

Calcium

Calcium is the most abundant mineral element in the body. It has two key roles. A very small proportion of body calcium plays a vital part in regulating critical functions including nerve impulses, muscle contractions and the activities of enzymes. More than 99% is located in the bones, where it plays an important role in their structure and strength . So critical is calcium's role in metabolic regulation that its concentration in the blood needs to be maintained within a narrow range. If insufficient calcium is obtained from the diet for this purpose , the bones act as a store of calcium from which the element can be withdrawn to keep the blood level constant . In short, we walk about on a vast store of calcium.

Biological functions

- Structural function:

Supporting material in bones. Present as calcium phosphate.

- Signalling function:

Intracellular calcium functions as a second messenger for some hormones.

- Enzymatic function:

Calcium acts as a coenzyme for clotting factors.

Calcium also causes the release of Acetylcholine from Pre-synaptic terminal in the transmission of nerve impulse..

Total calcium is made up of three components : protein bound calcium, ionized calcium and calcium that is complexed with other anions such as phosphate, citrate, bicarbonate and lactate . 99% of calcium in the body is part of bone .

1% in the blood :

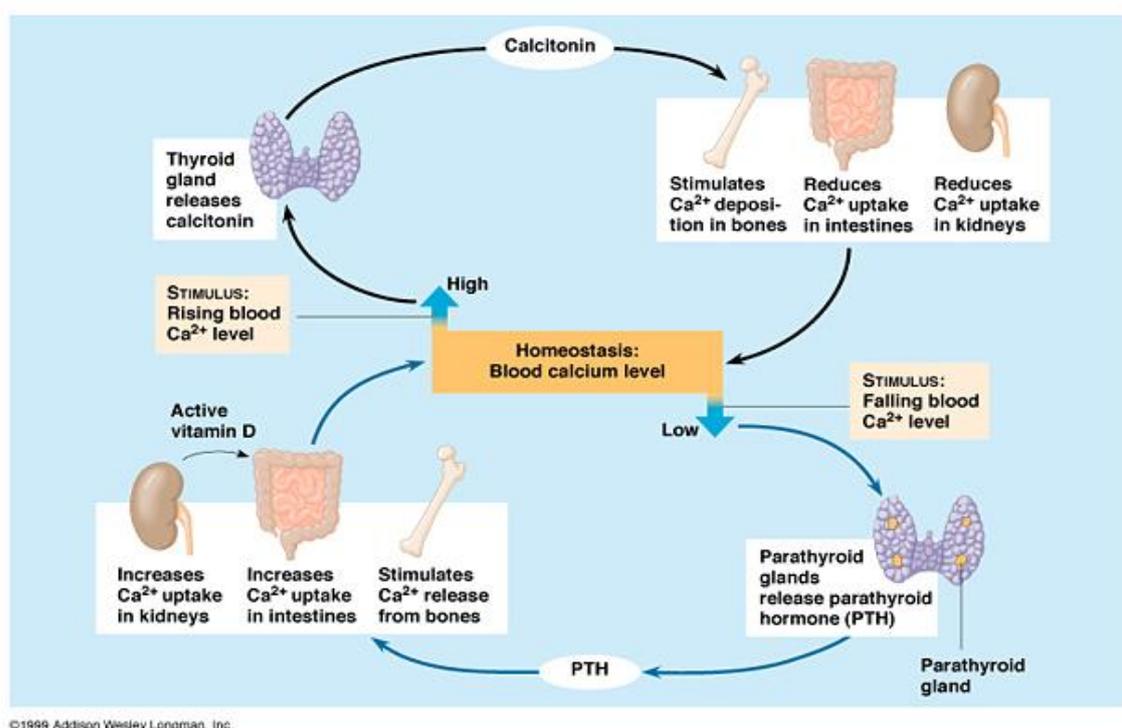
45% circulates as free Ca ions

40% bound to albumin

15% bound to anions (**citrate, sulfate, phosphate**)

calcium is determined by the amount of ionized calcium, rather than the total calcium. Ionized calcium does not vary with the albumin level, and therefore it is useful to measure the ionized calcium level when the serum albumin is not within normal ranges, or when a calcium disorder is suspected despite a normal total calcium level.

Calcium Regulation



Parathyroid hormone plays the key role. It is secreted from the parathyroid gland when the concentration of Ca⁺⁺ ions falls below a certain “set point” and acts by controlling the amount of calcium excreted in the urine. It also promotes the metabolism of vitamin D to calcitriol in the kidney and thus indirectly affects intestinal absorption. Parathyroid hormone is also a key regulator of bone remodeling and, hence, the release of calcium from bone.

Vitamin D (Calcitriol) promotes the active absorption of calcium from the small intestine and enhances the reabsorption of calcium by the kidneys. Increases in dietary calcium lead to decreases in the concentration of calcitriol in the plasma, probably through the influence

of parathyroid hormone. Calcitriol may also act directly on bone. Together, calcitriol and parathyroid hormone stimulate release of calcium from bone into blood (resorption) and its reabsorption from the kidneys, thus helping maintain the blood calcium concentration.

Calcitonin

Calcitonin is a 32 amino acid peptide hormone synthesized and released by the parafollicular cells (C-cells) of the thyroid. Calcitonin is released in response to high serum calcium levels (and, for unknown reasons, in response to some gastrointestinal peptides). Like PTH, calcitonin has a short half-life of about 10 minutes

The actions of calcitonin are opposite to those of PTH. In bone, calcitonin inhibits calcium resorption by inhibiting the function of mature osteoclasts and by inhibiting the differentiation of osteoclast precursor cells. In kidney, calcitonin inhibits the reabsorption of both calcium and phosphate

Hypercalcemia Symptoms

- Hypercalcemia of malignancy
- Addison's disease (30-40%)
- Primary hyperparathyroidism
- Bone cancer
- Bone infection (osteomyelitis)

Hypocalcemia Symptoms

- Fainting.
- Heart failure.
- Chest pains.
- Muscle cramps, particularly in the back and legs; may progress to muscle spasm (tetany)
- Difficulty swallowing.
- Voice changes due to spasm of the larynx

Lab Practices:

- Collect blood for the test in an appropriate tube.
- Follow the method in the pamphlet.
- Compare the results to the normal value.

Reagents component of calcium kit : R1 , R2, standard

Procedure:

Wavelength: 520 nm
Cuvette: 1 cm light path
Temperature. 37°C / 15-25°C
Adjust the instrument to zero with distilled water.
Pipette into a cuvette

Working reagent : Mix 0.5 ml R1 with 0.5 ml R2

Reagent	sample	Standard
1 ml working reagent	10 µl	10

Mix, and let test tube stand for 2 minute at room temperature . Read the absorbance (A) of the samples and standard, against the Blank

Calculation:

$$\text{Concentration of Calcium} = \frac{\text{Absorption of sample}}{\text{Absorption Standard}} \times \text{Conc of Stan}$$

Concentration of Standard is 10 mg/dl