PHARM.D • YEAR 1

Pharmaceutical Inorganic Chemistry

CHAPTER 16

Essential Trace Elements

PPT CHAPTER COVER



Essential Trace Elements: Definition

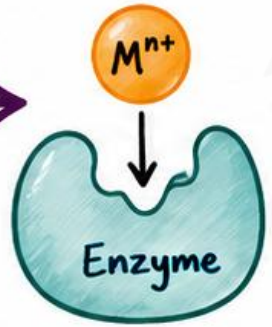
Essential trace elements are inorganic micronutrients required in very small amounts (< 100 mg/day) to act as cofactors, catalysts or structural components in vital biochemical and physiological processes; imbalance causes disease or dysfunction.

1. Required in trace amounts



< 100 mg/day

2. Act as cofactors, catalysts or structural components



Cofactor/ Catalyst

3. Support vital biochemical and physiological processes



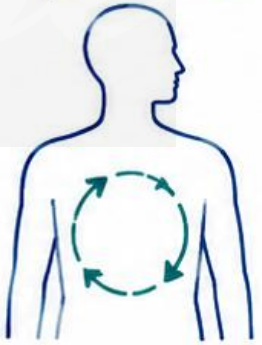
Metabolism • Enzymes
Hormones • Immunity

4. Imbalance leads to disease, dysfunction or death



Deficiency or excess → toxic or harmful

5. Homeostatic mechanisms maintain optimal levels



Regulation maintains balance

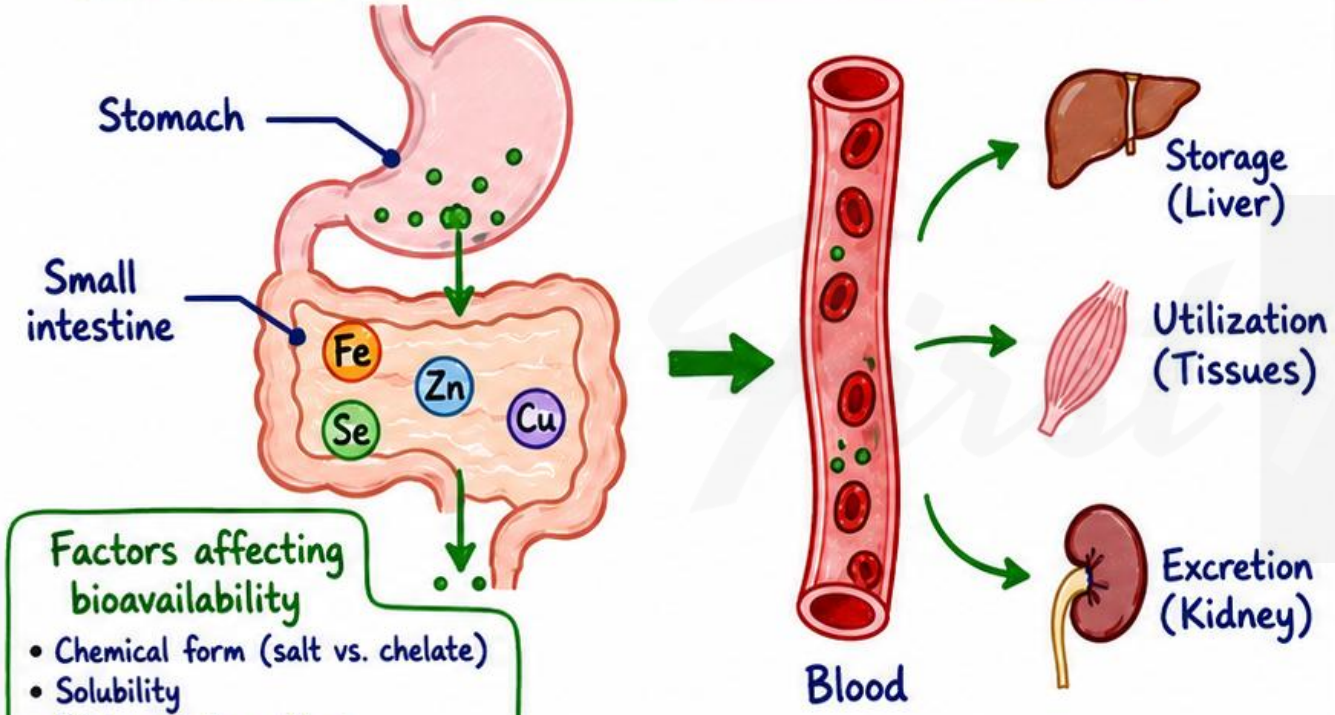
Key Characteristics

- **Requirement** < 100 mg/day
- **Function** Catalytic, cofactor, structural
- **Storage** Limited (except iron, zinc)
- **Toxicity** Can be toxic at high concentrations
- **Regulation** Homeostatic mechanisms maintain optimal levels

Examples: Iron, Zinc, Copper, Iodine, Selenium, Manganese, Chromium, Molybdenum, etc.

Bioavailability and Homeostasis

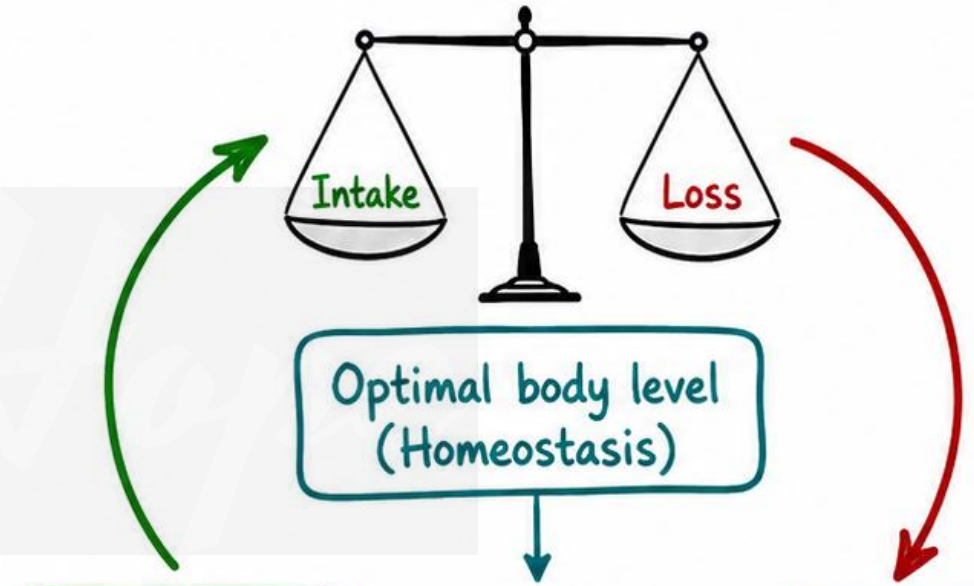
1) BIOAVAILABILITY OF TRACE ELEMENTS



Factors affecting bioavailability

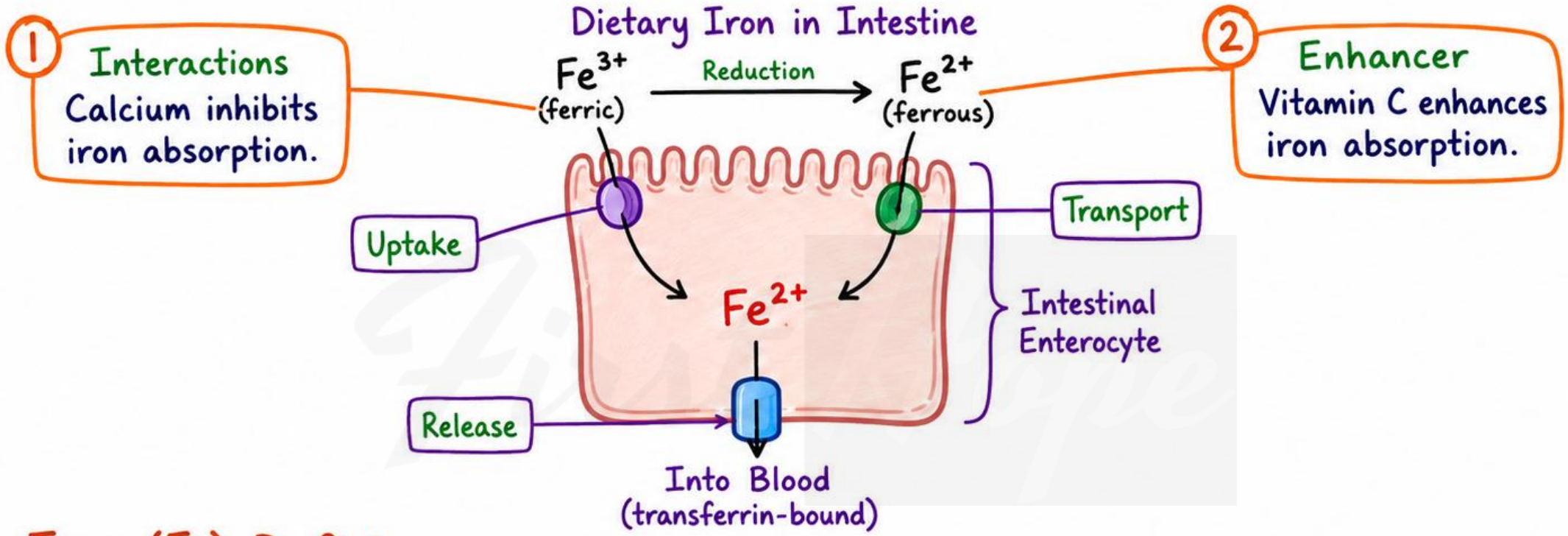
- Chemical form (salt vs. chelate)
- Solubility
- Dietary interactions (e.g., phytates ↓, vitamin C ↑)
- pH and gut conditions

2) HOMEOSTASIS OF TRACE ELEMENTS



- ★ Bioavailability = fraction of an ingested trace element that reaches systemic circulation.
- ★ Homeostasis = balance between intake and loss to maintain optimal body levels.
- ★ Toxicology studies determine safe intake limits and toxicity profiles for essential trace elements.

Iron



A. Iron (Fe) Deficiency

- Leads to iron-deficiency anemia.
- Symptoms: fatigue, pallor, dizziness, developmental delays in children.
- Importance: Ferrous sulfate ($FeSO_4$), ferrous gluconate, ferrous fumarate used as iron supplements; parenteral iron formulations like iron dextran.

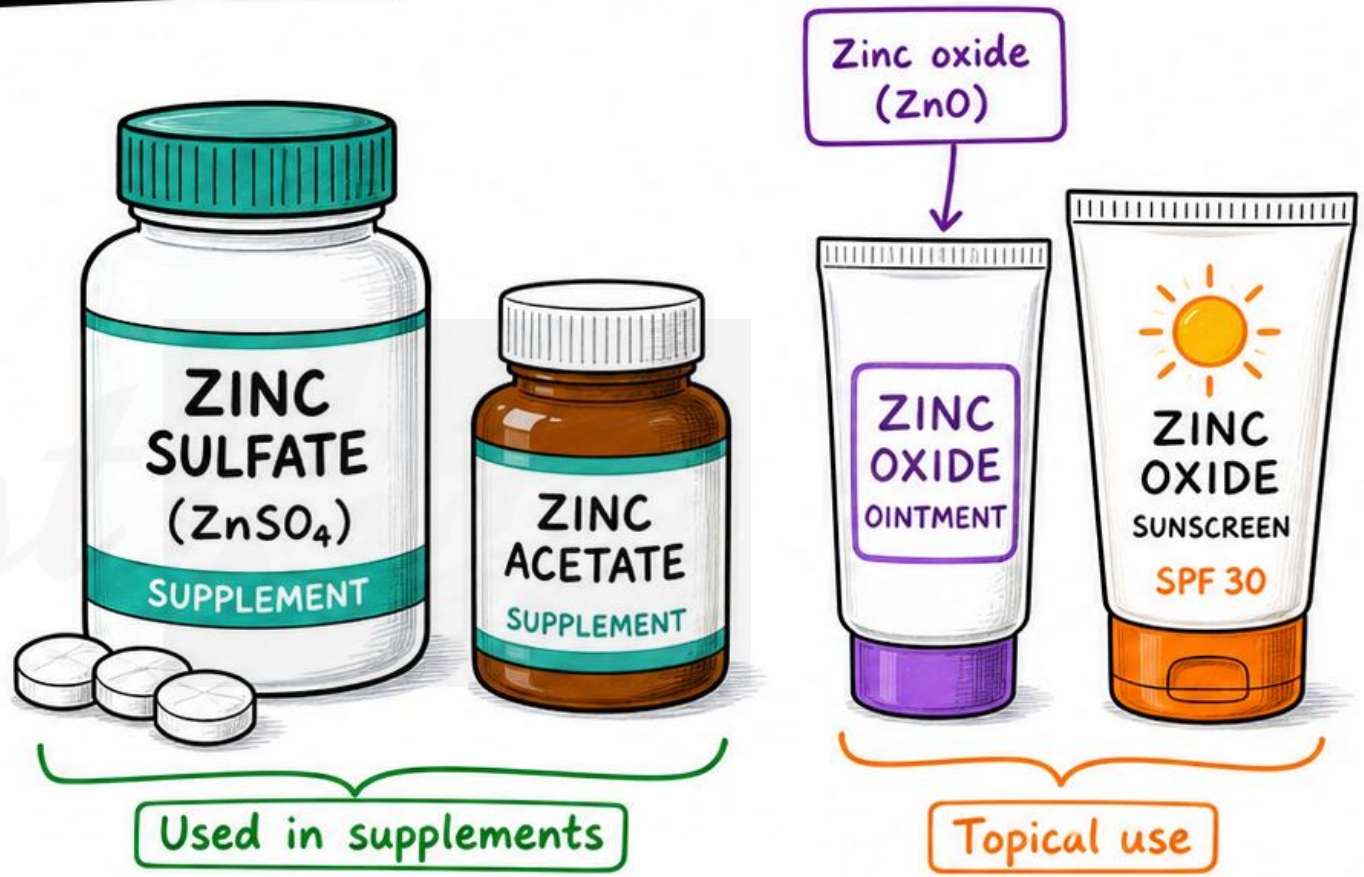
B. Toxicity

- Hemochromatosis (iron overload).
- Causes organ damage, especially in liver and heart.

Zinc

Importance:

- Zinc sulfate ($ZnSO_4$) and Zinc acetate used in supplements.
- Used topically as zinc oxide in ointments, sunscreens.



Takeaway: Zinc is supplied as zinc sulfate ($ZnSO_4$) and zinc acetate in supplements, and as zinc oxide (ZnO) in topical ointments and sunscreens.

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