SBCH322: UNIT 2

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Important notice

The questions and answers provided in this file are only for students' practice purposes. The intention of providing this information is purely to educate and make students aware of the correct way of answering the questions. All the sources used in the preparation of this material are properly cited at the end of this document. Students are requested not to regard this material as a reference, but as guidance on how to answer questions. However, ultimately the onus rests on the student to work hard and to read the books and other material on the topics listed in the module.

Define energy value of food?

The energy value of a food indicates its value to the body as a fuel. Food energy is chemical energy that animals (including humans) derive from food through the process of cellular respiration. Cellular respiration may either involve the chemical reaction of food molecules with molecular oxygen (aerobic respiration) or the process of reorganizing the food molecules without additional oxygen (anaerobic respiration).

Units for food energy

The unit of energy in the International System of Units (SI) is the joule (J).

A joule is the energy expended when 1 kg is moved 1 m by a force of 1 Newton. This is the accepted standard unit of energy used in human energetics and it should also be used for the expression of energy in foods. Because nutritionists and food scientists are concerned with large amounts of energy, they generally use kiloJoules (kJ = 103 J) or megaJoules (MJ = 106 J). For many decades, food energy has been expressed in calories, which is not a coherent unit of thermochemical energy. Despite the recommendation of more than 30 years ago to use only joules, many scientists, non-scientists and consumers still find it difficult to abandon the use of calories. This is evident in that both joules (kJ) and calories (kcal) are used side by side in most regulatory frameworks

The International System of Units (SI) unit for energy is the **joule**; however, the **calorie** is commonly used for a unit of food energy. A calorie is equal to the amount of energy per unit mass required to raise the temperature of 1 g of water by 1° C. Various definitions exist but fall into two broad categories. The first, the small calorie, or gram calorie (symbol: cal), is defined as the amount of energy needed to raise the temperature of one gram of water by one degree Celsius at a pressure of one atmosphere. The second, the large calorie or kilogram calorie (symbols: Cal, kcal), also known as the food calorie and similar names, is defined in terms of the kilogram rather than the gram. It is equal to 1000 small calories or 1 kilocalorie (symbol: kcal). One small calorie is approximately 4.2 joules (so one large calorie is about 4.2 kilojoules).

The British thermal unit (Btu or BTU) is a traditional unit of heat; it is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. It is part of the United States customary units. Its counterpart in the metric system is the calorie, which is defined as the amount of heat required to raise the temperature of one gram of water by one degree Celsius. Heat is now known to be equivalent to energy, for which the SI unit is the joule; one BTU is about 1055 joules.

- 1 Calorie = 1 kilocalorie = 1000 calories
- 4.184 J = 1 cal

Note: Please practice Joules, Food Calories, & Kilojoules - Unit Conversion With Heat Energy - Physics Problems. Watch the video.

Energy value of different materials

Energy value of building blocks of human body:

	kJ/g	kcal/g
Fat	37	9
Protein	17	4
Carbohydrate	16	4

Energy value of five vegetables:

	kJ	kcal
Broccoli, boiled (100g)	80	20
Cabbage, raw (50g)	110	25
Carrots, raw (50g)	100	25
Cauliflower, raw (50g)	55	15
Pumpkin (100g)	65	15

Energy value of five fruits:

	kJ	kcal
Raisins, dried (20g)	1050	245
Banana (100g)	340	80
Apple (100g)	150	35
Pineapple (80g)	195	45
Strawberries (100g)	110	25

Energy value of five beverages:

	kJ	kcal
Beer (240g)	165	40
Coffee, percolated (230g)	8	2
Tea, infusion (230g)	2	1
Drinking chocolate (10g)	1555	365
Wine, red (100g)	285	70

Calorimeter

A calorimeter is a device used to measure heat of reaction. Calorimetry, derived from the Latin calor meaning heat, and the Greek metry meaning to measure, is the science of measuring the amount of heat. All calorimetric techniques are therefore based on the measurement of heat that may be

generated (exothermic process), consumed (endothermic process) or simply dissipated by a sample. Bomb Calorimeter is usually used to measure energy value of food.

Bomb calorimeter

Definition and principle:

The energy in food is provided entirely by its carbohydrates, fats and protein. The energy value of food can be determined using bomb calorimeter. Basically, this device burns a fuel sample and transfers the heat into a known mass of water. From the weight of the fuel sample and temperature rise of the water, the calorific value can be calculated. The calorific value obtained in a bomb calorimeter test represents the gross heat of combustion per unit mass of fuel sample. This is the heat produced when the sample burns, plus the heat given up when the newly formed water vapor condenses and cools to the temperature of the bomb. Determining calorific values is profoundly important; fuels are one of the biggest commodities in the world, because of their calorific value

Components and their role(s):

1. The food chamber: Filled with oxygen and food will be placed in a food vial

2. The water chamber: Filled with water and absorbs the heat released when food is burned.

3. Ignition wire: The ignition wire ignites the food

4. Thermometer: The thermometer measures the increased temperature of the water

5. Air space and Insulation: prevent heat loss

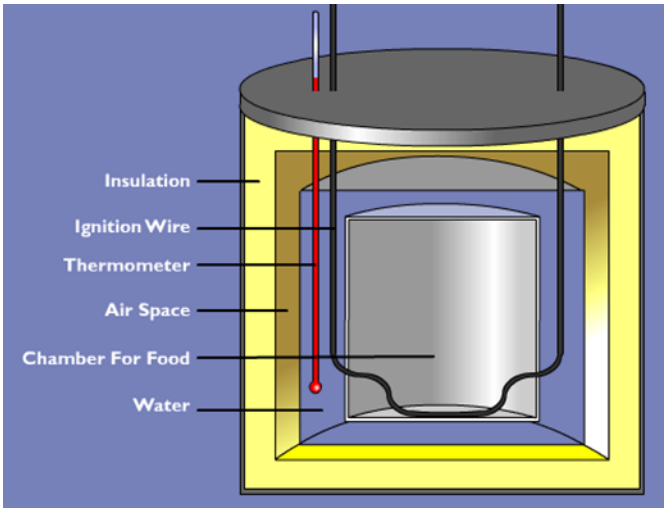

Figure : Basic components of Bomb calorimeter

Example 1: 61 g of Tomatoes changed 5 L water temperature from 22°C to 26°C.

Answer:

Definition of a calorie:

I kcal = 1 kg water x 1°C

Density of water:

1 kg/L

Difference in temperature:

26°C – 22°C = 4°C

Convert water volume to weight:

5 L water x 1 kg/L = 5 kg water

Calculate kcals:

$$4^{\circ}C \times 5 \text{ kg water} \times \frac{1 \text{ kcal}}{1 \text{ kg water} \times 1^{\circ}C} = 20 \text{ kcal}$$

NOTE: Please practice more questions and answers. Please watch the video on bomb calorimeter.

What is DRI's?

Define EAR, RDA, AI and UL.

State the purpose of DRI?

Discuss the specific aspects of RDS with respect to Energy, Protein, Carbohydrate and fat, Water, and Fiber.

Answers:

1.

DRI stands for dietary reference intakes (DRI's). DRIs were set by food and nutrition boards for safety, quality, and adequacy of the food supply; establishes principles and guidelines of adequate dietary intake; and renders authoritative judgments on the relationships among food intake, nutrition, and health.

DRI is the general term for a set of reference values used to plan and assess nutrient intakes of healthy people. These values, which vary by age and gender, include:

2.

Estimated Average Requirement (EAR): is the average daily nutrient intake estimated to meet the requirement of half the healthy individuals who are all the same sex and of a similar age. It's mostly used by dieticians when they need to plan diets for large groups and by nutrition researchers. It's not something the average consumer needs to worry about.

The Recommended Dietary Allowance (RDA) is the average daily dietary intake levels that are enough to meet the nutritional needs of about 98 percent of people of the same sex and similar age. This is when knowing the EAR comes in handy because the RDA is calculated from the EAR of any given nutrient.

The key thing with an RDA is knowing that as long as you meet your RDA for any given nutrient every day, then it's extremely unlikely that you'll be deficient in that nutrient.

So for example, for women, the RDA for vitamin C is 75 milligrams per day. So as long as you eat enough vitamin-C containing foods to meet that mark, you should have plenty of vitamin C. To do that you'll need to eat some fruits and veggies every day.

The Adequate Intake (AI) is similar to the RDA but not as exact because nutrition scientists haven't been able to establish an EAR and RDA. But, even though it's not exact, the AI is still based on good science so it's a great estimate that can be used for planning meals plans.

For example, there's no RDA for potassium intake, but it's certainly a vital mineral. The AI is set at 4.7 grams per day, which is a great mark to shoot for when you're planning your meals. And just like

vitamin C, if you eat plenty of fruits and vegetables, you should be able to meet this AI without too much problem.

The Tolerable Upper Intake Level (UL) is the highest level of daily intake of a given nutrient that won't pose a risk to your health in anyone of a similar age and same sex. The UL is most important for supplement use. It's not common to overdo any one nutrient simply by eating foods. But several nutrients can become dangerous if they're ingested in large enough amounts over time. So if you take dietary supplements for any reason, follow the dosage as directed on the label, unless your healthcare provider has told you otherwise and is monitoring any health conditions you may have.

An example of an important UL is for vitamin A. Daily consumption of more than 3,000 micrograms per day may result in vitamin A toxicity and liver problems. And women who are pregnant and take too much vitamin A on a daily basis have a greater risk of certain birth defects.

3.

Purpose: The purpose of these guidelines is to inform you how much of a specific nutrient your body needs on a daily basis. It is important to meet your daily recommended dietary allowances so that your body gets everything it needs to function.

4.

Following will be a discussion of the specific aspects of RDA:

Energy RDA Each individuals food energy intake must equal the energy expended, in order for the person to maintain their body weight. The average energy consumption is aimed at setting a standard for people to work from and it gives an example of how many kcalories are reasonable for this group. An output side of the energy balance equation, how much energy people should expend, has not been established.

Protein RDA Protein recommendations are mainly based on the individuals body weight. The protein RDA is high, to cover most person's needs. The average requirement for protein is 0.6 grams per kilogram of body weight; the RDA is 0.8 grams this is said to meet 97.5% of the population's needs.

No RDA for Carbohydrate and Fat The amount of protein recommended represents a small percentage of a person's energy allowance; with the remainder acquired from carbohydrates and fats. The general guideline for carbohydrate and fat is that more than half of daily energy should come from carbohydrates, with no more than one-third from fat.

Water Recommendation The larger and more active a person the greater the need for water. Most people need a least 6 to 8 eight-ounce glasses of liquids a day. *This is truly an area neglected by most individuals*.

Fiber recommendation There is no recommendation for fiber, however it is recommended that sufficient fiber be obtained from fruits, vegetables, legumes, and whole-grain products, which also provide vitamins, minerals and water.

Sources

http://www.fao.org/docrep/006/Y5022E/y5022e04.htm

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https://ods.od.nih.gov/Health_Information/Dietary_Reference_Intakes.aspx

https://www.voedingscentrum.nl/Assets/Uploads/voedingscentrum/Documents/Professionals/Pers/Factsheets/English/Factsheet%20Recommendations%20for%20vitamins,%20minerals%20and%20trace%20elements.pdf

https://www.verywellfit.com/what-are-dietary-recommended-intakes-4065355

Video links:

Energy Units: https://www.youtube.com/watch?v=nAIUfcxzQKk

The units of Energy: https://www.youtube.com/watch?v=rISsJwzovhY

Joules, Food Calories, & Kilojoules - Unit Conversion With Heat Energy - Physics Problems: https://www.youtube.com/watch?v=Pwr_yzR4kA4

Bomb Calorimeter:

https://highered.mheducation.com/sites/9834092339/student_view0/chapter48/bomb_calorimeter.html

DRI:

https://www.youtube.com/watch?v=UPsymcEobDk