Project 2 FDNS 4600/6600: greenhouse Gas Emissions Associated with Various Foods

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The purpose of this project is to create one healthy meal that follows the recommended Dietary Guidelines for Americans (United States Department of Health and Human Services and United States Department of Agriculture, USDHHS and USDA, 2010), Dietary Reference Intakes (Institute of Medicine, IOM, 2009), and food preferences for an individual. Several nutrients and greenhouse gas emissions (Carlsson-Kanyama and González, 2009) for this meal will also be calculated. The main focuses are greenhouse gases, calories, protein, fat, sodium, and cost. This individual is a 25 year old female who is active. She prefers not to eat beef and also has hypertension. Based on her age and activity level, her energy needs are 2,400 calories per day, her protein needs are 46 grams per day, her fat intake as 25% of her daily calorie intake should be around 67 grams, and because she has hypertension, she should consume less than 1,500 milligrams of sodium per day (USDHHS and USDA, 2010). The nutrient content of foods is from USDA (2009) and food costs are from a local grocery store (Kroger, Athens, GA). The information is summarized in the table.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Healthy meal (include all required items below) greenhouse gas information should be included in this column** | Amount served in household units and in grams | USDA  NDB number  for foods | Calories, kcal (for healthy meal must be 30% to 35% of recommended) | Protein, grams | Fat,  grams | Sodium, mg | greenhouse gas emissions, CO2 equivalents, kg | Cost per amount served, $ |
| Must include at least one serving of whole grains; greenhouse gas emissions for rice are 1.3 kg/kg of food | 1/2 cup, 97.5 grams | 20037 | 108 | 2.52 | 0.88 | 5 | 0.06 | 0.11 |
| Must include at least one serving of the meat group; greenhouse gas emissions for chicken are 4.3 kg/kg of food | 3 ounces, 84.84 grams | 05032 | 189 | 24.63 | 9.21 | 63 | 0.26 | 0.33 |
| Must include at least one serving from the milk group; greenhouse gas emissions for milk, as used for yogurt\*, are 1.0 kg/kg of food | 1 cup, 8 fluid ounces, 245 grams | 01117 | 154 | 12.86 | 3.8 | 172 | 0.11 | 0.11 |
| Must include at least one serving from the fruit group; greenhouse gas emissions for carrots, as used for strawberries\*, are 0.42 kg/kg of food | 1/2 cup, halves,  76 grams | 09316 | 24 | 0.51 | 0.23 | 1 | 0.03 | 0.34 |
| Must include at least one serving from the vegetable group; greenhouse gas emissions for soybeans, as used for spinach\*, are 0.92 kg/kg of food | 1/2 cup, 90 grams | 11458 | 21 | 2.67 | 0.23 | 63 | 0.08 | 0.30 |
| Any other foods to meet the 30% to 35% of the daily energy recommendation (e.g., one meal) |  |  |  |  |  |  |  |  |
| greenhouse gas emissions for carrots, as used for blueberries\*, are 0.42 kg/kg of food | 1/2 cup, 74 grams | 09050 | 42 | 0.55 | 0.24 | 1 | 0.03 | 0.74 |
| greenhouse gas emissions for whole wheat, as used for granola\*, are 0.63 kg/kg of food | 1/2 cup, 49 grams | 08189 | 190 | 3.92 | 2.55 | 107 | 0.03 | 0.22 |
| Totals |  |  | 728 | 47.66 | 16.03 | 407 | 0.60 | 2.15 |
| Recommendations from USDA and USDHHS (2010), assigned person is 25 years old, female, and active, 25% of calories from fat, with hypertension |  |  | 2400 | 46 | 67 | 1500 |  |  |
| % of recommendation for the nutrients |  |  | 30.33 | 103.6 | 23.93 | 27.13 |  |  |
| greenhouse gases from driving; I usually drive 12 miles round trip to the grocery store; 0.5 kg CO2eq/mile; so 12 x 0.5 = 6 |  |  |  |  |  |  | 6 |  |
| % of greenhouse gases coming from the foods vs. from driving; note that this is quite arbitrary to compare one trip to grocery store with one meal. Formula is 100% x 0.60/(6 + 0.60) = 9.09% from food |  |  |  |  |  |  | 9.09 |  |

\*Reasons for choosing these foods for greenhouse gas emissions:

Yogurt- In place of yogurt greenhouse gas emissions, I used the values given for milk because the main ingredient in yogurt is milk.

Strawberries and Blueberries- The reason I chose to use the greenhouse gas emissions values for carrots as opposed to apples or tropical fruit is because strawberries and blueberries are both domestically grown. The values listed for apples and tropical fruit are higher because they must be imported into Sweden.

Spinach- Because spinach was not listed on the table, I used the greenhouse gas emissions for soybeans. I used soybeans because both foods are green vegetables. There are values listed for frozen vegetables, but they are imported. Spinach is usually domestic in the United States.

Granola- I used the values listed for whole wheat in place of granola because whole wheat is the only grain product listed.

**Questions**

1. What accounts for the differences in greenhouse gas emissions from the various foods?

Multiple variables such as fermentation, processing, and transportation affect the greenhouse gas emissions of foods. Plants that require excessive amounts of water and products from animals that digest food through enteric fermentation produce the highest levels of greenhouse gasses.

1. Choose one food that you analyzed and discuss why it might have different greenhouse gas emissions if produced and consumed in the US vs. in Sweden (the source of the GHG data).

Spinach produced and consumed in the US instead of in Sweden may have lower greenhouse gas emissions. Sweden must import spinach which increases greenhouse gas emissions.

1. Discuss how much and why greenhouse gas emissions change if you chose a different protein source. Discuss a specific example with two protein sources, one from your table and one from Table 3 in Carlsson-Kanyama and González, 2009, <http://www.ajcn.org/cgi/reprint/89/5/1704S>).

Chicken contributes 4.3 kg/kg of food for total greenhouse gas emissions, while beef contributes 30 kg/kg of food, 25.7 kg/kg of food more than chicken. The major difference that causes such increased greenhouse gas emissions is the amount of methane produced by cattle manure and enteric fermentation processes due to differing digestion methods between the two animals.

1. How well did this one meal meet the sodium recommendations for this individual? What food substitutions could you make to lower the sodium content of this meal?

This meal accounted for 27% of this individual’s daily sodium recommendation. Yogurt contributed the highest amount of sodium with 172 milligrams per serving. One substitute that may lower the sodium content of this meal is soymilk which would contribute 119 milligrams of sodium.

1. Compare the greenhouse gas emissions from driving vs. the foods analyzed. Based on your analyses, what could this person do to decrease their greenhouse gas emissions related to transportation, shopping and food choices?

To lower greenhouse gas emissions, this individual may consider public transportation if available in their location. Switching shopping locations may also be beneficial if there is a closer grocery store. Being aware of greenhouse gas emissions for foods may also aid decision making. Replacing spinach with potatoes would lower the total greenhouse gas emissions by 0.47 kg/kg of food and CO2 emissions by 0.52 kg/kg of food.

1. What is the relationship, if any, between cost of the foods and their greenhouse gas emissions?

High protein foods tend to produce the highest greenhouse gas emissions and also seem to be the most expensive. The relationship between greenhouse gas emissions and cost seems to have a positive correlation.

1. Conclusions and what you learned from this project.

Unless shipped overseas by plane, fresh fruits and vegetables usually have the lowest greenhouse gas emissions while high protein foods, especially beef, have the highest. Soy products and high protein vegetables may be one way to lower greenhouse gas emissions.

**References**

Carlsson-Kanyama A, González AD. Potential contributions of food consumption patterns to climate change. Am J Clin Nutr. 2009;89(5):1704S-1709S, <http://www.ajcn.org/cgi/reprint/89/5/1704S>, accessed March 8, 2011. Use Table 3 for foods and total CO2 equivalents/kg food.

Institute of Medicine, Dietary Reference Intakes (DRIs): Recommended Dietary Allowances and Adequate Intakes, Vitamins and Elements, <http://iom.edu/Activities/Nutrition/SummaryDRIs/~/media/Files/Activity%20Files/Nutrition/DRIs/RDA%20and%20AIs_Vitamin%20and%20Elements.pdf>, accessed on March 8, 2011. .

Kroger, Athens, GA, March 9, 2011, food prices.

United States Department of Agriculture, Agricultural Research Service, USDA National Nutrient Database for Standard Reference, Release 23, Nutrient Data Laboratory Home Page, <http://www.nal.usda.gov/fnic/foodcomp/search/>, accessed on March 8, 2011.

United States Department of Health and Human Services and United States Department of Agriculture, Dietary Guidelines for Americans, 2010; sodium and hypertension recommendations are on page “x”; energy recommendations are on page 14 or page 78; DRIs for several nutrients are on page 76 (not correct for calcium and vitamin D); meal patterns for energy recommendations and serving size recommendations for various food groups are on pages 79 and 80; <http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf>, accessed on March 8, 2011.

**USDA-NNDSR Information**

Spinach, cooked, boiled, drained, without salt

Refuse: 0%    
NDB No: 11458 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 0.5 X 1 cup  90g |
| Proximates |  |  |
| Water | g | 82.09 |
| Energy | kcal | 21 |
| Energy | kJ | 86 |
| Protein | g | 2.67 |
| Total lipid (fat) | g | 0.23 |
| Fiber, total dietary | g | 2.2 |
| Sodium, Na | mg | 63 |

## Rice, brown, long-grain, cooked

## Refuse: 0%   NDB No: 20037 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 0.5 X 1 cup  97.5g |
| Proximates |  |  |
| Water | g | 71.26 |
| Energy | kcal | 108 |
| Energy | kJ | 452 |
| Protein | g | 2.52 |
| Total lipid (fat) | g | 0.88 |
| Fiber, total dietary | g | 1.8 |
| Sodium, Na | mg | 5 |

## Chicken, broilers or fryers, light meat, meat and skin, cooked, roasted- 28.28 grams= 1 ounce, information for 1 ounce serving size

Refuse: 29%  (Bone)  
NDB No: 05032 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | Value per 28.28 grams |
| Proximates |  |  |
| Water | g | 17.11 |
| Energy | kcal | 63 |
| Energy | kJ | 263 |
| Protein | g | 8.21 |
| Total lipid (fat) | g | 3.07 |
| Fiber, total dietary | g | 0.0 |
| Sodium, Na | mg | 21 |

## Yogurt, plain, low fat, 12 grams protein per 8 ounce

## Refuse: 0%   NDB No: 01117 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 1.00 X 1 cup (8 fl oz)  245g |
| Proximates |  |  |
| Water | g | 208.42 |
| Energy | kcal | 154 |
| Energy | kJ | 649 |
| Protein | g | 12.86 |
| Total lipid (fat) | g | 3.80 |
| Fiber, total dietary | g | 0.0 |
| Sodium, Na | mg | 172 |

## Strawberries, raw

Refuse: 6%  (Caps and stems)  
Scientific Name: *Fragaria X ananassa*  
NDB No: 09316 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 0.5 X 1 cup, halves  76g |
| Proximates |  |  |
| Water | g | 69.12 |
| Energy | kcal | 24 |
| Energy | kJ | 103 |
| Protein | g | 0.51 |
| Total lipid (fat) | g | 0.23 |
| Sodium, Na | mg | 1 |

## Cereals ready-to-eat, KELLOGG, KELLOGG'S Low Fat Granola without Raisins

Refuse: 0%    
NDB No: 08189 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 1.00 X 0.5 cup (1 NLEA serving) 49g |
| Proximates |  |  |
| Water | g | 1.72 |
| Energy | kcal | 190 |
| Energy | kJ | 793 |
| Protein | g | 3.92 |
| Total lipid (fat) | g | 2.55 |
| Fiber, total dietary | g | 3.0 |
| Sodium, Na | mg | 107 |

\* note from Dietary Guidelines for Americans (USDA and USDHHS, 2010): Serving sizes vary between ½ cup and 1¼ cups, depending on cereal type. Check product’s Nutrition Facts label.

For this cereal, the serving size is ½ cup according to label.

## Blueberries, raw

## Refuse: 5%  (Stems and green or spoiled berries) Scientific Name: *Vaccinium spp.* NDB No: 09050 (Nutrient values and weights are for edible portion)

|  |  |  |
| --- | --- | --- |
| Nutrient | Units | 0.5 X 1 cup  ------- 74g |
| Proximates |  |  |
| Water | g | 62.32 |
| Energy | kcal | 42 |
| Energy | kJ | 178 |
| Protein | g | 0.55 |
| Total lipid (fat) | g | 0.24 |
| Fiber, total dietary | g | 1.8 |
| Sodium, Na | mg | 1 |

**Evaluation Form**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Requirements** | **Did not follow directions** | **A few problems** | **Very**  **Good** | **Points** |
| 1. Filename is **LastnamesDateProject2**, e.g., SamsonSmithJonesApril1Project2; **no punctuation in the filename**; only one file submitted (all information must be in one file); submitted to elc through the correct “assignment” area; **WORD files only** (NO pdf, NO zipped files) | Did not do all of this (-2) |  | Did all of this |  |
| 1. Provided project number, title, date submitted, your name, followed by an introductory paragraph with mandatory references for the required information about age, gender, activity level, nutrient needs, USDA and USDHHS (2010), IOM (2010), greenhouse gas emissions (Carlsson-Kanyama and González, 2009), and stores where nutrition and price information obtained (about 1/3 page, 300 word limit) | 2 or more errors (0) | 1 error (2) | Did all of this (4) |  |
| 1. Table can be 8- to 10-point font; no abbreviations; has required column headings; includes minimum of at least one serving of each of the 5 healthy food groups recommended by USDHHS and USDA (2005); and follows any food preferences | 2 or more errors (0) |  | Did all of this (4) |  |
| 1. Calculations for serving sizes, amounts, and grams served are all correct | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for calories are all correct | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for protein are all correct | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for fat are all correct | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for sodium are all correct | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for greenhouse gases are all correct; watch out for decimal place errors | 1 or more errors (0) |  | All correct (4) |  |
| 1. Calculations for costs are all correct and appear reasonable | 1 or more errors (0) |  | All correct (4) |  |
| 1. Questions are shown and then answered accurately and thoughtfully based on information in the table and the references (up to 1 page, 500 word limit including the questions) | Outside word limit, inaccurate, and/or inconsistent with data (0) | Somewhat accurate, thoughtful, and consistent (2) | Within word limit, accurate, thoughtful, consistent with data (4) |  |
| 1. References cited correctly as shown in the example, in alphabetical order, with attention to capitalization, commas, periods, **correct access date**; no textbooks should be listed (1/2 page) | Did not do this (0) |  | Did this accurately (2) |  |
| 1. National Nutrient Database for Standard Reference (USDA-NNDSR) information is included at the end of the file and the data are correct in the table | Did not do this; incorrect foods, units, serving sizes, other problems (0) |  | Did this accurately (4) |  |
| 1. Follow formatting guidelines as illustrated in previous projects (spacing for units with a space between the number and the unit, number of significant digits), **do not capitalize nutrients or foods or greenhouse gases in the middle of a sentence,** correct spelling, grammar and punctuation, chemical formulas correctly written, 11 or 12 point font for text, single-spaced, 1 inch margins, no extra formatting (no colors, no borders, no shading, etc), no use of “&”, do not use a title page, do use subheadings, follow word count (see above), pages are numbered | 1 or more errors or omissions (0) |  | Professionally prepared with no errors (4) |  |
| Penalty for late, -50% if 1 day late, 0 if more than 1 day late |  |  |  |  |
|  |  |  |  |  |
| **Total points** |  |  |  | **50** |