Contemporary Nutrition

6th ed.

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Chapter 4, ***Carbohydrates***

Lecture Outline

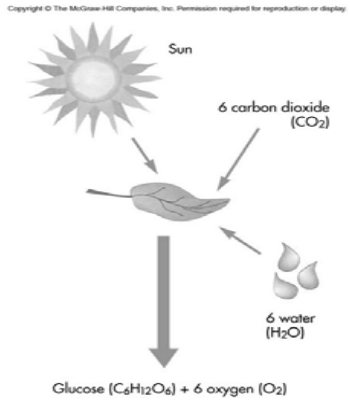
Carbohydrates

- Fuel source
- 4 kcal/gram
- Blood glucose & glycogen

Glycogen

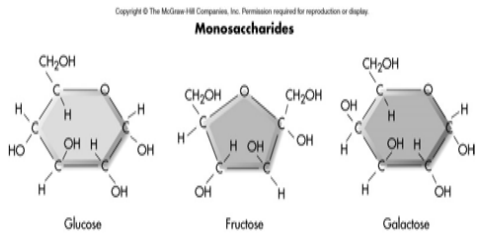
- Stored in liver
- Helps maintain blood glucose

Photosynthesis



Monosaccharides

- Structure
- **Glucose**
- Fructose
- Galactose



Glucose

- Major monosaccharide in the body
- Also known as dextrose
- In bloodstream called blood sugar
- Breakdown of starches and sucrose
- Source of fuel for cells

Fructose

- In sucrose
- In fruit, honey, and high-fructose corn syrup
- Absorbed in small intestines & converted into glucose in the liver

Galactose

- In lactose
- Converted to glucose in the liver

Disaccharides

- Simple sugars”
- Sucrose (Gluc + Fruc)
  - Sugar
- Lactose (Galactose + Gluc)
  - Milk products
- Maltose (Gluc + Gluc)
  - Fermentation
  - Alcohol production

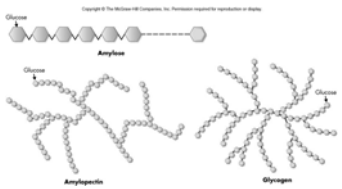
- Food labels lump all simple sugars, label will say “sugars”

Complex Carbohydrates

- Polysaccharides: Starch & Glycogen
- Amylose
- Amylopectin
- Dietary fiber

Polysaccharides

- 1,000+ glucose units bonded together
- Grains, vegetables & fruits
- Food label states “other carbohydrates”



Plants

- Store carbohydrates in forms digestible by humans

Glycogen

- Form of carbohydrates that animal store
- Stored in liver & muscle

Fiber

- Indigestible by humans
- Labeled as “dietary fiber”
  - Cellulose
  - Hemicellulose
  - Pectins
  - Gums
  - Mucilages
  - Lignin

  Insoluble & Soluble

Insoluble Fiber

- Do not dissolve in water
- Not metabolized by intestinal bacteria
- cellulose

Soluble Fiber

- Dissolve or swell in water
- Fermented by intestinal bacteria
  - Pectins, gums

examples

Table 4-1 Classification of Fibers

Type	Component(s)	Examples	Physiological Effects	Major Food Sources
Insoluble (poorly fermented)				
Noncarbohydrate	Lignin	Wheat bran	Increases fecal bulk	Whole grains
Carbohydrate	Cellulose, hemicelluloses	Wheat products Brown rice	Increases fecal bulk Decreases intestinal transit time	All plants Wheat, rye, rice, vegetables
Soluble (viscous)				
Carbohydrate	Pectins, gums, mucilages, some hemi-celluloses	Apples Bananas Oranges Carrots Barley Oats Kidney beans	Delays stomach emptying; slows glucose absorption; can lower blood cholesterol	Citrus fruits, oat products, beans, thickeners added to foods

Sugars in food

- 4kcal/gram
- High fructose corn syrup
- Brown sugar
- Raw sugar
- Honey
- Maple syrup

High Fructose Corn Syrup

- 55% fructose
- Cornstarch mixed with acid and enzymes
- Starch is broken down to glucose
- Some glucose is converted to fructose
- Cheaper than sucrose
- Does not form crystals

Sugar alcohols

- 206 kcal/gram
- Metabolized slowly
- Laxative effect

Alternative Sweeteners

- No kilocalories
- Saccharin
- Aspartame
- Neotame
- Acesulfame-K
- Sucralose (Splenda)

Carbohydrate Digestion

Effects of Cooking

- Softens fibrous tissues
- Easier to chew and swallow

Digestion of Carbohydrate in the Mouth

- Salivary amylase
  - Breaks starch to shorter saccharides
  - Prolonged chewing
- Short duration in the mouth

Digestion of Carbohydrate in the Stomach

- Acidic environment
- No further starch digestion

Digestion of Carbohydrate in the Small Intestine

- Pancreas releases enzymes
  - Pancreatic amylase
- Absorptive cells release
  - *Maltase*
  - *Sucrase*
  - *Lactase*
- Monosaccharides are absorbed

Absorption

- Glucose and Galactose
  - Active absorption
  - Energy is expended
- Fructose
  - Facilitated absorption using a carrier
  - No energy expended

Functions of Carbohydrates

- Supply energy
- Allowing protein to be reserved for energy
- Blood glucose levels need to be regulated

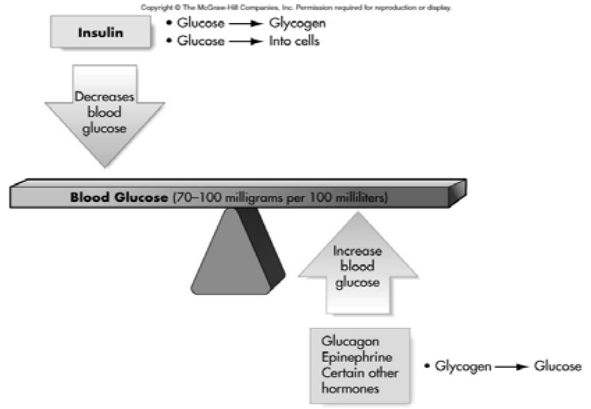
Regulation of Blood Glucose

- Hyperglycemia
- Hypoglycemia

Blood Glucose Control

- Role of the liver
  - Regulates glucose that enters bloodstream
- Role of the pancreas
  - Release of insulin
  - Release of glucagon

Regulation of Blood Glucose



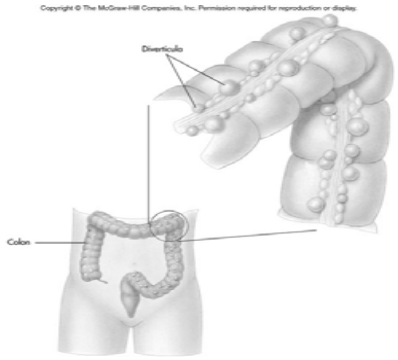
Dietary Fiber and Health

Putting fiber to work

- Adds mass to feces, making elimination easier
- Helps maintian healthy weight
- Filling
- Low in kcal
- Satisfied after eating
- Decrease risk of colon cancer
- Reduce cardiovascular disease

Too little fiber

- Small, hard feces
- Diverticua can become infected



Carbohydrate Needs

- RDA is 130 grams/day for adults
- Average U.S. intake is 180-330 grams
- Recommendations vary
  - FNB: 45%-65% of total calories
  - Nutrition Facts panel: 60%
- Focus on fruits, vegetables, whole grains

Recommended Dietary Fiber Intake

- AI is 25 grams/day for women
- AI is 38 grams/day for men
- (Goal of 14 grams/1000 kcal)
- DV is 25 grams for 2000 kcal diet
- Average U.S. intake:
  - 14 grams/day for women
  - 17 grams/day for men

Too Much Fiber

- 60 grams/day
- Extra fluid needed
- May decrease availability of some minerals
- Unmet energy needs in children

Recommendation for Simple Sugar Intake

- Low nutrient density
- Dental caries
- Added to food and beverages
- $\leq$ 10% of total kcal/day with a maximum of 50 grams (12 tsp) per day--WHO
- Average U.S. intake: 16% of total kcal/day
  - ~82 grams per day

Glycemic Response

- Glycemic Index
  - Ratio of blood glucose response to a given food

Metabollic Syndrome

- 25% of adults have it
- High blood triglycerides
- Poor blood glucose regulation
- Hypertension
- Risk factors
  - Obesity
  - Lack of physical activities
  - High simple/refined sugar intake
  - Low fiber intake

Lactose Maldigestion

- Reduction in lactase
  - Lactose is undigested and not absorbed
  - Lactose is metabolized by large intestinal bacteria
    - Causes gas, bloating, cramping, discomfort

What to study for Quiz #2

- P. 139 # 2,4 & 6
- Homework – p. 141