Vitamins are noncaloric essential nutrients necessary for many metabolic tasks and the prevention of associated deficiency diseases.

Dietary Reference Intakes

Recommendations for nutrient intake by healthy population groups

Based on gender and age

- RDA
- EAR
- AI
- UL

Discovery: Early Observations

Discovered while searching for cures for classic diseases

- Dr. James Lind and scurvy
  - Sailors dying on long voyages without fresh food
  - Lemons and limes provided, no one became ill
  - British soldiers got the nickname “limeys”

Discovery: Early Animal Experiments

- Dr. Frederick Hopkins of Cambridge University
— Two groups of rats
  • Group 1: Fed synthetic mix of protein, carbohydrate, fat, mineral salts, and water
    — All rats died
  • Group 2: Fed same ration but with purified milk
    — All rats grew normally
— Proved that accessory factors are present in natural foods that are essential to life

• Era of Vitamin Discovery

• Most vitamins were discovered in the first half of the 1900s

• At first scientists assigned letters of the alphabet to each vitamin
  — A, C, D, E, K

• This practice was abandoned in favor of more specific names based on structure and function
  — Cobalamin, pyridoxine, choline

• Definition of Vitamin

• It must be a vital, organic substance that is only necessary in extremely small amounts.

• It cannot be manufactured by the body in sufficient quantities to sustain life, so it must be supplied by diet.

• Function of Vitamins

• Metabolism: Enzymes and coenzymes

• B vitamins are part of coenzymes
  — Coenzymes needed to perform certain functions, such as:
    • Glucose metabolism
• Protein metabolism
  • Fatty acid metabolism

• Functions of Vitamins, cont’d

• Tissue structure and protection
  — Vitamin C

• Prevention of deficiency diseases
  — Scurvy
  — Beriberi
  — Pellagra

• Vitamin Metabolism

• Fat soluble
  — Vitamins incorporated with absorbed fat and transported by chylomicrons
  — Best absorbed when eaten with fat
  — May be stored for long periods

• Water soluble
  — Easily absorbed and transported by the portal circulation
  — Not stored, so must be eaten on regular basis (exceptions: B12 and B6)

• Chapter 7
  Lesson 7.2

• Key Concepts

• Certain health problems are related to inadequate or excessive vitamin intake.
Vitamins occur in a wide variety of foods that are packaged with the energy- and tissue-building macronutrients (carbohydrate, fat, and protein). The body uses vitamins to make coenzymes required for some enzymes to function.

Fat-Soluble Vitamins:
Vitamin A (Retinol)

- Functions
  - Vision
  - Tissue strength and immunity
  - Growth

- Requirements
  - Food forms and units of measure
  - Body storage

- Deficiency disease: Xerophthalmia

- Toxicity symptoms

- Food sources

- Stability

Vitamin D (Cholecalciferol)

- Functions
  - Absorption of calcium and phosphorus
  - Bone mineralization

- Requirements

- Deficiency disease: Rickets and osteoporosis

- Toxicity symptoms

- Food sources

- Stability

Child with Rickets
Vitamin E (Tocopherol)

Functions
- Antioxidant function
- Relation to selenium metabolism

Requirements

Deficiency disease: Hemolytic anemia

Toxicity symptoms

Food sources

Stability

Vitamin K

Functions
- Blood clotting
- Bone development

Requirements

Deficiency disease: Uncommon

Toxicity symptoms

Food sources

Stability

Chapter 7
Lesson 7.3

Key Concepts

Certain health problems are related to inadequate or excessive vitamin intake.
• Vitamins occur in a wide variety of foods that are packaged with the energy- and tissue-building macronutrients (carbohydrate, fat, and protein). The body uses vitamins to make coenzymes required for some enzymes to function.

• Water-Soluble Vitamins:
  - Vitamin C (Ascorbic Acid)

  • Functions
    - Connective tissue
    - General body metabolism
    - Antioxidant function

  • Requirements

  • Deficiency disease: Scurvy

  • Toxicity symptoms

  • Food sources

  • Stability

• Thiamin (Vitamin B1)

  • Functions
    - Gastrointestinal system
    - Nervous system
    - Cardiovascular system

  • Requirements

  • Deficiency disease: Beriberi

  • Toxicity symptoms

  • Food sources

  • Stability
• **Riboflavin (Vitamin B2)**
  
  **Functions**
  - Energy production
  - Tissue protein building

  **Requirements**

  **Deficiency disease**

  **Toxicity symptoms**

  **Food sources**

  **Stability**

• **Niacin (Vitamin B3)**
  
  **Functions**
  - Energy metabolism
  - DNA repair

  **Requirements**

  **Deficiency disease: Pellagra**

  **Toxicity symptoms**

  **Food sources**

  **Stability**

• **Niacin Deficiency: Pellagra**

• **Vitamin B6 (Pyridoxine)**
• Functions
  — Protein metabolism
  — Neurotransmitter

• Requirements

• Deficiency disease

• Toxicity symptoms

• Food sources

• Stability

• Folate

• Functions
  — Converted to tetrahydrofolate, which aids in:
    • DNA synthesis
    • Regulation of blood homocysteine levels

• Requirements

• Deficiency diseases: Megaloblastic anemia, Neural tube defects

• Toxicity symptoms

• Food sources

• Stability

• Cobalamin (Vitamin B12)

• Functions
  — Regulation of blood homocysteine levels
  — Heme synthesis
— Nervous system functioning

• Requirements
• Deficiency disease: Pernicious anemia
• Toxicity symptoms
• Food sources
• Stability
• Digestion and Absorption of Vitamin B12
• Pantothenic Acid
• Functions
  — Acetyl coenzyme A
    • Needed to extract energy from all macronutrients

• Requirements
• Deficiency disease: Unlikely
• Toxicity symptoms
• Food sources
• Stability
• Biotin
• Functions
  — Coenzyme for carboxylases

• Requirements
• Deficiency disease: No natural deficiency known
• Toxicity symptoms
• Food sources
• Stability
• Choline
• Data insufficient to determine its essentiality
• Associated with the B-complex vitamins
  — Functions
    • Structural integrity of cell membranes
    • Neurotransmission
  — Requirements
  — Deficiency disease: Liver damage
  — Toxicity symptoms
  — Food sources
  — Stability

• Chapter 7 Lesson 7.4

• Key Concept
• The need for particular vitamin supplements depends on a person’s vitamin status.

• Phytochemicals
• Bioactive molecules with health benefits
• Act as antioxidants or hormones
• Some researchers believe there are more than 25,000 phytochemicals, many of which have yet to be identified.

• Phytochemicals, cont’d
• Functions
  — Link between intake and chronic diseases
  — Synergistic action

• Recommended intake

• Food sources
  — Seven colors with corresponding phytochemical
    • Lycopene, zeaxanthin, anthocyanin, beta-carotene, flavonoids, glucosinolate, allyl sulfides

• Vitamin Supplementation

• Ongoing debate

• Biochemical individuality
  — Life cycle needs
    • Pregnancy and lactation
    • Infancy
    • Children and adolescents
    • Aging

• Vitamin Supplementation, cont’d

• Lifestyle
  • Oral contraceptive use
  • Restricted diets
  • Exercise programs
  • Smoking
  • Alcohol
• Caffeine
  – Disease

• Vitamin Supplementation, cont’d

• Megadoses
  – Toxic effects
    – "Artificially induced" deficiencies

• Supplementation principles

• Functional foods

• Summary

• Vitamins are food substances required in very small amounts.

• Body cannot make vitamins, but a well-balanced and varied diet usually supplies sufficient intake.

• Fat-soluble vitamins are A, D, E, K.

• Water-soluble vitamins are C and B-complex.

• Summary, cont’d

• Possibility of toxicity is increased for fat-soluble vitamins compared with water-soluble vitamins.

• Water-soluble vitamins C and pyridoxine in megadoses can be harmful.

• Phytochemicals are found in whole and unrefined plant foods.

• Nutrition supplementation is a controversial subject.