



# HME103-Principles of Nutrition

## Components in foods and their relationship with health: Minerals I

Lesson Code: HME103-Principles of Nutrition

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# Minerals

Mineral substances are inorganic substances that do not contain carbon.

Inorganic elements left behind as ash as a result of burning food are called **minerals**.

When the Earth was forming approximately 4 billion years ago, mineral substances were incorporated into the earth's crust.

Over time, as water circulates among the rocks on the earth, mineral substances mix with the water; They pass from water to soil, from there to plants, from plants to animals, and finally to humans who consume water, plants and animal products.



# Minerals



- Minerals are essential nutrients. Since the body cannot produce them, they must be taken with food.
- It is known that there are elements such as Na, K, Cl, Ca, P, Mg, Cu, Fe, Co, I, Se, Mn, Cr, S, and Zn that participate in the structure of living organisms.
- Mineral substances constitute approximately 5-6% of our total body weight. It has been determined that the majority of these are consist of calcium and phosphorus.
- The amount of mineral substances contained in the body varies according to gender and race.
- Mineral substances have **regulatory and/or structural functions**. However, mineral substances are not used as energy sources in the body.

# Minerals

Elements found in the form of ions within the cells or in body fluids of the organism are called **electrolytes**.

- Electrolytes found in the organism are in the form of cations such as  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  or in the form of anions such as  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ ,  $\text{HPO}_4^{2-}$ ,  $\text{SO}_4^{2-}$ .
- After being taken into the body with various foods, electrolytes are absorbed from the digestive system, transported by circulation, and distributed inside and outside the cell.





# Minerals

Minerals found in electrolyte form have various functions:

- They affect metabolic events.
- They play a role in regulating osmotic pressure.
- They are effective in the distribution of water in the body.
- They are effective in regulating acid-base balance.
- They play a role in regulating heart and muscle functions.
- They contribute to the regulation of oxido-reduction events.
- They act as cofactors in catalysis.



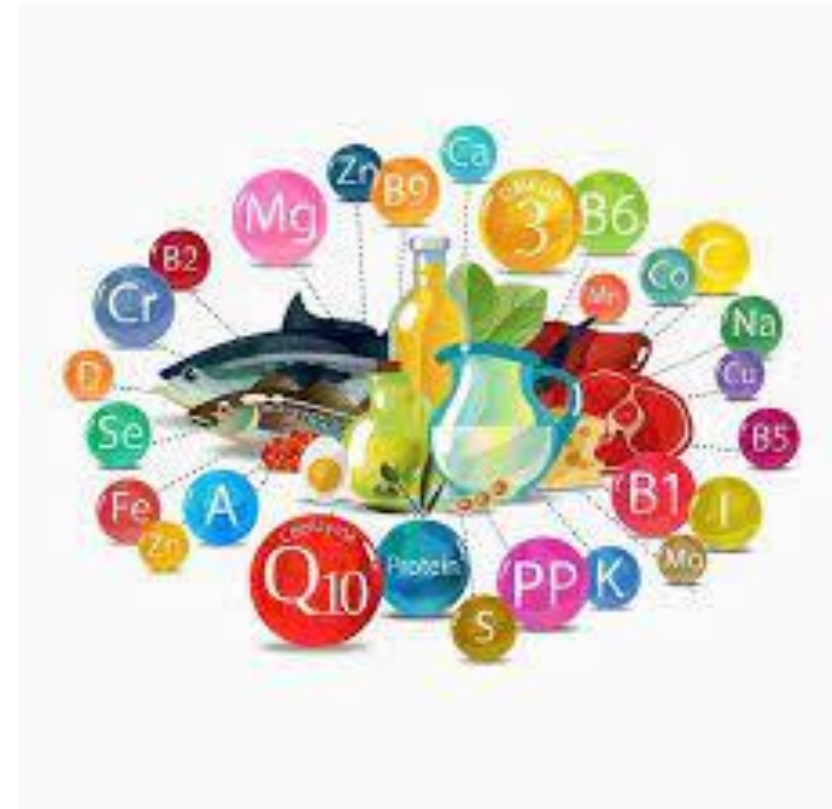
In short, mineral substances play an important role in the normal growth of bones and teeth, the regular functioning of the nervous system, muscles and organs, the balancing of body fluids, the maintenance of acid-base balance, the activity of enzymes and the synthesis of some substances.

# Minerals

Minerals are examined in two groups, macro (major) minerals and trace minerals, depending on the amount needed in the body.

Calcium, phosphorus, sulfur, potassium, chlorine, sodium and magnesium (Ca, P, S, K, Cl, Na and Mg) are found in larger amounts in the blood at mg% level than others and are known as **macro minerals**.

Iron, zinc, selenium, molybdenum, iodine, cobalt, copper, manganese, fluorine and chromium (Cu, Fe, Co, I, Se, Mn, Mo, Sr, Cr, Al and F) are present in the blood in lower amounts than others. They are present at the  $\mu\text{g}$  level and are known as **trace minerals** (minor elements); They function mostly depending on enzymes, hormones and vitamins.



# MACRO MINERALS

- They are found in more than 0.01% of body weight.
- More than 100 milligrams should be taken per day.
- They have both structural and regulatory functions.
- Calcium, phosphorus, sodium, potassium and magnesium are in the macro mineral substances group.



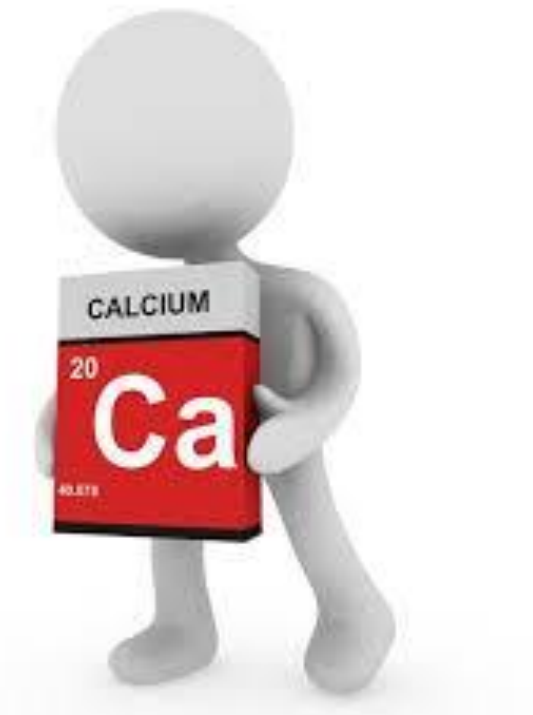




## FUNCTIONS OF CALCIUM

In addition to participating in the structure of bones, calcium also;

- Enables blood to clot in its ionized state.
- Controls the passage of fluid through the membrane by controlling the permeability of the cell membrane.
- Affects the sensitivity of nerves and muscles to stimuli.
- Plays a role in the normal contraction and rest of the heart muscles,
- Plays a role in the activation of some enzymes involved in digestion and metabolism (such as ATPase, lipase, choline esterase..).



When the serum Ca (blood calcium) level falls below normal, the parathyroid gland is stimulated and parathyroid hormone (PTH) is secreted.

### PTH:

1. Allows Ca to pass from bone to blood
  2. Increases calcium reabsorption from the kidney
  3. Increases Ca absorption from the intestine by stimulating the conversion of vitamin D to calcitriol in the kidneys.
- Thus, serum Ca level returns to normal.

When the serum Ca level rises above normal, the thyroid gland is stimulated and calcitonin is secreted.

### Calcitonin:

1. Ensures that serum Ca settles and stores in the bone.
2. Reduces Ca reabsorption from the kidneys. It increases urinary Ca excretion. (opposite effect to PTH).

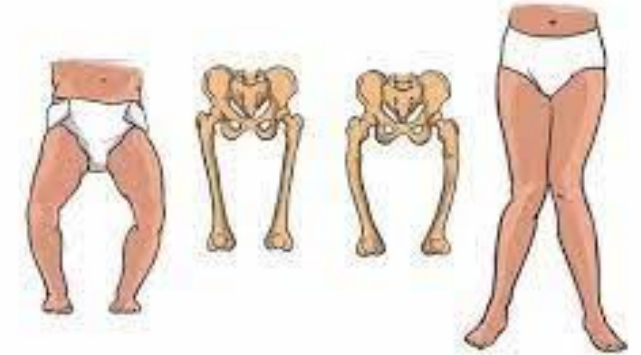
### Vitamin D

1. Increases Ca reabsorption from the kidney.
2. Stimulates the formation of calcitriol in the kidney and increases Ca absorption from the small intestines.

# CALCIUM deficiency

**Children:** It is very important to meet calcium needs during childhood. Due to the constant development of bones, the amount of calcium in the diet should be kept high.

- Deficiency causes a disease called **rachitism** in children. Along with calcium, vitamin D is also important in the development of this disease. In vitamin D deficiency, calcium taken with food cannot be absorbed in the small intestines.



**Adults:** **Osteoporosis** develops in adults as a result of calcium deficiency. The reason is that the structure of the bones changes due to calcium deficiency and osteoporosis begins. Bones with osteoporosis break easily, especially in the spine, hips and wrists.



## BIOAVAILABILITY OF CALCIUM

- ✓ The bioavailability of calcium is approximately 20-30% for adults. In other words, only 20-30% of the calcium taken with food is absorbed.
- ✓ However, during pregnancy, the bioavailability rate increases to 50% to provide resources for the formation of the baby's skeleton and the lactation period.
- ✓ During adolescence and rapid development periods, bioavailability is again around 50%.
- ✓ If you take at least one glass of milk or 250 g of yoghurt (a medium-sized bowl) in a day, half of your calcium needs will be met.
- ✓ In order for the calcium taken from food to be absorbed into the body, it must first be separated from organic substances and become a solution.
- ✓ **Calcium absorption** is facilitated by vitamins C and D, fats, a balanced diet and being spiritually balanced.



# What is bioavailability?

Bioavailability refers to the percentage of nutrients utilized or absorbed by our body. The part of the food that is not digested by the body is thrown out.

The bioavailability of minerals varies. While this value is below 5% for iron in spinach, it can rise up to 60% for sodium found in junk food.



It is not possible to prepare a diet based on the amount of mineral substances found in foods. The important thing is the rate at which mineral substances in foods are digested by our body, that is, the bioavailability rate.

- Although the amount of iron in spinach is high, the human body can only utilize 5% of this iron. If we want to meet our iron needs with spinach, we need to consume 10 to 20 times the amount of spinach we eat. This is not possible. Therefore, it is necessary to pay attention to the recommended daily food intake.





## CALCIUM SUPPLEMENTS AND OVERCONSUMPTION

The rapidly increasing risk of osteoporosis poses a threat to many people, especially women. This situation directs people to consume calcium-fortified foods and calcium supplements.

For calcium support, it should be taken as a single daily dose with food, not exceeding 500 milligrams.

*Why should we not consume more calcium than necessary?*

Excessive calcium consumption reduces the absorption of other minerals, such as iron, which is important for our body.



# FOOD SOURCES OF CALCIUM

FOOD ITEM	SERVING SIZE	ESTIMATED CALCIUM CONTENT (MG)
<b>Milk (whole, low fat, or skim)</b>	8 oz. (1 cup)	300
<b>Yogurt and ice cream</b>		
Plain yogurt, fat free or low fat	8 oz. (1 cup)	415
Fruit yogurt, low fat	8 oz. (1 cup)	245–385
Frozen yogurt, vanilla, soft serve	8 oz. (1 cup)	205
Ice cream, low fat or high fat	8 oz. (1 cup)	70–90
<b>Cheese</b>		
American	1 oz.	175
Cheddar, shredded	1 oz.	205
Cottage cheese, 1% milk fat	1 oz.	140
Mozzarella, part skim	1 oz.	145–205
Parmesan, grated	1 tbsp	70
Ricotta, part skim	4 oz. (1/2 cup)	335
Swiss	1 oz.	220–270
<b>Fish and shellfish (canned)</b>		
Sardines, canned in oil with bones	3 oz.	325
Salmon, pink, canned with bones	3 oz.	180
Shrimp, canned	3 oz.	50
<b>Vegetables</b>		
Bok choy (Chinese cabbage) raw	8 oz. (1 cup)	75
Broccoli, cooked and drained	8 oz. (1 cup)	60
Kale, cooked	8 oz. (1 cup)	95
Soybeans, mature, cooked and drained	8 oz. (1 cup)	175
Turnip greens, fresh, cooked and drained	8 oz. (1 cup)	200
<b>Fruits</b>		
Oranges	1 whole	50
Dried figs	2 figs	55

## FOOD SOURCES OF CALCIUM



**The best sources:** milk and its derivatives.

**Good sources:** molasses, sesame, hazelnuts, peanuts, etc., green leafy vegetables, legumes and dried fruits.

**Moderate sources:** foods such as green vegetables, eggs, oranges, lemons and strawberries.

**Poor sources:** grains, other fresh vegetables and fruits, and meats.

# PHOSPHORUS

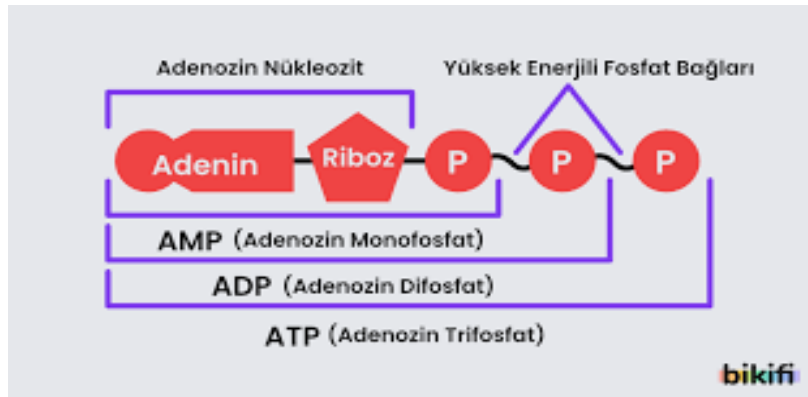
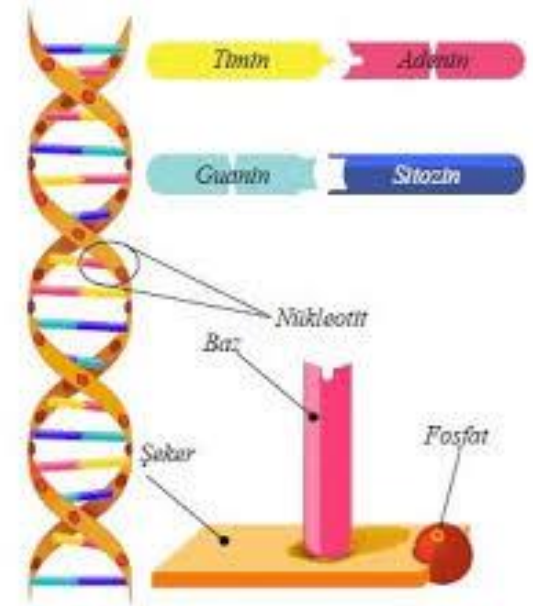
**It is the most abundant mineral in the body after calcium.**

- Approximately 80% of the phosphorus in the body, along with calcium, is found in the structure of bones and teeth.
- A newborn baby's 16-18 grams and adults' 600-900 grams are phosphorus.
- It is responsible for bone formation like calcium. The absorption, excretion and metabolic regulation of both are related to vitamin D and parathyroid hormone.
- 80% of the phosphorus in the body is found in bones and teeth, and the rest is in cells and outside cells.



# PHOSPHORUS

- ❑ Phosphorus is found in the structure of **nucleic acids** (DNA and RNA), **phospholipid** (such as lecithin, cephalin), **phosphoprotein** (e.g. casein), **some coenzymes** (NAD + -vitamin B3-, FAD -vitamin B2-) and **ATP**, which carries high energy.
- ❑ Phosphorus acts as a buffer in the functioning of the nervous system, energy metabolism, regular use of nutrients and cell functioning, as well as maintaining the neutrality of blood and other body fluids.





# DAILY PHOSPHORUS REQUIREMENT AND PHOSPHORUS SOURCES

- ❖ The body's daily phosphorus need is approximately as much as calcium.
- ❖ Although the phosphorus need of children increases according to their age, it is around 250-500 mg, and for adults it is around 1000-1500 mg.

## The best sources of phosphorus are:

Milk and its products,  
Meat and its products (non-fatty),  
Egg,  
Fish,  
Oily seeds,  
legumes, and  
grains



## Deficiency:

- Phosphorus deficiency, although very rare, is a condition that we may encounter, especially when it occurs with neurological diseases such as tingling, numbness and anger.
- 90% of this mineral is found in bones and muscles, so in case of deficiency, symptoms appear more frequently there, causing weakness in the bones and weakness in the muscles. Also,
- Bone diseases, (Rachitism, osteomalacia, etc.)
- Developmental disorders in teeth, tooth decay and tooth loss
- Loss of appetite and mental depression
- Dullness of the skin,
- Anemia,
- Confusion of consciousness, and
- an increased risk of catching infections may occur.

