Minerals

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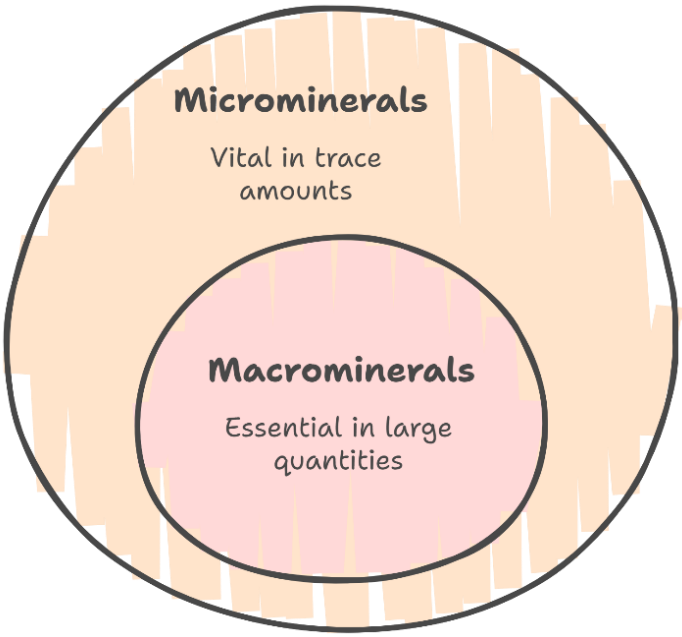
What Are Minerals

- Minerals are inorganic elements essential for various physiological and biochemical functions in the human body.
- Unlike organic nutrients such as carbohydrates, proteins, and fats, minerals are not produced in the body and must be obtained through diet.
- They are necessary for:
    - Enzyme activation
    - Hormonal synthesis and function
    - Nerve transmission
    - Muscle contraction
    - Bone and teeth formation
    - Acid-base balance
    - Electrolyte homeostasis

➢ Minerals play a critical role in the formulation of supplements, intravenous fluids, and in monitoring for deficiency or toxicity during disease management.

Classification of Minerals

Minerals are classified based on the required daily intake:



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A. Macrominerals (Major Minerals)

- Required in amounts **greater than 100 mg/day**.

Mineral	Symbol	Common Sources
Calcium	Ca	Milk, cheese, leafy greens
Phosphorus	P	Meat, dairy, legumes
Potassium	K	Bananas, potatoes, spinach
Sodium	Na	Table salt, processed foods
Chloride	Cl	Salt, tomatoes, olives
Magnesium	Mg	Nuts, whole grains, legumes
Sulfur	S	Protein-containing foods

B. Microminerals (Trace Elements)

- Required in amounts **less than 100 mg/day**.

Mineral	Symbol	Common Sources
Iron	Fe	Red meat, beans, spinach
Zinc	Zn	Meat, dairy, nuts
Iodine	I	Iodized salt, seafood
Copper	Cu	Shellfish, nuts, seeds
Selenium	Se	Brazil nuts, seafood
Fluoride	F	Fluoridated water, tea
Chromium	Cr	Whole grains, broccoli
Manganese	Mn	Nuts, legumes, whole grains
Molybdenum	Mo	Legumes, grains, leafy veggies
Cobalt	Co	Animal foods (as part of B12)

Functions of Minerals

1. Calcium (Ca)

- **Biochemical Role**: Key structural component of bones and teeth. Necessary for blood clotting, neurotransmitter release, muscle contraction, and activation of various enzymes.

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- **Clinical Relevance**: Calcium homeostasis is regulated by parathyroid hormone, calcitonin, and vitamin D.
- **Pharmacy Note**: Calcium supplements are used for osteoporosis, hypocalcemia, and as antacids.

2. Phosphorus (P)

- **Biochemical Role**: Present in ATP, DNA, RNA, and phospholipids. Vital for energy metabolism and acid-base buffering.
- **Clinical Relevance**: Essential in bone formation along with calcium.
- **Pharmacy Note**: Phosphate binders are used in patients with chronic kidney disease to prevent hyperphosphatemia.

3. Magnesium (Mg)

- **Biochemical Role**: Cofactor in more than 300 enzymatic reactions. Important for ATP utilization, muscle and nerve function.
- **Clinical Relevance**: Deficiency leads to neuromuscular symptoms and cardiac arrhythmias.
- **Pharmacy Note**: Magnesium sulfate is used for eclampsia, constipation, and magnesium deficiency.

4. Iron (Fe)

- **Biochemical Role**: Component of hemoglobin, myoglobin, and cytochromes. Critical for oxygen transport and cellular respiration.
- **Clinical Relevance**: Iron deficiency causes anemia, leading to fatigue and pallor.
- **Pharmacy Note**: Iron supplements are used for iron-deficiency anemia; parenteral iron may be required in severe cases.

5. Zinc (Zn)

- **Biochemical Role**: Essential for DNA synthesis, protein synthesis, wound healing, and immune function.
- **Clinical Relevance**: Zinc deficiency leads to impaired immunity, delayed wound healing, and growth retardation.
- **Pharmacy Note**: Zinc is included in oral rehydration solutions and used in wound care.

6. Iodine (I)

- **Biochemical Role**: Required for synthesis of thyroid hormones (T3 and T4).
- **Clinical Relevance**: Deficiency causes goiter, hypothyroidism, and cretinism in children.
- **Pharmacy Note**: Iodine preparations are used in antiseptics and contrast agents in radiology.

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7. Sodium (Na), Potassium (K), Chloride (Cl)

- **Biochemical Role**: Major electrolytes for maintaining osmotic pressure, acid-base balance, and nerve conduction.
- **Clinical Relevance**: Abnormal levels can cause muscle weakness, seizures, and cardiac arrhythmias.
- **Pharmacy Note**: Electrolyte imbalances are treated with intravenous fluids and electrolyte supplements.

Deficiency Diseases & Recommended dietary requirements Minerals

1. Macrominerals

Mineral	Biochemical Functions	Deficiency Disorders	RDA (Adults)
Calcium	Bone and teeth formation, muscle contraction, blood coagulation, nerve transmission, coenzyme activity	Rickets, osteomalacia, osteoporosis, tetany	1000–1300 mg/day
Phosphorus	Component of ATP, nucleic acids, phospholipids, bones and buffer systems	Hypophosphatemia, bone pain, muscle weakness	700 mg/day
Magnesium	Enzyme cofactor (ATP-related), neuromuscular function, bone health	Muscle cramps, arrhythmia, neuromuscular irritability	310–420 mg/day
Sodium	Major extracellular cation, regulates fluid balance, nerve transmission, acid-base balance	Hyponatremia, confusion, seizures	<2300 mg/day
Potassium	Major intracellular cation, regulates muscle function, nerve impulse, and cardiac rhythm	Hypokalemia (weakness, arrhythmia), hyperkalemia	4700 mg/day
Chloride	Main extracellular anion, acid-base balance, gastric acid (HCl) production	Hypochloremia, metabolic alkalosis	2300 mg/day
Sulfur	Component of amino acids (methionine, cysteine), vitamins (biotin, thiamine), disulfide bridges in proteins	Rarely deficient alone (usually with protein deficiency)	No established RDA

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