(c).

After we repeated this entire protocol with a peanut using a new sample of water, and recording the data in Table 1, we performed our analysis.

**Analysis and calculation of energy content**. In order to determine the change in temperature *(∆T)* for each sample, we subtracted the initial temperature from the final temperature *(∆T = Tfinal – Tinitial)*, or g-f, and recorded this value in Table 1. To calculate the mass of water (*m*) heated for each food sample, we subtracted the mass of the empty beaker from the mass of the flask plus water (e – d) and recorded in Table 1. Knowing that the specific heat capacity for water is 4.184 J/ g ▪ ˚C, we inserted the other values into the heat equation, and calculated the energy content of each food. To determine the energy content per gram we divided the number of joules by the mass of food that was actually burned (b – c in Table 1) and recorded this value.

In order to compare the energy content between the two foods, we converted the energy expressed in J/g to Calories/g. Finally, we calculated our percent error by comparing our empirically derived values for energy, to that of food industry standards values.

**Results**

The data our lab team collected, along with the computations performed, are tabulated in the table below. Please note that we performed only a single trial for each food item.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 1  *Data Recorded from Calorimetry Protocol* | | | |
|  |  | Sample 1 | Sample 2 |
| a. | Food Used | crouton | peanut |
| b. | Mass of food and holder (initial) | 4.91 g | 4.59 g |
| c. | Mass of food and holder (final) | 4.28 g | 4.12 g |
|  | Mass of the food that was burned (c – b) | 0.63 g | 0.47 g |
| d. | Mass of empty flask | 96.03 g | 96.03 g |
| e. | Mass of flask plus water | 205.59 g | 210.08 g |
|  | Mass of water only (e – d) | 109.56 g | 114.05 g |
| f. | Initial water temperature | 19.9 ̊C | 20.1 ̊C |
| g. | Final water temperature | 25.2 ̊C | 41.03 ˚C |
|  | Temperature change (g – f) | 5.3 ̊C | 21.2 ̊C |
|  | Empirical\* energy content per gram (J/g) | 3,856.37 J/g | 21,524.19 J/g |
|  | Theoretical energy content per gram (J/g) | 20,920.00 J/g | 24,685.60 J/g |
|  | % error (empirical value/theoretical value x 100) | 81.57 % g | 12.81 % g |

\*Crouton: 5.00 kcal/ gram; Peanut: 5.9 kcal/ gram

**Comparison of Energies**

From our data it was obvious the peanut had more energy as measured in joules per gram (21,524.19 J/g), than the crouton (3,856.37 J/g). While we were not surprised that the peanut had more energy density, we were surprised at just how much more when compared to the crouton. Theoretically, the peanut should have had 24,685.60 J/g, and the peanut 20,920.00 J/g.

**Percent Error**

We calculated the percent error of the peanut as follows:

And the percent error of the crouton accordingly:

Note that the percent error for the peanut (12.81%) demonstrates that our empirically-derived numbers were much more accurate when compared to theoretical values, than those for the crouton (81.57%). We have a few ideas as to why this is – for one thing, it required many attempts to light the crouton and simply get it to burn. In all those attempts, the crouton was more than likely losing mass and not contributing any energy to the flask of water.

**Discussion**

Not yet written…

# **Citations and References**

My food diary. (2019). Retrieved from <https://www.myfooddiary.com/foods/search?q=croutons>

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