

## Chapter 1

### Macronutrients (CHO, Lipids, Proteins)

#### Nutrients

- Macronutrients
  - CHO
  - Protein
  - Fat
- Micronutrients
  - Vitamins (water and fat-soluble)
    - Must be obtained from the diet (13 vitamins)
  - Minerals
    - Macrominerals (major minerals) → 100 mg or more/day intake
      - Calcium, magnesium, potassium, etc.
    - Microminerals (trace elements) → less than 100 mg/day
      - Dietary mineral that is needed in minute quantities for proper growth, development, and physiology of organism
      - Iron, zinc, selenium, etc.

#### Functions of Nutrients

- Promotion of growth and development
  - Anabolic (building) environment is desirable for optimum growth
- Provision of energy
  - Energy is from the MACRONUTRIENTS (not b-vitamins or caffeine as most energy drinks claim)
- Regulates metabolism
- Maintains structure and integrity
  - This includes cell walls for example

#### Carbohydrates

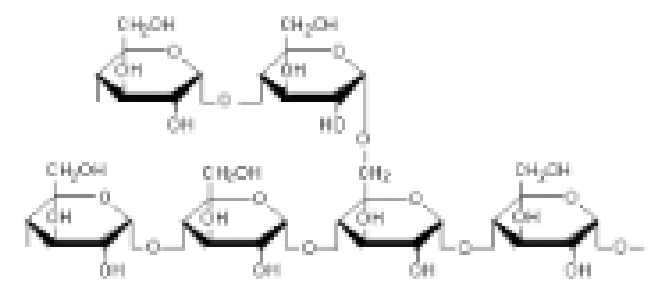
- Composed of Carbon, Oxygen, and Hydrogen
- $(CH_2O)_n$ 
  - Can also be expressed as a ratio of 1:2:1
  - $C_6H_{12}O_6$
- CHO is an important fuel during exercise
- CHO rich foods include:
  - Grains
  - Pasta
  - Potatoes
  - Rice
  - Beans
  - Sugar or sucrose

#### Different Carbohydrate Categories

- Monosaccharides (ONE sugar molecule)
  - Includes:
    - Glucose
      - Also called dextrose or blood sugar
    - Fructose
      - Also called levulose or fruit sugar
    - Galactose
  - Disaccharides (TWO monosaccharides linked)
    - Sucrose (glucose + fructose)

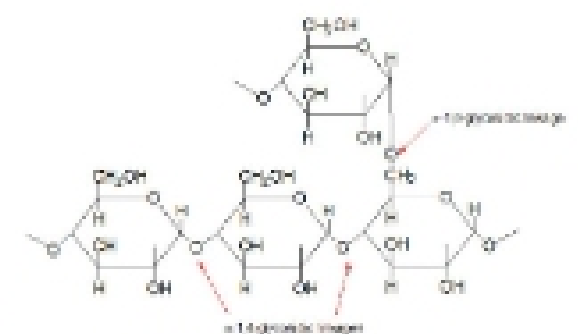
- \*\*Provides 20-25% of daily energy intake in Western diet
- Examples are beet and cane sugar, brown sugar, table sugar, maple syrup, and honey
- Lactose (glucose + galactose)
  - Examples are milk sugar
- Maltose (glucose + glucose)
  - Examples are beer, cereals, germinating seeds (only small amounts in our diet)
- Oligosaccharides (THREE to NINE monosaccharides linked)
  - Includes:
    - Seed legumes (peas, beans, and lentils)
    - Not digested well, but metabolized by bacteria located in the lower intestine
- Polysaccharides (TEN or MORE monosaccharides linked)
  - 10 to 20 monosaccharides = maltodextrin
  - Up to thousands of monosaccharides:
    - Includes:
      - Pasta
      - Potato
      - etc.
  - Starch (complex carbohydrate)
    - 50% of our total daily CHO intake; storage form of CHO in plants
    - Contains two components → amylose and amylopectin
    - Amylose and amylopectin are broken down and digested at different rates

- Amylopectin can be digested FASTER because it has multiple branches
  - Has increased surface area allowing it to be more exposed to digestive enzymes
- Amylose is digested SLOWER because it is a long chain; 200-4000 twisted in helical coil)



- Fiber (nonstarch, structural polysaccharide)
  - Exists EXCLUSIVELY in PLANTS
  - Gives "bulk," binds chemicals and fats, and shortens transit time for food
  - Includes:
    - Insoluble
      - Cellulose
      - Hemicellulose
      - Lignin
    - Soluble
      - Pectin
      - Gums
  - Recommended intake:
    - Men: 38 g/day
    - Women: 25 g/day

- Glycogen
  - Storage polysaccharide found in mammalian muscle (300-900 g) and liver (80-100 g)
    - Upper limit = 15 g/kg of bw
  - Consists of irregularly shaped, branched polysaccharide polymer
    - Structure is SIMILAR to amylopectin in plant
  - MAJOR source of CHO energy for active muscle during exercise



- o Liver → glycogenolysis (break down of glycogen) → extramuscular glucose

### Functions of Carbohydrates

- o Energy source
  - o Muscle glycogen and blood glucose can provide 32 kcal/minute during very high-intensity exercise
  - o 1500-2000 kcal (375-500g) of TOTAL storage
    - Exceeding the cells' capacity to store glycogen triggers conversion and storage of excess dietary CHO calories as FAT.
- o Affects of Metabolic Mixtures and Spares Protein
  - o Glycogen stores rapidly deplete during these three conditions:
    - Starvation
    - Reduced energy intake and low-CHO diets
    - Prolonged strenuous exercise
  - o These conditions will trigger an increase need for glucose synthesis or gluconeogenesis from both PROTEIN and the GLYCEROL portion of the fat
  - o In extreme cases, gluconeogenesis may reduce lean tissue mass
- o Metabolic Primer/Prevents Ketosis
  - o When glycogen stores are depleted like the scenarios stated above can cause more FAT MOBILIZATION than oxidation
  - o Can cause incomplete fat breakdown which then causes an accumulation of acetone like by-products called KETONE BODIES
    - As a result acidosis or ketosis can occur
- o Fuel for CNS
  - o CNS requires CHO to function properly
  - o Brain uses blood glucose as its fuel

### Glycemic Load

- o Glycemic index → provides a measure of how quickly blood sugar levels rise after eating a particular type of food
- o GI = ratio of BG response COMPARED to white bread
  - o Therefore, white bread = 100/100 on the glycemic index
- o When blood glucose spikes, there is a hormone response to foods
  - o Hyperinsulinemia
  - o Stimulation of fat synthesis
  - o Increased oxidative damage and inflammation
- o Rebound hypoglycemia can lead to over eating

### Glycemic Index vs. Glycemic Load

- o Glycemic index –
  - o Comparison of blood sugar response (% increase) between consuming 50 g of CHO from the food item and 50 g of pure glucose
- o Glycemic load –
  - o  $[GI * (g \text{ of CHO/serving})/100]$ 
    - High:  $\geq 20$
    - Medium: 11-19
    - Low:  $\leq 10$

### Fats

- SECOND major macronutrient
- They dissolve poorly in water
- o Categories:
  - Simple
    - Neutral fats – consists primarily of triglycerides

