

**SUBJECT:**  
**PHARMACOLOGY**  
**TOPIC : TRACE**  
**ELEMENTS**

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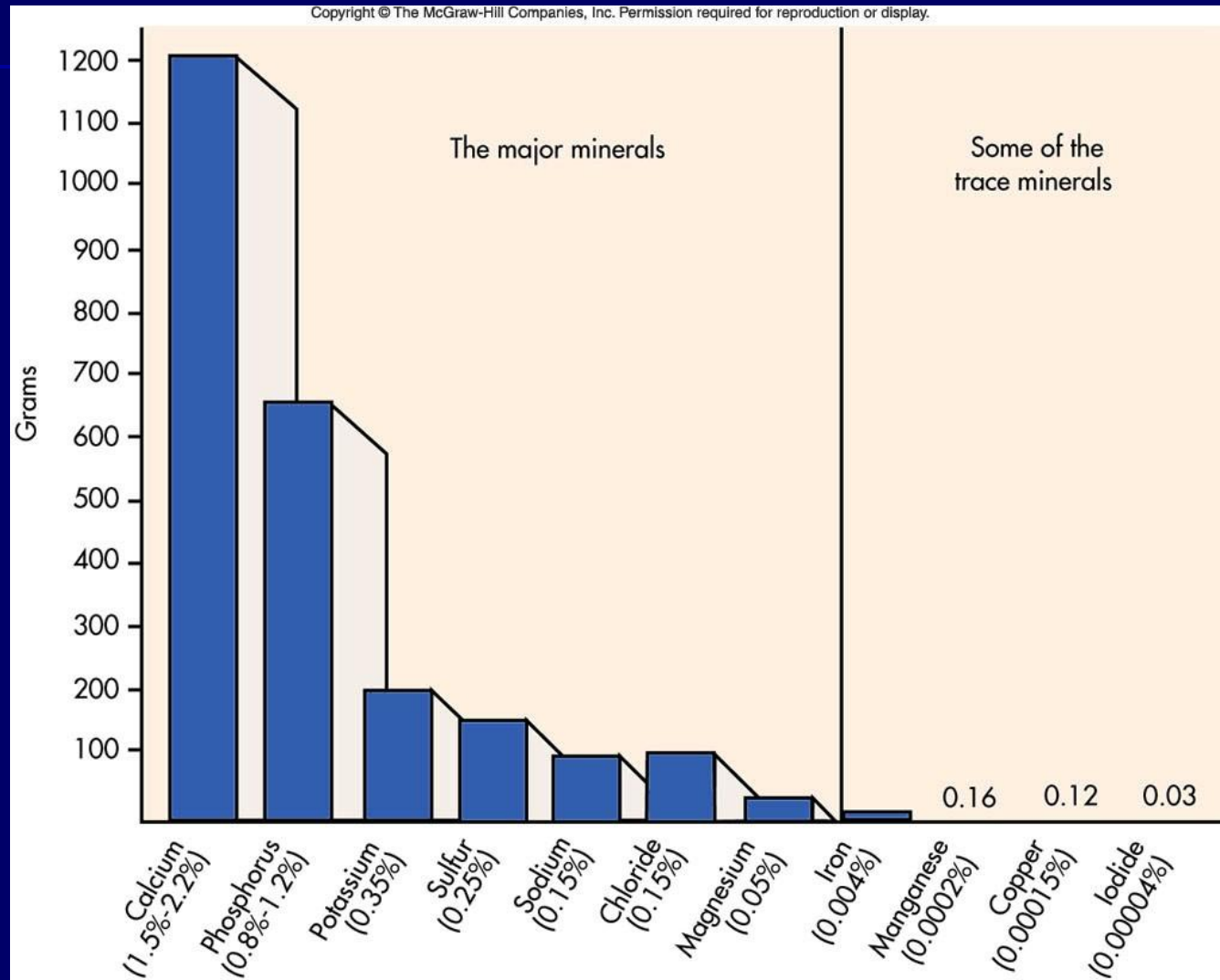
Academic year : 2019

# Trace Minerals

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# Minerals in the Body



# The Trace Minerals

- Needed in much smaller amounts
- Are essential
- Difficult to study due to the trace amounts needed by the body
- Food content dependent on soil content
- Animal sources of mineral are generally better absorbed.



# Iron

- Found in minute amount in every cell
- 15% is absorbed
- **Heme iron Vs. Nonheme iron**
  - 40% of iron in animal flesh is heme iron
  - Heme iron is better absorbed than nonheme
- Vitamin C enhances absorption

# Absorption of Iron

- Determined by body's need
- Acidic environment
- Upper small intestine is absorption site
- Hindered by phytic acid, oxalic acid, high fiber, high calcium, polyphenols
- Zinc competes with iron for absorption

# Functions of Iron

- **Hemoglobin** in red blood cells
  - Transports oxygen and carbon dioxide
  - High turnover, high demand for iron
- **Myoglobin** in muscle cells
  - Binds oxygen
- Electron transport chain
- Enzyme cofactor
- Immune function
- Drug-detoxification pathway

# Iron-Deficient Anemia

- Most common form of anemia (30% of world population)
- Low levels of hemoglobin and hematocrit
- Insufficient intake and storage
- Reduction in the production of red blood cells and oxygen capacity
- Infants, toddlers, chronic blood loss, vegans, runners, and women of childbearing years are most at risk
- Paleness, brittle nails, fatigue, difficulty breathing, poor growth

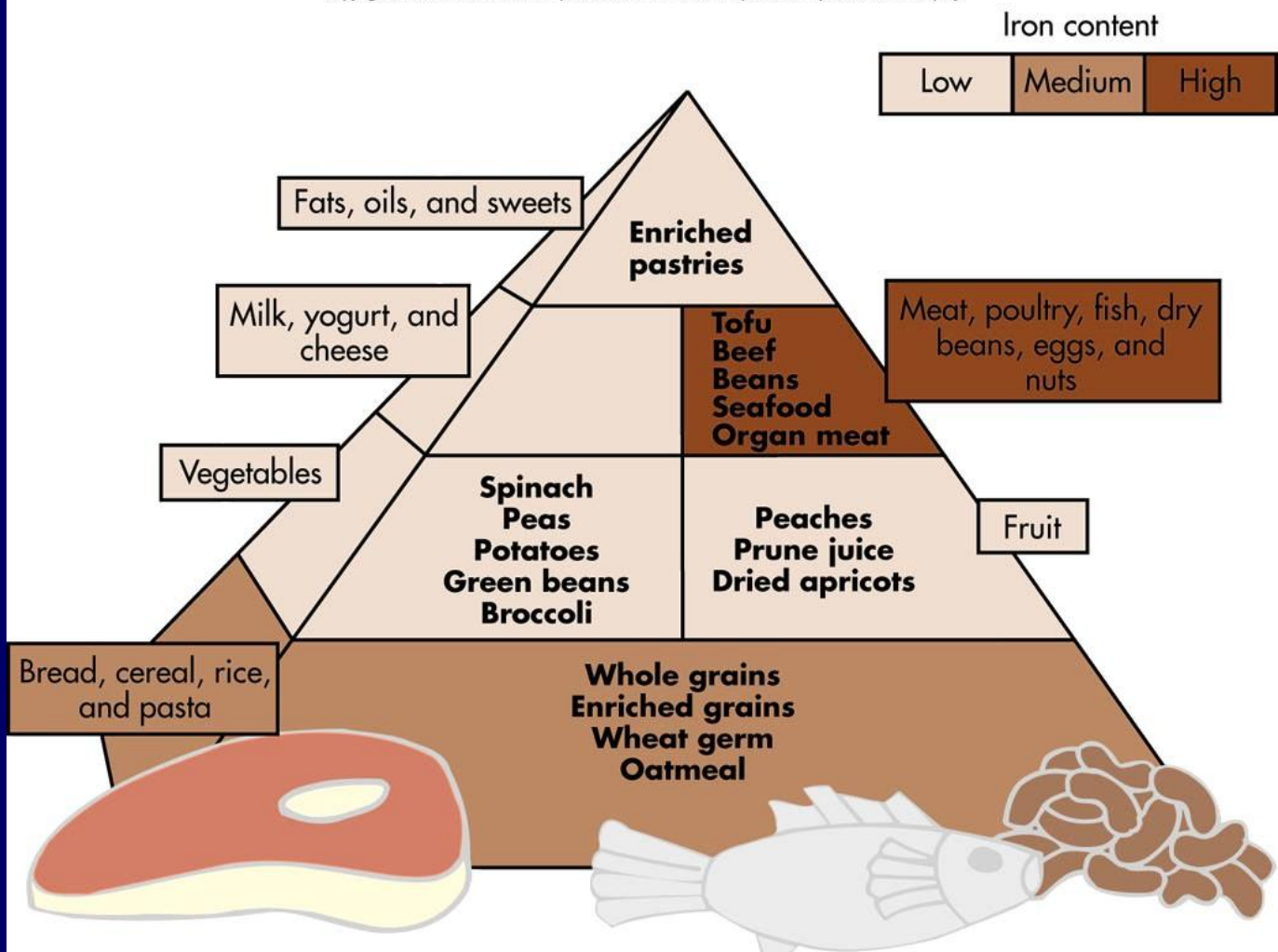
# Food Sources of Iron

- Red meats
- Enriched grains
- Fortified cereals
- Iron skillet
- Milk is a poor source



# Iron Pyramid

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# Nonheme Iron

- Not as well absorbed
- Found in animal flesh, eggs, milk, vegetables, grains and other plant foods
- Better absorbed if eaten along with sources of heme iron

# Iron Needs

- RDA is 8 mg/day for adult male
- RDA is 18 mg/day for female age 11 to 50; 8 mg after 50
- Assumes that 18% of dietary iron is absorbed
- Average American diet: females 12 mg/day; males 17 mg/day
- Average intake exceeds RDA for men, low for women



# Toxicity of Iron

- Can be serious, especially for children
- Diarrhea, constipation, nausea, abdominal pain
- Upper Level is 45 mg/day
- Causes death due to respiratory collapse (shock); liver damage
- Alcohol increases absorption, damages mucosal cells

# Hemochromatosis

- Genetic disease (carrier can also over absorb)
- Iron deposit which can lead to organ damage
- May go undetected until 50-60 years of age when organ fails

# Zinc

- Essential nutrient
- Better absorption from animal source
- Deficiencies cause growth retardation and poor sexual development

# Absorption of Zinc

- Influenced by the foods consumed
- 40% of zinc from an animal source is absorbed if body's needs are great
- Dependent on body's need
- Presence of phytic acid decreases absorption
- Calcium supplement decreases zinc absorption
- Competes with copper and iron absorption

# Functions of Zinc

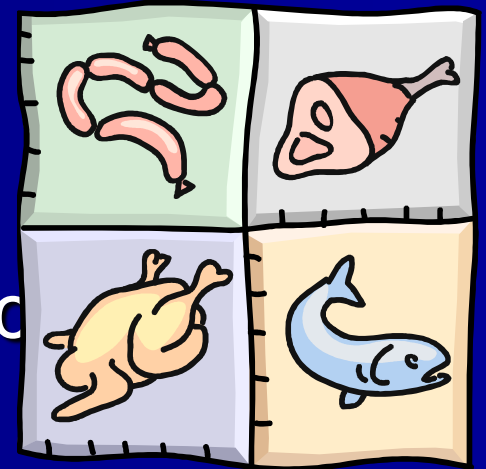
- Cofactor to many enzymes
- Synthesis of DNA, RNA
- Protein metabolism, cell membrane
- Wound healing, immune function, growth
- Development of sexual organs and bones
- Insulin function
- Component of superoxide dismutase

# Zinc Deficiency

- Growth retardation
- Slow sexual maturity
- Loss of taste
- Lethargy, emotional disorders
- Slow wound healing

# Food Sources of Zinc

- Animal products
- Shellfish
- Legumes
- Not part of the enrichment process
- RDA for women is 8 mg/day
- RDA for men is 11 mg/day
- Daily value is 15 mg
- Average intake is marginal for women and adequate for men



# Toxicity of Zinc

- Upper Level is 40 mg/day
- Inhibits copper absorption
- Reduces HDL
- Increases risk of heart disease
- Diarrhea, cramps, Nausea, vomiting
- Depressed immune function
- Do not exceed 100 mg/day without medical supervision
- Some take for sore throats, colds



# Selenium

- Readily absorbed
- Excreted through the urine and feces
- Co-factor for glutathione peroxidase
- Protects the heart and other cells from oxidative damage
- Works together with vitamin E
- Cancer prevention

# Deficiency of Selenium

- Muscle pain
- Muscle wasting
- Cardiomyopathy

# Food Sources of Selenium

- Fish, meat (organ meat), egg, milk, shell fish
- Grains, seeds, nuts dependent on soil content
- RDA for adults is 55 ug/day
- Average intake exceeds RDA

# Toxicity of Selenium

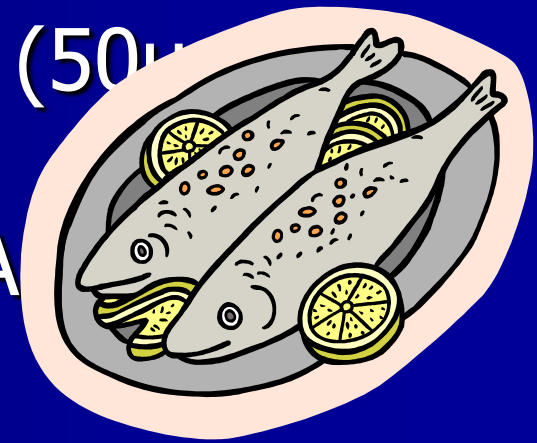
- Upper Level is 400 ug/day
- Garlicky breath
- Hair loss
- Nausea, vomiting
- Weakness
- Rashes
- Cirrhosis of the liver

# Iodine

- Found in an ion form, iodide
- Used for thyroid hormone synthesis
- Regulates metabolic rate, growth, development
- Thyroid gland enlarges (**goiter**) with low intake of iodide
- **Cretinism** is the stunting of fetal growth and mental development as a result of low iodine diet

# Food Sources of Iodine

- Iodized salt (1/2 tsp. meets RDA for iodine)
- Saltwater fish, seafood, dairy, grains
- Sea salt is a poor source (loss during processing)
- Plant source dependent on soil content
- RDA for adult is 150 ug/day (50ug prevent goiter)
- Average intake exceeds RDA



# Toxicity of Iodine

- Thyroid hormone synthesis is inhibited
- “Toxic goiter” results
- Consumption of seaweed
- Upper Level is 1.1 mg/day

# Copper

- Aids in iron metabolism
- Absorption dependent on body's needs
- Absorption decreased with high intakes of vitamin C, phytic acid, fiber, zinc, iron, certain amino acids



# Functions of Copper

- Increases iron absorption
- Formation of connective tissue
- In superoxide dismutase
- Immune system, blood clot, brain development, cholesterol metabolism

# Deficiency of Copper

- Anemia
- Decrease WBC
- Bone loss
- Inadequate growth
- Pre-term infants at risk
- Cardiovascular disease

# Food Sources of Copper

- Organ meats
- Seafood
- Cocoa
- Mushroom, legumes, seeds, nuts, whole-grain
- RDA is 900 ug/day for adults
- Daily Value is set at 2000 ug
- Average intake is about or slightly below the RDA

# Who is at Risk For Deficiency?

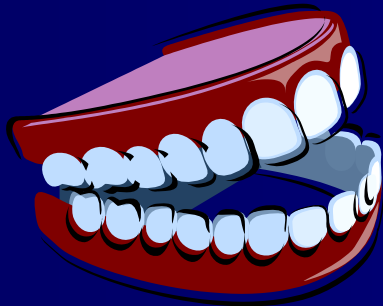
- Preterm infants
- Undernourished infants
- Intestinal surgery
- Long-term TPN
- Dialysis
- Burn patients
- Excess zinc supplement

# Toxicity of Copper

- Upper Level is 10 mg/day
- Not common

# Fluoride

- Role in prevention of cavities
- Resists acid and dental caries
- Fluoride inhibits bacterial growth that may cause cavities
- Fluoridated water (1ppm)



# “Food” Sources of Fluoride

- Fluoridated water (~0.2 mg/cup)
- Tea
- Seafood, seaweed
- Toothpaste
- Adequate intake is 3.1 -3.8 mg/day for adults
- Typical fluoridated water contains 0.2 mg/cup

# Toxicity of Fluoride

- Mottling of the teeth in children
- Limit toothpaste to pea size for children
- In high amounts can weaken teeth in children
- Upper Level is 10 mg/day

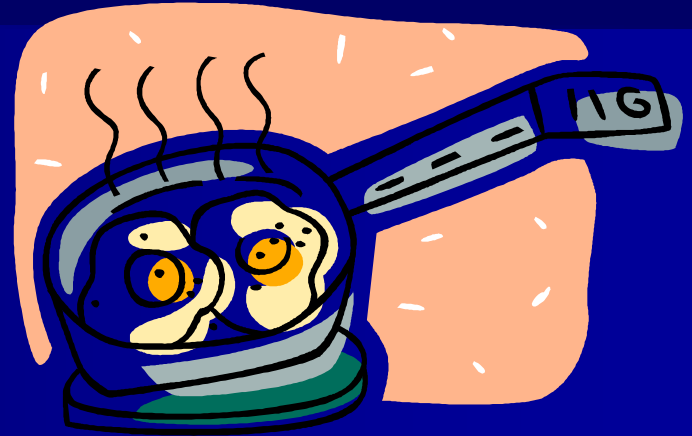


# Chromium

- Not well understood
- Role in Type 2 diabetes
- May increase the transport of glucose across the cell membrane
- Impaired glucose tolerance with low intake
- Elevated cholesterol and triglyceride with low intake

# Food Sources of Chromium

- Little information
- Egg yolk
- Bran, whole grain, cereal
- Organ meat, meat
- Beer
- Plant source dependent on soil content
- Adequate Intake is 25 - 35 ug/day for adults
- Daily Value is set at 120 ug
- Average intake meets the AI



# Toxicity of Chromium

- No toxicity from foods
- No Upper Level
- Exposed to chromium waste sites, painters and artists exposed to paints
- Lung & liver damage

# Manganese

- Role in CHO metabolism
- Role in bone formation
- No deficiency symptom observed in human
- Adequate Intake is 1.8-2.3 mg/day
- Average intake meets AI

# Manganese Toxicity

- Seen in individuals working in manganese mine
  - Severe psychiatric abnormalities
  - Violence, impaired muscle control
- Upper Level is 11 mg/day

# Molybdenum

- High intake will inhibit copper absorption
- Required by several enzymes
- Deficiency rare
  - Increased heart and respiration rates
  - Night blindness, mental confusion
  - Edema, weakness, coma
- RDA is 45 ug/day
- Average intake is 75-110 ug/day
- Toxicity seen in animals
- Upper Level is 2 mg/day

# Other Minerals

- Boron
- Nickel
- Silicon
- Vanadium
- Arsenic

# Mineral Pyramid

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