

## Biological Role of alkaline earth metals

Magnesium and calcium are the two alkaline earth metals required in bulk quantities in the life process. These alkaline earth metals are distributed in the living system mainly in the form of carbonates and phosphates. Calcium is the bulk structural element associated mainly associated with animal skeleton and magnesium is mainly associated with animal and plant physiological process. Thus these two alkaline earth metals have different biochemical properties.

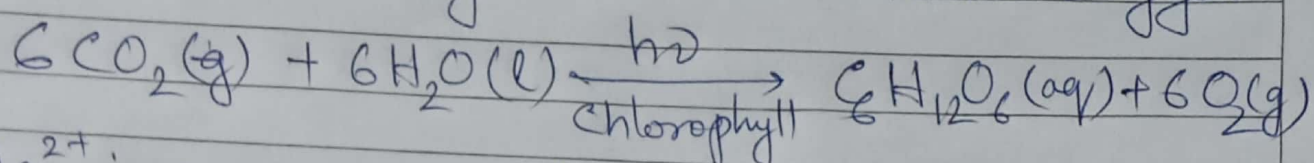
### Biological role of magnesium ion ( $Mg^{2+}$ )

Magnesium is the major component of intracellular fluid after potassium. It has higher concentration in red blood cells. In plants  $Mg^{2+}$  ion has important role in photosynthesis. The small double charge cation has high charge/size ratio, so it can easily hydrate and also form strong complex with oxygen of the various phosphate groups. It has carry the following important functions in the living systems:

- 1) One of the most important aspect of biochemistry of magnesium is its role in photosynthesis.  $Mg^{2+}$  ions are present in

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chlorophyll, which is the green colouring matter present in plants. Chlorophyll using energy from the sun and converts carbon dioxide and water into glucose and release oxygen.



2)  $\text{Mg}^{2+}$  ions are concentrated in animal cells in the same way as  $\text{K}^+$  ions concentrated inside the cell.  $\text{Mg}^{2+}$  ion forms complex with adenosine triphosphate (ATP) and constituent of enzymes phosphohydrolase and phosphotransferase. These enzymes are involved in the energy releasing process. It has been observed that all transphosphorylation reactions involving ATP proceeds smoothly in presence of  $\text{Mg}^{2+}$  ions.

3)  $\text{Mg}^{2+}$  ions are present in enzymes aminopeptidase which hydrolyse polypeptides into free amino acids and lower peptides.

4)  $\text{Mg}^{2+}$  ions formed complex with nucleic acids inside cells and are necessary for nerve impulse transmission

5) In muscles  $\text{Mg}^{2+}$  ions content is comparatively high where it plays the role of activation of ions in a variety of enzymatic reactions.

6) Metabolism of carbohydrate is also associated with the interaction of  $\text{Mg}^{2+}$  ion.

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## Biological role of calcium ion ( $\text{Ca}^{2+}$ )

Calcium is the ~~st~~ essential bulk element. About 90% calcium is distributed in the skeleton of the animals mainly as calcium phosphate and in bones and as fluorapatite  $[3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2]$  in teeth and rest of the calcium is involved in animal physiology. It is mainly present in out side of the cell like sodium ion in body fluid. Small amount of calcium is also present in blood. ( $0.0022$  to  $0.0028 \text{ mol L}^{-1}$ ) Very small amount ( $10^4$  times less than extracellular fluid) of  $\text{Ca}^{2+}$  ions are present in the intracellular fluid to carry out the function of Calcium pump (like sodium pump) which carry the expulsion of  $\text{Ca}^{2+}$  ions of the muscle cells.

The external skeleton of creatures like tortoise, star fish, Jelly fish, Coral and egg shells of birds and reptiles are made up of calcium carbonate as protective cover.

Some ~~im~~ of the important role of magnesium ion in biological process are as follows

- 1)  $\text{Ca}^{2+}$  ions plays important biochemical role in trigger muscle contraction. In the state of rest the level of  $\text{Ca}^{2+}$  ions near the muscle fibres are very low since all the  $\text{Ca}^{2+}$  ions in muscle are pumped into complex network of vesicles called sarcoplasmic reticulum (SR). Nerve impulse

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induce the SR membrane to release large amount of  $\text{Ca}^{2+}$  ions quickly.  $\text{Ca}^{2+}$  ion is the intermediate between the nerve impulse and muscle contraction. Relaxation of the muscle demands reduction in  $\text{Ca}^{2+}$  ion level to their level of rest. This is accompanied by an ATP-driven  $\text{Ca}^{2+}$  ion transport protein called ~~cat~~  $\text{Ca}^{2+}$ -ATPase.

- 2) The dipositive calcium ion influence protein folding. This change in protein structure due to folding controls cell structure and function such as rate of cell growth, metabolism and energy.
- 3) Calcium ions play important ~~role~~ regulatory role in the function of enzymes like lipase, ATPase, actomyosin and myosin. These enzymes require  $\text{Ca}^{2+}$  ion for their activation.
- 4) Calcium ions play important regulatory role in blood clotting. Blood contains prothrombin, a soluble protein. This is converted to the enzyme thrombin by the ~~reaction~~ action of prothrombin activator in the presence of  $\text{Ca}^{2+}$  ions. Thrombin again added by  $\text{Ca}^{2+}$  ions and clots the blood by converting its soluble fibrinogen into insoluble fibrin.

- 5) The deficiency of Vit. D causes rickets which mainly occurring in children due to lack of proper absorption of calcium phosphate in bones.
- 6) Deficiency of calcium causes tetany while excess deposition of calcium is known as Calcification. Deficiency of calcium occurs due to precipitation of calcium as calcium oxalate by reaction of  $\text{Ca}^{2+}$  ions with soluble oxalates present in the body. Tiny crystals of calcium oxalates pass out of the body by urine. Some times these crystals deposited in large amount and deposited in kidney without passing through urine. These deposition of calcium oxalate in kidney is known as painful kidney stone.