Chapter 5: Carbohydrates

Simple Carbohydrates

**Monosaccharides:**

**Glucose**

Synonyms: dextrose, blood sugar
Fruits, honey, maple sugar

**Fructose**

Food sources: fruit, honey, and high fructose corn syrup

**Galactose**

Food sources: dairy products

**Disaccharides**

Structure:

Examples

Maltose (___________________ + __________________)

Sprouted seeds

Sucrose (___________________ + __________________)

Table sugar

Lactose (___________________ + __________________)

Milk

Complex Carbohydrates

**Oligosaccharides/Polysaccharides**

Examples:

Starch
Glycogen
Pectin
Cellulose, hemicellulos, lignins (fiber)

Complex carbohydrates

**Digestible polysaccharides vs Indigestible polysaccharides**

Digestible Polysaccharides:

**Starch**

1,000 or more monosaccharides bound together(digestible by humans)

Examples

Amylose –

Amylopectin –
**Glycogen**

Structure similar to amylopectin – many sites for enzyme action

Stored in the ______________ and ______________

**Indigestible Polysaccharides**

**Fiber**

Monosaccharides bound (indigestible by humans)

**Total fiber**

**Carbohydrate Digestion:**

**Mouth**

__________________________________________ breaks starch down into smaller units

(__________________________________________)

Taste the sweetness with prolonged chewing

**Stomach**

**Small Intestine**

**Pancreatic amylase**

Starch → simple sugars
Intestinal cells release

Monosaccharides are absorbed

**Functions of Glucose and Other Sugars**

Protein sparing

Prevents ketosis

Frame-work for making some proteins
Main source of energy for brain

**Fiber**

Polysaccharide that __________________________ be broken down

Two types:

**Insoluble (nonfermentable) fiber**

Examples: cellulose, hemicellulose, lignin
Functions:

Food sources: whole grains, vegetables
Comes from structural part of plant cell
**Soluble (viscous) fiber**
Examples: gum, pectin, mucilage
Functions:

Food sources: fruits, vegetables, rice bran, psyllium seed
Comes from inside the plant cell

**Functions of Fiber**
- Promotes softer, larger stool and regularity
- Reduces hemorrhoids and diverticula
- Slows glucose absorption
- Reduces blood cholesterol
- Reduces heart disease

**Carbohydrate Needs**

**Recommendations**
- RDA is 130 g/d for adults – adequate energy for brain and central nervous system
- ____% of total energy
- Primary sources: fruits, vegetables, whole grains, beans

Actual intake of North Americans
- ____ g/d (primarily from white bread, sodas, baked goods)
- ____% of total energy (~70% in some countries)
- Primary sources: white bread, sodas, baked goods

**Carbohydrate Needs: Fiber**

**Recommendations**
- Adequate Intake is based on 14 g/1000 kcals
  - 25 g/d for women and 38 g/d for men
- Daily Value = 25 g/d (3 servings/d of whole grains)

Actual intake of North Americans = 13-17 g/d

**Health Concerns: High-Fiber Diets**
- >60 g/d
  - Painful elimination, Intestinal blockages, Decreased nutrient absorption, Restricted energy intake in young children

**Health Concerns: High-Sugar Diets**
- Low nutrient density, Soda replaces milk in diet, Contributes excessive energy,
  - Dental caries, High glycemic index

**Recommendations**

**Actual intake of North Americans**
- ____% of total energy intake

**Health Concerns: Low-Sugar Diets**

**Gluconoegenesis**

**Ketosis**
Sugar Substitutes in the Diet

Alternative Sweeteners

**Saccharin**
- 180-200x sweeter than sucrose
- Can be heated
- Initial studies showed excessive intake is linked to bladder cancer in lab animals
- No longer considered having cancer causing potential
- Not a potential risk in humans

**Aspartame**
- 180-200x sweeter than sucrose
- 4 kcals/g, but only a trace amount is needed to sweeten foods
- Not heat stable
- Complaints of sensitivity to aspartame = headaches, dizziness, seizures, nausea, etc.
- Not recommended for people with phenylketonuria (PKU)

**Neotame**
- ~7000 –13000 times sweeter than sucrose
- Structure is similar to aspartame (but not a risk for PKU)
- Heat stable
- Safe for use by the general population (including children, diabetics, pregnant and lactating women)
- Used in a variety of products

**Acesulfame-K**
- K for potassium
- 200x sweeter than sucrose
- Not digested by the body
- Heat stable
- AKA Sunette

**Sucralose**
- 600 x sweeter than sucrose
- Heat stable
- Excreted in feces (small amount in urine)
- “Made from sugar so it tastes like sugar”

Regulation of Blood Glucose

**Hyperglycemia**

**Hypoglycemia**

Blood Glucose Control

Role of the **liver**

Role of the **pancreas**
- Release of___________________________ (hormone)
- Release of___________________________ (hormone)
Functions of **Insulin**

- Increases glucose uptake by the cells
- Net effect:

Functions of **Glucagon**

- Net effect:

Other Hormonal Influence

**Epinephrine/norepinephrine**

- “Fight or flight” response
- Breakdown glycogen (Rapidly)
- Raises blood glucose

Health Concerns

**Type 1 Diabetes Mellitus (Insulin-Dependent)**

- Decreased production/release of insulin
- Resulting in ________________________________
- Treatment for Type 1 DM
  - Carbohydrate intake must be coordinated with insulin injections to maintain blood-glucose levels and Insulin therapy

**Type 2 Diabetes Mellitus (Non-Insulin-Dependent)**

- Genetically linked
- _____% is associated with obesity
- Defective insulin receptors on the cells
- Over secretion of insulin to compensate
- Treatment: medication and diet therapy (weight loss)

Consequences of Uncontrolled Blood Glucose

- **Ketosis** leading to ion imbalances, dehydration, coma, death
- Degenerative diseases: nerve damage, heart disease, kidney disease, blindness
- **Atherosclerosis**
- Increased risk for wound infections

**Lactose Maldigestion**

- Lactose is undigested and not absorbed
- Lactose is metabolized by large intestinal bacteria
  - causes gas, bloating, cramping, discomfort
- Primary lactose maldigestion
- Secondary lactose maldigestion
- Coping with lactose maldigestion
  - Determine tolerated amount, Eat dairy with fat, Cheese and yogurt more easily tolerated, Lactase pills
Dental Caries

Tooth decay or dental cavities
Infectious disease which damages the structures of Teeth
Bacteria collect around the teeth and gums in a sticky, creamy-coloured mass called plaque
Prevented by eating sugar-free products
Personal hygiene care consists of proper brushing and flossing daily

Glycemic Index
Blood glucose response to given food compared to standard
Influenced by amount of starch, fiber, processing, structure, and presence of other macronutrients

Glycemic Load
Amount of CHO in food X GI of food
Better reflection of food’s effect on blood glucose

Effect of high glycemic load
Stimulates release of insulin
Insulin increases blood triglycerides
Insulin increases LDL
Insulin increases fat synthesis
Increases risk for CVD
Returns to hunger quicker
Muscle may become resistant to insulin

How to decrease glycemic load
Avoid overeating high glycemic load foods
Combine a low glycemic load food with a high one
Maintain healthy weight
Regular physical activity