Daswani 6A (23)

Chemistry Lab Report 13

How much energy can we get from margarine?

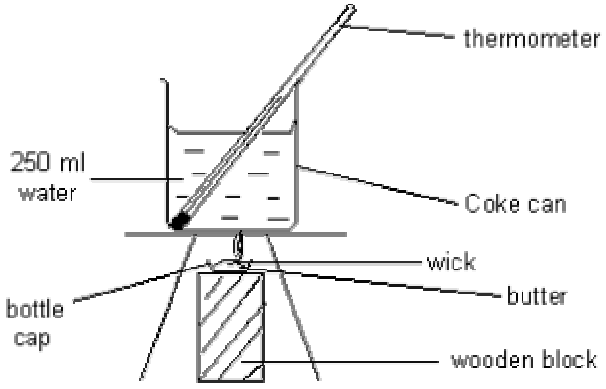
Objective

To determine the enthalpy change of combustion of margarine, which is the energy stored in margarine per gram.

Principle

Margarine is a kind of fat. It can give out energy by burning or by respiration. By using simple calorimetric method, the quantity of this energy can be established.

Experimental set-up



Chemicals

margarine, water

Apparatus

thermometer, aluminium can, wick, bottle cap, wooden block, tripod

Procedure

1.> Fill a bottle cap with margarine up to the rim of the cap.

2.> Smear the whole length of about 4 cm of a thick string (not nylon or synthetic fibre)

with margarine.

3.> Push the string into the margarine leaving about 0.5 cm sticking out at the edge of the bottle cap and pointing up like a wick.

4.> Weigh the bottle cap and contents.

5.> Weigh an aluminium can (a used Coke or 7-up can will do) empty.

6.> Measure out 250 cm^3 of water in the can. Take the temperature of the water.

7.> Place the bottle cap and contents on top of a wooden block, light the wick with matches and immediately place the can and its contents on a tripod (do NOT add a wire gauze) to enable the burning wick to heat up the can of water directly. The wick should be positioned as to minimize heat loss to surroundings and to ensure uninterrupted burning.

8.> Stir the water gently with the thermometer. When the temperature of the water rises by about 10 - 15℃, take the final temperature and at once blow out the flame.

9.> Reweigh the bottle cap and remaining contents when cool.

10.> (Optional) Some other groups of students may perform the experiment with low fat margarine or slimmers' spread. These burn less well and the wick may go out due to the amount of water present in the melted material. If this happens, relight the wick and resume the experiment until 10℃ rise in temperature of the water is achieved.

Data Analysis

Mass of margarine burnt: 4.92 - 3.86 = 1.06 g

Temperature change of water: 33.5 - 18.5 = 15 ℃

Assuming that all the energy given out by combustion of margarine is absorbed by 250 cm^3 of water,

Energy content of margarine
= heat change of water
= (0.25) (4200) (15) kJ
= 15750 kJ

Energy content of margarine per gram
= 15750 ÷ 1.06 = 14.86 kJg^{-1}

Precaution

1.> The distance between the bottle cap and the Coke can should be as close as

possible (BUT the wick should not touch the bottom of the can and its burning should not be interrupted) to reduce heat loss.

2.> The temperature of water should close to room temperature at initial, to avoid any extra heat loss to (or gain from) the surroundings, which may increase the percentage error.

3.> The wick should be centered or it will be put off easily since the bottle cap absorb most of its heat.

4.> Wire gauze should not be used, since it will absorb part of heat.

5.> The thermometer should not touch the bottom of the aluminium can and should use it to stir water gently to distribute heat uniformly.

Discussion

1.> Using Coke can (made up of aluminium) in this experiment is that the heat can be transmitted ideally to water since aluminium is a good conductor of heat. Besides, aluminium can is so light (relative to 250g of water, it's only 12g) that it's specific heat capacity may be neglected.

2.> The initial temperature of water should not be much higher than room temperature and the distance between bottle cap & Coke can should not be too long to reduce heat loss to surroundings.

3.> In this experiment, simple calorimetry is used to calculate the energy content of margarine per gram, no heat loss to surroundings is assumed.

However, the experimental value should be less than expected since there are some source of errors in this experiment:

(i) heat lost from top and sides of aluminium can

(ii) incomplete combustion of margarine may occur

(iii) specific heat capacity of aluminium can is ignored

Some improvements may be done to minimize the errors:

(i) determine the specific heat capacity of Coke can and count it.

(ii) a lid with a hole (to insert the thermometer) to cover the Coke can and a draught screen surrounds the calorimeter.

4.> Animals store up energy in form of fat, which also serves to keep animal warm in cold climates. Vegetable oils are pressed or extracted from various nuts and seeds, while marine oils may come from herring or sardine. Although fats are solid whereas oils are liquid at room temperature, their chemical compositions are quite similar. They are usually esters of glycerol & long chain fatty acids.

5.> Margarine is an artificial fat, made by hydrogenation of vegetable oils. Fat can give us 2 times more of energy (36 - 38 kJg^{-1}) than carbohydrate & protein (16 - 20 kJg^{-1}). The respiratory process inside our body to release energy from fat

is similar to combustion in this experiment - they both give out CO_2 & H_2O. The only difference is that respiratory process release energy more slowly, no light is given out & in a non-vigorous way.

Excess fat will store under our skin, around heart & kidney as adipose tissue and cause health problem, e.g. coronary heart disease. Thus, the energy content data of foods is important to people, especially the slimmers.

6.> The experimental energy content of margarine in this experiment is only about 15 kJg^{-1} which is much lower than natural fat content (36 - 38 kJg^{-1}). This may due to the margarine used is low fat margarine, or due to the experimental errors.

Conclusion

Simple calorimetry can be used to calculate the energy content of food substance per gram. This values are important to scientists and those people who are on diet.