FAT VS SUGAR: THE CULTURE OF AMERICAN DIETING

Katherine Richeson
Mary Gearing
Abbe Clark
Your Meal for the Evening

1. Building Blocks: Macronutrients for Energy

2. How do Scientists Evaluate Diets?

3. How has Society Changed Food?
Your Meal for the Evening

1. Building Blocks: Macronutrients for Energy
After the First Course

• Purpose of Food

• Three Macronutrients
  – Carbohydrates
  – Proteins
  – Fats

  What are they made of?
  Why are they important?
  How does our body use them?

• A Balanced Diet of Macronutrients
  – How Much of Each Macronutrient?
Deserted Island

Water + one food below:

1. Corn on the Cob
2. Hotdog
3. Autumn Red Peaches
4. Chocolate

Hold up fingers for which food you would choose
Purpose of Food

ENERGY
Food is Fuel

Energy from Food → Basic Survival → Work

- Body Temperature
- Organ Function
- Blood Circulation
Calories

“Tiny creatures that live in your closet and sew your clothes a little bit tighter every night.”

- **Calorie** = Unit of **Energy**
  - 1 Calorie = amount of energy needed to raise the temperature of 1 kg of water 1°C

- **Practical Examples:**
  - 1 Calorie = 4,184 heart beats
  - 1 Calorie = Walk 20 ft
  - 1 Calorie = Use muscles for 1 min

---

**Nutrition Facts**

Serving Size 1 cup (228g)
Servings Per Container 2

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories 250</td>
</tr>
<tr>
<td>Calories from Fat 110</td>
</tr>
<tr>
<td>Total Fat 12g</td>
</tr>
<tr>
<td>Saturated Fat 3g</td>
</tr>
<tr>
<td>Trans Fat 3g</td>
</tr>
<tr>
<td>Cholesterol 30mg</td>
</tr>
<tr>
<td>Sodium 470mg</td>
</tr>
<tr>
<td>Total Carbohydrate 31g</td>
</tr>
<tr>
<td>Dietary Fiber 0g</td>
</tr>
<tr>
<td>Sugars 5g</td>
</tr>
<tr>
<td>Protein 5g</td>
</tr>
</tbody>
</table>
Excess Calories Stored as Fat

Calories
Energy from Food

Work

Basic Survival

Body Temperature

Organ Function

Blood Circulation

Stored Fat
Fewer Calories = Fat Burned

- Calories: Energy from Food
- Basic Survival
- Work
- Stored Fat
- Body Temperature
- Organ Function
- Blood Circulation
Calories come from Macronutrients
Three Main Sources of Energy

1. Carbohydrates

2. Proteins

3. Fats
Calories come from Macronutrients
Three Main Sources of Energy

1. Carbohydrates

2. Proteins

3. Fats
I. Carbohydrates
Made of Simple Sugars

Three Simple Sugars
- Glucose
- Fructose
- Galactose

Sugars
- Table Sugar “sucrose”
- Milk Sugar “lactose”

Complex Carbohydrates
- Starch

Dietary Fiber
I. Carbohydrates

High Fructose Corn Syrup

= Starch

High Fructose Corn Syrup (HFCS)

55% Fructose
45% Glucose

Table Sugar
“sucrose”

50% Fructose
50% Glucose
1. Carbohydrates
High Fructose Corn Syrup

**Found In?**
- Soft drinks
- Ketchup
- Breakfast cereals
- Yogurt

**Why?**
- Cheaper
- Sweeter
- Easy to transport
- Longer shelf life

**HFCS**
- 55% Fructose
- 45% Glucose

**Table Sugar**
- 50% Fructose
- 50% Glucose

“Corn on the Cob” by Darwin Bell / CC BY 2.0
I. Carbohydrates

High Fructose Corn Syrup

FOUND IN?
• Soft drinks
• Ketchup
• Breakfast cereals
• Yogurt

WHY?
• Cheaper
• Sweeter
• Easy to transport
• Longer shelf life

HEALTH RISKS?
• Fatty liver
• Bad cholesterol
• Diabetes
• Linked to obesity

"Corn on the Cob" by Darwin Bell / CC BY 2.0
I. Carbohydrates

Digestion and Utilization
I. Carbohydrates
Digestion and Utilization

Sugars and Starches → Bloodstream
Dietary Fiber → Bloodstream

NIH, National Digestive Diseases Information Clearinghouse
1. Carbohydrates
Digestion and Utilization (GLUCOSE)

Insulin

Muscle Cell

Muscle Cell
1. Carbohydrates
Digestion and Utilization (FRUCTOSE)


High Fructose Corn Syrup
HFCS

Table Sugar
“sucrose”

Bloodstream

Insulin

Liver Cell

FAT
1. Carbohydrates

Review

• Carbohydrates made of simple sugars
  – Absorbed in small intestine

• Glucose is the main energy source for cells
  – Insulin needed for cells to use glucose
  – Excess glucose stored as fat

• Fructose stored as fat in liver
Questions?
Calories come from Macronutrients
Three Main Sources of Energy

1. Carbohydrates

2. Proteins

3. Fats
2. Proteins
Made of Amino Acids

Alanine  Glutamine  Leucine  Serine
Arginine  Glutamic acid  Lysine  Threonine
Asparagine  Glycine  Methionine  Tryptophan
Aspartic acid  Histidine  Phenylalanine  Tyrosine
Cysteine  Isoleucine  Proline  Valine

Protein
## 2. Proteins
Made of Amino Acids

<table>
<thead>
<tr>
<th>Alanine</th>
<th>Glutamine</th>
<th>Leucine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arginine</td>
<td>Glutamic acid</td>
<td>Lysine</td>
</tr>
<tr>
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<td>Glycine</td>
<td>Methionine</td>
</tr>
<tr>
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<td>Histidine</td>
<td>Phenylalanine</td>
</tr>
<tr>
<td>Cysteine</td>
<td>Isoleucine</td>
<td>Proline</td>
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**9 Essential Amino Acids** = Required in Our Diet

- Alanine
- Arginine
- Asparagine
- Aspartic acid
- Cysteine
- Glutamine
- Glutamic acid
- Glycine
- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine
- Proline
- Serine
- Threonine
- Tryptophan
- Tyrosine
- Valine
2. Proteins

Digestion and Utilization
2. Proteins
Digestion and Utilization

In circumstances where carbohydrates and fats are low
2. Proteins
Review

• Proteins made of amino acids
  – 20 unique amino acids
  – Absorbed in small intestine

• Proteins essential in our diet
  – 9 essential amino acids

• Amino acids used in body
  – To make new proteins
  – For energy
  – Excess stored as fat
Calories come from Macronutrients
Three Main Sources of Energy

1. Carbohydrates
2. Proteins
3. Fats

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<td></td>
<td></td>
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Three Main Sources of Energy:

1. Carbohydrates
2. Proteins
3. Fats
3. Fat
Made of Fatty Acids

Two Types of Fatty Acids

Saturated Fatty Acids

Unsaturated Fatty Acids

Fats (Triglycerides)
3. Fat

Guess That Fatty Acid

Group A
- Solid at room temperature
- Associated with heart disease
- Increases lousy cholesterol

Group B
- Liquid at room temperature
- Considered “good fats”
- Increases healthy cholesterol

Raise your hand if you think Group A is saturated fatty acids

“Western Pack Butter” by Steve Karg / CC BY 2.5, “Cottonseed Oil” by Cottonseed Oil / CC BY 2.0
3. Fat

Guess That Fatty Acid

<table>
<thead>
<tr>
<th>Saturated Fatty Acid</th>
<th>Unsaturated Fatty Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid at room temperature</td>
<td>Liquid at room temperature</td>
</tr>
<tr>
<td>Associated with heart disease</td>
<td>Considered “good fats”</td>
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<tr>
<td>Increases lousy cholesterol</td>
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“Western Pack Butter” by Steve Karg / CC BY 2.5, “Cottonseed Oil” by Cottonseed Oil / CC BY 2.0
3. Fat

Trans Fatty Acids

Unsaturated Fatty Acids

Partial Hydrogenation

Vegetable Shortening

Trans Fatty Acids
Partially Hydrogenated Vegetable Oil

**FOUND IN?**
- Fried food
- Frosting
- Coffee Creamer

**WHY?**
- Cheaper
- Easy transport
- Longer shelf life

**HEALTH RISKS?**
- High cholesterol
- Heart disease
- Diabetes
3. Fat
Friend or Foe?

Essential Fatty Acids = Required in Diet

Omega-3

Omega-6

Blood Clotting

Immune System

Brain

© Graphics Factory.com, “Boy Sneezing” by Mark A. Hicks Clip art licensed from the Clip Art Gallery on DiscoverySchool.com, “Lobes of the Brain” by Mysid / CC BY 2.0
3. Fat Digestion and Utilization

Fats are digested and absorbed in the small intestine as lipoprotein “suitcases.” These suitcases enter the bloodstream (blood stream) and are transported to the liver cell. In the liver, the fats are stored as energy reserves.
3. Fat

Cholesterol = Type of Fat
3. Fat

Two Types of Lipoprotein Suitcases

- **LDL**
  - Low Density Lipoprotein
  - "Lousy"
  - BAD

- **HDL**
  - High Density Lipoprotein
  - "Healthy"
  - GOOD
3. Fat
LDL and HDL Cholesterol Packages

Liver
LDL - BAD
Artery
Plaque
3. Fat

LDL and HDL Cholesterol Packages

Liver

Artery

LDL - BAD

HDL - GOOD

Gearing (2014) SITN
3. Fats

Review

• Fats made from fatty acids
  – Saturated or unsaturated fatty acids
    • Trans fat = partially hydrogenated vegetable oil
  – Not all fat is bad [omega-3 and omega-6]

• Lipoprotein “suitcases” package fat and cholesterol for transport in the bloodstream
  – LDL = BAD
    • Moves cholesterol away from the liver, can accumulate in plaques
  – HDL = GOOD
    • Moves cholesterol back to the liver to be broken down
### Calories come from Macronutrients
Three Main Sources of Energy

| 1. Carbohydrates |
| 2. Proteins |
| 3. Fats |

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<tr>
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</tr>
<tr>
<td>Dietary Fiber 0g</td>
</tr>
<tr>
<td>Sugars 5g</td>
</tr>
<tr>
<td>Protein 5g</td>
</tr>
</tbody>
</table>
A Balanced Diet of Macronutrients

2000 Calories
“FDA Recommended”

- Carbohydrate 320g
- Protein 55g
- Fat 64g

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### Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>% Daily Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories 250</td>
<td></td>
</tr>
<tr>
<td>Total Fat 12g</td>
<td>18%</td>
</tr>
<tr>
<td>Saturated Fat 3g</td>
<td></td>
</tr>
<tr>
<td>Trans Fat 3g</td>
<td></td>
</tr>
<tr>
<td>Cholesterol 30mg</td>
<td></td>
</tr>
<tr>
<td>Sodium 470mg</td>
<td></td>
</tr>
<tr>
<td>Total Carbohydrate 31g</td>
<td>10%</td>
</tr>
<tr>
<td>Dietary Fiber 0g</td>
<td></td>
</tr>
<tr>
<td>Sugars 5g</td>
<td></td>
</tr>
<tr>
<td>Protein 5g</td>
<td>9%</td>
</tr>
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</table>

Food and Agriculture Organization of the United Nations, Food Balance Sheets 2010

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A Balanced Diet of Macronutrients

2000 Calories
“FDA Recommended”

- Carbohydrate: 320g
- Fat: 64g
- Protein: 55g

3,770 Calories
Average American 2010

Nutrition Facts
Serving Size 1 cup (228g)
Servings Per Container 2

- Amount Per Serving
- Calories: 250
- Total Fat: 12g
  - Saturated Fat: 3g
  - Trans Fat: 3g
- Cholesterol: 30mg
- Sodium: 470mg
- Total Carbohydrate: 31g
  - Dietary Fiber: 0g
  - Sugars: 5g
- Protein: 5g

Food and Agriculture Organization of the United Nations, Food Balance Sheets 2010
Take Home Points

• **Food is fuel** to provide our bodies with energy

• **Energy = calories from macronutrients**
  – Carbohydrates
  – Proteins
  – Fats

• **Excess calories are converted to fat**

• **A balanced diet of macronutrients**
Questions?
Your meal for the evening

1. Building blocks

2. How do scientists evaluate diets?

3. How has society changed food?
Nutrition gets a lot of press

Why nutrition is important

The Expanding American Waistline
By NICHOLAS BAKALAR  SEPTEMBER 19, 2014 8:32 AM  139 Comments

Obesity Around the Nation
By ANAHAD O’CONNOR  SEPTEMBER 8, 2014 12:14 PM  27 Comments

PERSONAL HEALTH | SEP 15 10:49 AM  228

Beating Back the Risk of Diabetes
By JANE E. BRODY

New findings in the field

New Answers About Carbs and Fat
By ANAHAD O’CONNOR  SEPTEMBER 5, 2014 1:02 PM  174 Comments

Advice From a Vegan Cardiologist
By ANAHAD O’CONNOR

FOOD | AUG 6 6:00 AM  399

Is Breakfast Overrated?
By GRETCHEN REYNOLDS

FOOD | AUG 21 12:01 AM  237

SundayReview | OPINION

Why Nutrition Is So Confusing
By GARY TAUBES  FEB. 8, 2014
Menu for second course

• Why do we need human studies?

• Short-term case study

• Long-term case study
Menu for second course

• Why do we need human studies?

• Short-term case study

• Long-term case study
What is a diet?

• “a regimen of eating and drinking sparingly so as to reduce one’s weight”

• “food and drink regularly provided or consumed”

We are all on a diet!
Calories come from macronutrients

1. Carbohydrates
2. Proteins
3. Fats
We understand nutrient metabolism...
...but how do these nutrients interact in the body?
Studies come in all shapes and sizes
Studies can be reduced to fundamental questions

- Who?
- What?
- Where?
- When?
- Why?
- How?
How do scientists evaluate diets?

• Why do we need human studies?

• **Short-term case study**

• Long-term case study
Short-term case study: Tulane

Why?
15-20%
>30%
20-25%

Where?
2011 obesity rates by state

Who?
150 obese participants without heart disease

“Human_heart” - Mikael Häggström, public domain; “USA Obesity 2011” by Falcorian/ GFDL; CC BY-SA 3.0; “Adam and Eve / Fernando Botero” by Piponwa/ CC BY-SA 3.0
Short-term case study: Tulane

What?
- Low carb diet
  - 30% (50 g)
- Low fat diet
  - 40 g digestible carb

When?
- 3 months
- 6 months
- 12 months
Low-carb = higher-fat

Low-fat diet

Low-carb diet

“FDA diet”
Short-term case study: Tulane

How? Weight loss!

HDL cholesterol - healthy

LDL cholesterol - lousy
Low-carb = more weight loss

Change in body weight

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Low fat</th>
<th>Low carb</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-20</td>
<td>-15</td>
</tr>
<tr>
<td>3</td>
<td>-15</td>
<td>-10</td>
</tr>
<tr>
<td>6</td>
<td>-10</td>
<td>-5</td>
</tr>
<tr>
<td>12</td>
<td>-5</td>
<td>0</td>
</tr>
</tbody>
</table>

Change in fat percentage

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>% change in fat mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>-1</td>
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<tr>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

Bazzano et al. 2014
Human studies must consider variation.

• What basic characteristics could affect weight loss?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low-carb</th>
<th>Low-fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47.8</td>
<td>45.8</td>
</tr>
<tr>
<td>% Female</td>
<td>65</td>
<td>66</td>
</tr>
<tr>
<td>Initial body weight</td>
<td>215</td>
<td>213</td>
</tr>
<tr>
<td>% Fat mass</td>
<td>40</td>
<td>40</td>
</tr>
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</table>

Bazzano et al. 2014
Low-carb diet: more positive changes

<table>
<thead>
<tr>
<th>Parameter measured</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low fat</td>
</tr>
<tr>
<td>Body weight</td>
<td>▼</td>
</tr>
<tr>
<td>Lean mass</td>
<td></td>
</tr>
<tr>
<td>Fat mass</td>
<td></td>
</tr>
</tbody>
</table>

Bazzano et al. 2014; Gearing 2014
Strengths of this study

• Compare two groups – direct effects of diets!
  - Low carb diet
  - Low fat diet

• Close monitoring/consistency

• High compliance
Weaknesses of this study

Why?

What we can’t see:
Possible weight regain
Changes in disease frequency

2011 obesity rates by state
Questions?
How do scientists evaluate diets?

• Why do we need human studies?

• Short-term case study

• Long-term case study
Nutrition is heavily debated

A Call for a Low-Carb Diet That Embraces Fat

By ANAHAD O’CONNOR  SEPTEMBER 1, 2014

The Opinion Pages

A Debate Fueled by Carbs (or the Lack Thereof)

By ANNA NORTH  SEPTEMBER 4, 2014 5:00 AM  215 Comments

New Answers About Carbs and Fat

By ANAHAD O’CONNOR  SEPTEMBER 5, 2014 1:02 PM  174 Comments

Massachusetts is a center for long-term nutrition studies!

- **Framingham Heart Study**
  - 1948 – 5,209 patients
  - 1971 – 2\textsuperscript{nd} generation
  - 2002 – 3\textsuperscript{rd} generation

- **Nurses’ Health Study**
  - 1976 – 122,000 RNs
  - 1989 – 116,686 RNs

Thomas Dawber
Frank Speizer
Walter Willett
Case study: Nurses’ Health Study and carbohydrates

Who? 82,802 women

Why?

Where?
Case study: Nurses’ Health Study and carbohydrates

What?

When?

How?

Heart disease diagnosis

years

When?
Patients sorted into groups based on carb intake

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>High carb</td>
<td></td>
<td>Low fat/protein</td>
<td></td>
<td>High fat/protein</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Similar total calories (about 1800)

Surprising result:
No significant increase in heart disease was observed.
Strengths of this study

• Determine frequency of disease and death
• Large number of subjects
• Varied population
Weaknesses of this study

• Other factors may affect results

• This is an “observational study”
Short-term vs. long-term

- Change fat/carbs in diet
- Closely monitor subjects
- Measure short-term changes
- Direct effects of diet
- Group subjects by fat/carb consumption
- Monitor subjects every two years
- Measure long-term changes
- Correlations with diet
Are these two things correlated?

Adapted from Spurious Correlations – Tyler Vigen
Correlations cannot stand alone!
What to consider

• Who – what kind of subjects?

• How – what/how did they test?

• Who else – has anyone shown the same thing?
Take home points

• It’s not about the headlines, it’s about the studies!

• Different types of studies ask different questions.

• Results should be replicable!
Questions?
Your Meal for the Evening

1. Building blocks

2. How do scientists evaluate diets?

3. How has society changed food?
Your Meal for the Evening

1. Building blocks

2. How do scientists evaluate diets?

3. How has society changed food?
Menu for the Third Course

1. Decoding artificial sweeteners
2. Gluten sensitivity – is it real?
3. How has society changed food?
Menu for the Third Course

1. Decoding artificial sweeteners
   – What are artificial sugars?
   – Are there artificial sugars in your food?
   – Are artificial sugars safe?

2. Gluten sensitivity – is it real?

3. How has society changed food?
Decoding Artificial Sweeteners

Artificial sweeteners: zero-calorie sweeteners up to 20,000x as sweet as sugar
Decoding Artificial Sweeteners

Identify artificial sweeteners by their chemical name

Aspartame
Saccharin
Sucralose

Stevia
Acesulfame Potassium

MADE FROM SUGAR

Natural Calorie-Free Sweetener
Does my food contain artificial sugars?

Maple and brown sugar oatmeal

Ingredients
WHOLE GRAIN ROLLED OATS, WHEY PROTEIN ISOLATE, MALTODEXTRIN, NATURAL AND ARTIFICIAL FLAVOR, SALT, OAT FLOUR, CALCIUM CARBONATE, GUAR GUM, CARAMEL COLOR, SOY LECITHIN, ACESULFAME POTASSIUM, SUCRALOSE, NIACINAMIDE*, REDUCED IRON, VITAMIN A PALMITATE, PYRIDOXINE HYDROCHLORIDE*, RIBOFLAVIN*, THIAMIN MONONITRATE*, FOLIC ACID*.

Fruit-vegetable juice
WATER, HIGH FRUCTOSE CORN SYRUP, RECONSTITUTED VEGETABLE JUICE (WATER AND CONCENTRATED JUICE OF CARROTS), CONTAINS LESS THAN 2% OF: RECONSTITUTED FRUIT JUICE BLEND (WATER AND CONCENTRATED JUICES OF APPLES, CHERRIES, STRAWBERRIES, RED RASPBERRIES, BLACKBERRIES), NATURAL FLAVORING, CITRIC ACID, MALIC ACID, VITAMIN C (ASCORBIC ACID), RED 40, SUCRALOSE.

Light Yogurt

Ingredients: Cultured Pasteurized Grade A Nonfat Milk, Modified Corn Starch, Sugar, Kosher Gelatin, Natural and Artificial Flavoring, Potassium Sorbate Added to Maintain Freshness, Acesulfame Potassium, Sucralose, Vitamin D3, Vitamin A Palmitate, Vitamin D2, Vitamin B12.
Why are artificial sugars calorie-free?

Dietary Fiber

Sugars and Starches

Blood Stream
Why are artificial sugars calorie-free?

Sugars and Starches → Artificial Sugars → Blood Stream
Artificial sugars and…

• Weight loss
• Weight gain
• Cancer

What is the evidence?
Artificial sugars and...weight loss?

Does consumption of aspartame aid weight loss?

**What?** Measure weight loss over 3 years

**Who?** 163 obese women

**How?**

- Active weight loss
  - Week 1
  - Week 19
- Nutritional counseling weekly
- Exercise plan
- Weight measured weekly
- Continue exercise
- Weight measured yearly

Blackburn et al., 1997
Artificial sugars and...weight loss?

Artificial sugars may aid in maintaining weight loss

Blackburn et al., 1997
Artificial sugars and...weight loss?

Artificial sugars may aid in maintaining weight loss

[Graph showing percent change in weight over study weeks, with two lines indicating active weight loss and maintenance phases.]

Blackburn et al., 1997
Artificial sugars and... weight gain?

Does daily consumption of artificial sweeteners increase risk of becoming obese?

**What?**
Weight change over 7-8 years

**Who?**
Ages 25-64 years

**Where?**

**How?**

None  | < 3  | 3-10 | 11-21 | 22+  
--- | --- | --- | --- | ---

# of artificially sweetened beverages per week

Fowler et al., 2008;
http://commons.wikimedia.org/wiki/File:Man-and-woman-icon.svg
“USA Obesity 2011” by Falcorian/ GFDL; CC BY-SA 3.0
Artificial sugars and...weight gain?
Artificial sugars may contribute to unintended long-term weight gain
Artificial sugars and...weight gain?

Artificial sugars may contribute to unintended long-term weight gain

Fowler et al., 2008
Artificial sugars and...weight gain?

Artificial sugars may contribute to unintended long-term weight gain

But how could someone consume that much?!?

<table>
<thead>
<tr>
<th>Chance of becoming obese</th>
<th>None</th>
<th>&lt; 3</th>
<th>3-10</th>
<th>11-21</th>
<th>22+</th>
</tr>
</thead>
<tbody>
<tr>
<td># of artificially sweetened beverages consumed per week</td>
<td>0.7</td>
<td>1.0</td>
<td>1.4</td>
<td>2.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Fowler et al., 2008; A Photo of a Cup of Coffee by Julius Schorzman / CC-BY-SA-2.0; A Glass of Iced Tea by Evan Swigart / CC-BY-2.0
Artificial sugars and...cancer?

Does daily consumption of artificial sweeteners increase risk of getting cancer?

What?  Development of cancer over 18 months

Who?  Food with or without

How?  Food with or without

Taylor et al., 1980; WT and TK rat photo by Jason Snyder / CC-BY-2.0
Artificial sugars and...cancer?

Artificial sugars may contribute to cancer in rats

Taylor et al., 1980
Artificial sugars and...cancer?

Artificial sugars may contribute to cancer in rats

BUT...results not relevant to humans

Taylor et al., 1980
A typical day of artificial sweeteners

Breakfast
- Coffee

Lunch/Snack
- Diet Soda

Dinner
- Fat Free honey dijon dressing

Dessert
- Oatmeal
- Rice pudding
Questions?
Menu for the Third Course

1. Decoding artificial sweeteners
2. Gluten sensitivity – is it real?
3. How has society changed food?
1. Decoding artificial sweeteners

2. Gluten sensitivity – is it real?
   – What is gluten?
   – What foods contain gluten?
   – What is celiac disease?
   – Is gluten sensitivity real?
   – Is it safe/healthy to be gluten-free?

3. How has society changed food?
Gluten is a protein
Gluten is a protein

Gliadin

Glutenin

Gluten

Multi-purpose Glue

Bonds Strong For All Your Cooking Needs
Safe, Non-Toxic?
Where can gluten be found?

**Found in:**
- Wheat
- Barley
- Rye

**Not found in:**
- Oats
- Potatoes
- Beans
- Rice
- Corn

http://www.ars.usda.gov/is/graphics/photos/k3607-20.html; Beer by Len Rizzi / National Cancer Institute; Easy Rye Bread by Veganbaking.net / CC-BY-SA-2.0; Oatmeal by Renee Cornet / National Cancer Institute; http://www.usda.gov/oc/photo/94cs3834.html; Black Beans by Cookbookman17 / CC-BY-2.0; One a day food item 20 by Darwin Bell / CC-BY-SA-2.0; Rice Bowl by Georgereyes / CC-BY-SA-2.0
Celiac disease is an autoimmune disorder

• Allergy to gluten
Celiac disease is an autoimmune disorder

- Allergy to gluten
- Affects ~ 1:100 people
Celiac disease is an autoimmune disorder

- Allergy to gluten
- Affects ~ 1:100 people
- Symptoms:
  - Fatigue
  - Gastrointestinal pain
  - Malnutrition

Celiac disease is an autoimmune disorder

- Allergy to gluten
- Affects ~ 1:100 people
- Symptoms
- Long-term damage

Damages small intestine

Celiac disease is an autoimmune disorder

- Allergy to gluten
- Affects ~ 1:100 people
- Symptoms
- Long-term damage
- Treatment

Gluten sensitivity

• Symptoms similar to celiac disease
• BUT…
• Treatment

No damage to small intestine
What does science say about gluten sensitivity?

2011 study

What? Measure gastrointestinal symptoms

Who? Patients with gastrointestinal symptoms that have improved on a gluten-free diet

Biesiekierski et al., 2011
What does science say about gluten sensitivity?

2011 study

How?

Biesiekierski et al., 2011
What does science say about gluten sensitivity?

A gluten-free diet can reduce overall symptoms

2011 study
Gluten-free does not mean healthier
Which has more…?
Gluten-free does not mean healthier

Which has more…?

<table>
<thead>
<tr>
<th></th>
<th>Gluten-free</th>
<th>Gluten-containing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Barilla Spaghetti</td>
<td></td>
</tr>
<tr>
<td>2 oz.</td>
<td></td>
<td>2 oz.</td>
</tr>
<tr>
<td>SERVING SIZE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>CALORIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 g</td>
<td></td>
<td>MORE 1.5 g</td>
</tr>
<tr>
<td>FAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 mg</td>
<td></td>
<td>MORE 10 mg</td>
</tr>
<tr>
<td>SODIUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44 g</td>
<td>MORE</td>
<td>41 g</td>
</tr>
<tr>
<td>TOTAL CARBS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 g</td>
<td></td>
<td>MORE 6 g</td>
</tr>
<tr>
<td>FIBER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 g</td>
<td></td>
<td>MORE 2 g</td>
</tr>
<tr>
<td>SUGARS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 g</td>
<td></td>
<td>MORE 7 g</td>
</tr>
<tr>
<td>PROTEIN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Gluten-free does not mean healthier

Which has more…?

<table>
<thead>
<tr>
<th></th>
<th>Gluten-free</th>
<th>Whole Grain Bread</th>
<th>Gluten-containing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Udi’s</strong></td>
<td>2 slices</td>
<td>SERVING SIZE</td>
<td>1 slice</td>
</tr>
<tr>
<td><strong>2 oz.</strong></td>
<td>140 CALORIES</td>
<td>1 slice</td>
<td>90</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 1 g FAT</td>
<td>4 g</td>
<td></td>
<td>1 g</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 260 mg SODIUM</td>
<td>260 mg SODIUM</td>
<td></td>
<td>190 mg</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 22 g TOTAL CARBS</td>
<td>22 g TOTAL CARBS</td>
<td></td>
<td>17 g</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 2 g FIBER</td>
<td>2 g</td>
<td></td>
<td>2 g</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 3 g SUGARS</td>
<td>3 g SUGARS</td>
<td></td>
<td>2 g</td>
</tr>
<tr>
<td><strong>2 oz.</strong> 4 g PROTEIN</td>
<td>4 g PROTEIN</td>
<td></td>
<td>5 g</td>
</tr>
</tbody>
</table>
Gluten-free does not mean healthier

Which has more…?

<table>
<thead>
<tr>
<th></th>
<th>Gluten-free</th>
<th>SERVING SIZE</th>
<th>Gluten-containing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillsbury Pie Crust</td>
<td>1/8 pie crust</td>
<td></td>
<td>1/8 pie crust</td>
</tr>
<tr>
<td>1/8 pie crust</td>
<td>125</td>
<td>MORE CALORIES</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>8.5 g</td>
<td>MORE FAT</td>
<td>3 g</td>
</tr>
<tr>
<td></td>
<td>170 mg</td>
<td>MORE SODIUM</td>
<td>130 mg</td>
</tr>
<tr>
<td></td>
<td>12 g</td>
<td>MORE TOTAL CARBS</td>
<td>6 g</td>
</tr>
<tr>
<td></td>
<td>0 g</td>
<td>FIBER</td>
<td>0 g</td>
</tr>
<tr>
<td></td>
<td>2 g</td>
<td>MORE SUGARS</td>
<td>0 g</td>
</tr>
<tr>
<td></td>
<td>0 g</td>
<td>PROTEIN</td>
<td>&lt;1 g</td>
</tr>
</tbody>
</table>
Questions?
How has society changed food?

Proposed changes to nutritional labels

http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm#images
How has society changed food?

Proposed changes to nutritional labels

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size 2/3 cup (55g)</td>
</tr>
<tr>
<td>Servings Per Container About 8</td>
</tr>
<tr>
<td>Amount Per Serving</td>
</tr>
<tr>
<td>Calories 230</td>
</tr>
<tr>
<td>% Daily Value*</td>
</tr>
<tr>
<td>Total Fat 8g</td>
</tr>
<tr>
<td>Saturated Fat 1g</td>
</tr>
<tr>
<td>Trans Fat 0g</td>
</tr>
<tr>
<td>Cholesterol 0mg</td>
</tr>
<tr>
<td>Sodium 160mg</td>
</tr>
<tr>
<td>Total Carbohydrate 37g</td>
</tr>
<tr>
<td>Dietary Fiber 4g</td>
</tr>
<tr>
<td>Sugars 1g</td>
</tr>
<tr>
<td>Protein 3g</td>
</tr>
<tr>
<td>Vitamin A</td>
</tr>
<tr>
<td>Vitamin C</td>
</tr>
<tr>
<td>Calcium</td>
</tr>
<tr>
<td>Iron</td>
</tr>
</tbody>
</table>

Servings larger
Calorie type larger
New: added sugars included

http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm#images
How has society changed food?

Gluten-free menus
Take home points from the third course

• Artificial sugars may be consumed in limited amounts safely
  – Does not necessarily mean it is healthy

• Gluten sensitivity may affect people without celiac disease
  – Explanation is unclear

• Science has provided evidence for changing our food
  – Society drives these changes
Take home points

1. Carbs, proteins and fats are fuel to provide our bodies with energy
   - Excess calories are converted to fat

2. It’s not about the headline, it’s about the study

3. It’s about making informed decisions
   - We can influence changes
Thank you!

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The Harvard Biomedical Graduate Students Organization (BGSO)

The Harvard/MIT COOP