Chapter 10
Minerals:
Mining for Nutrients

Hewlings/Medeiros

PowerPoint presentation created by
Susan J. Hewlings, PhD, RD

Classifying Minerals

• Essential components of the diet
• New and existing dietary minerals are still being researched.

• Classification of minerals
  – Macrominerals
  – Microminerals

Macrominerals vs. Microminerals

<table>
<thead>
<tr>
<th>Macrominerals</th>
<th>Microminerals</th>
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<tbody>
<tr>
<td>(Require 100 mg or more per day)</td>
<td>(Require less than 100 mg per day)</td>
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<tr>
<td>Calcium</td>
<td>Iron</td>
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<tr>
<td>Phosphorus</td>
<td>Zinc</td>
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<td>Sodium</td>
<td>Copper</td>
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<tr>
<td>Potassium</td>
<td>Selenium</td>
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<td>Chloride</td>
<td>Iodine</td>
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<td>Magnesium</td>
<td>Fluoride</td>
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<td>Chromium</td>
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<td>Manganese</td>
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<td>Molybdenum</td>
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<td>Cobalt</td>
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<td>Vanadium</td>
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Calcium

- Bone
  - Synthesis and maintenance
  - Constant turnover
  - Storage place for calcium

- Muscle and nerves
- Importance of calcium and vitamin D in disease
  - Youth and adolescent intake
    - Critical period for building bone
  - Prevention of osteoporosis

Osteoporosis

To Prevent Osteoporosis

- Consume two or three servings per day from the milk and dairy group from MyPyramid
  - Spread throughout the day
- Participate in weight-bearing exercise such as strength training, walking, running, etc.
- Females should maintain estrogen levels by maintaining a healthy weight
Bone Basics

Bone Turnover or Remodeling

Other Uses of Calcium

- Metabolism
- Blood clotting
- Blood pressure
- Calcium in weight loss?
Serum Calcium

- Calcium absorption
- Parathyroid hormone (PTH)
- Certain natural compounds can inhibit absorption of calcium  
  - Phytate
  - Oxalate

To increase calcium absorption:
- Spread intake throughout the day
- Presence of lactose in the gut may also increase absorption.

Calcium DRI

- Adolescents – 1,300 mg/day
- Adults <51 yrs old – 1,000 mg/day
- Adults >50 yrs old – 1,200 mg/day
- Food sources  
  - Dairy
  - Sardines
  - Greens
  - Spinach

Phosphorus

- Second most abundant mineral in the body  
  - Found in bones and soft tissue
- DRI: 700 mg/day
- Deficiency is rare
- Excess may decrease blood calcium (controversial)  
  - May be that people who drink a lot of soda don’t consume dairy

Food Sources:
- Meat
- Fish
- Poultry
- Eggs
- Milk and milk products
- Cereals
- Legumes
- Grains
- Tea
- Coffee
- Chocolate
- Soft drinks
Role of Phosphorus in the Body

- Bone and teeth
- ATP
- Enzyme support
- DNA and RNA
- Blood buffer

Magnesium

- The macromineral found in the smallest amount in the body
- Several functions:
  - Bone
  - Blood
  - Muscle relaxation
  - Cofactor

Magnesium Deficiency

- Rare
- Can occur as a result of:
  - Severe diarrhea
  - Vomiting
  - Heavy sweating
  - Alcoholism
  - Certain medications
Magnesium Requirements and Food Sources

- Absorbed in small intestines
- Men: 400 mg/day
- Women: 320 mg/day

Food Source
- Green leafy vegetables
- Grains
- Nuts
- Legumes
- Whole-grain cereals and breads
- Chocolate

Microminerals

- Commonly referred to as trace minerals
- Need < 100 mg/day
- Equally as important as macrominerals
  - Several diseases and conditions are linked to micromineral deficiencies.

Iron

- Prevention of anemia
- Oxygen delivery
- The amount of iron absorbed in a typical diet is quite low.
- Absorption can be influenced by the body's need.
Anemia

- Normal Hemoglobin:
  - Men: 13.8–17.2 g/100 ml of blood
  - Women: 12.1–15.1 g/100 ml of blood
- Hematocrit (%RBC in blood)
- Normal = 40–48
- Anemia if lower than normal

Caused by:
- Poor hemoglobin production
- Decreased RBC formation
- Increased blood loss
- Deficiency of iron, B₁₂, folate

Heme Iron vs. Non-Heme Iron

Heme Iron
- Found only in meats, fish, and poultry
- Can cross small intestine wall more readily than can non-heme form

Elemental Iron
- From plant and animal sources
- Absorption enhanced by vitamin C as well as presence of meat, fish, or poultry
Iron Requirements

- Higher for women than for men
  - Male DRI: 8 mg/day
  - Vegetarians – 14 mg/day
  - Women > 50 DRI: 8 mg/day
  - Women 19–50 DRI: 18 mg/day
    - Vegetarians: multiply DRI by 1.8 (need a supplement)
  - Pregnancy DRI: 27 mg/day
    - Prenatal vitamins often contain DRI

Food Sources of Iron

- Meat
- Fish
- Poultry
- Shellfish, especially oysters
- Beans
- Enriched cereal
- Green leafy vegetables
- Eggs
- Dried fruit

Iron Toxicity

- Toxic in too great quantities
- Hematocromatosis
  - Genetic disorder
  - Store high amounts of iron

  Symptoms of iron overload
  - Abdominal pain
  - Fatigue
  - Mental depression
  - Long term can lead to liver damage

  Symptoms of iron toxicity
  - Infections
  - Joint pain
  - Skin pigmentation due to iron deposits
  - Diabetes
  - Blood in the stool
  - Shock
Zinc

Functions of zinc include:
- 200 different enzymes
- Alcohol metabolism
- Hemoglobin synthesis
- Protein digestion
- Antioxidant enzyme function
- Blood pressure regulation
- DNA replication
- Protein synthesis, growth, and development
- Wound healing
- Immune function
- Development of sexual organs and bone growth
- Insulin release and function
- Gene regulation

Signs of Zinc Deficiency
- Dwarfism in young teens, particularly males
- Poor sexual development (underdeveloped testes in males)
- Deformed bones
- Poor healing of wounds
- Abnormal hair and nails; loss of hair
- Hypoguesia, or the inability to taste food
- Gastrointestinal disturbances, impaired lipid absorption
- Central nervous system defects
- Impaired folate and vitamin A absorption

Dwarfism in a Young Boy Suffering from Zinc Deficiency
Zinc Absorption and DRI

- Regulated by the small intestine
- ~40 percent of dietary zinc is absorbed.
- Men have higher DRI due to greater muscle mass.
- Adult male DRI: 11 mg/day
- Adult female DRI: 8 mg/day
- Tolerable upper intake level: 40 mg/day

Sources of Zinc

- Meats
- Poultry (turkey in particular)
- Oysters
- Herring
- Eggs
- Legumes
- Whole-grain cereals are good sources of zinc.

Copper

- A cofactor for enzymes
- Iron use and incorporation into hemoglobin and red blood cells
- Antioxidant defense against free radicals
- Strengthens collagen and therefore connective tissue
- Immune defense
- Synthesis of neurotransmitters
- Energy production via ATP synthesis

Copper Absorption and DRI

- Absorbed in small intestine and, to a certain extent, the stomach
- Regulated by the same protein as zinc
- Usually more than half of the dietary copper is absorbed
- DRI: 900 micrograms/day – Deficiency rare
- Tolerable Upper Intake Level of copper is 10 mg per day.

- Good sources of copper include organ meats, shellfish, mushrooms, chocolate, nuts, legumes, the germ and bran portions of cereals, and drinking water from copper pipes.
### Selenium

- **Antioxidant defense**
  - Glutathione peroxidase
- **Thyroid hormone**
- **Adult DRI:** 55 micrograms/day
- **Tolerable upper intake level:** 400 micrograms/day

**Food Sources**

- Seafood is an excellent source of selenium
- Fish (especially tuna)
- Meats
- Egg
- Wheat-based cereals*
- Sunflower seeds*

*Only if grown in selenium-rich soils

### Iodine

- **Synthesis of thyroxin**
- **Iodine deficiency**
  - Goiter
  - Cretinism
- **DRI:** 150 micrograms/day
- **Tolerable Upper Intake Level:** 1,000 micrograms per day

**Food Sources**

- Iodized salt
- Plants (grown in areas with sufficient iodine)

### Iodine Deficiency Leads to a Goiter
Fluoride

- Healthy teeth
  - Hard teeth for resistance to decay
- Excessive fluoride can lead to fluorosis.
- DRI for women: 3 mg/day
- DRI for men: 4 mg/day
- Found in fluoridated water and processed foods that use water
- Tolerable Upper Intake Level for adults: 8 mg/day

Chromium

- Glucose uptake
- Chromium picolinate
- Doesn’t seem to influence body composition in humans
- DRI for women: 25 micrograms/day
- DRI for men: 35 micrograms/day

**Food Sources**

- Brewer’s yeast
- Liver
- Nuts
- Whole grains
- Cheese