

**Deficiency/excess of  
Mn, Co, and Zn metal  
ions.**

## ■ Manganese metal ions .

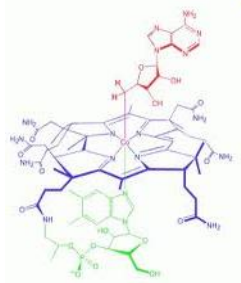
- In biology, manganese(II) ions function as cofactors for a large variety of enzymes with many functions.
- Manganese enzymes are particularly essential in detoxification of superoxide free radicals in organisms that must deal with elemental oxygen. Manganese also functions in the oxygen-evolving complex of photosynthetic plant .Manganese is an essential trace nutrient in all known forms of life.
- The classes of enzymes that have manganese cofactors are very broad, and include oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases, lectins, and integrins.
- Mn-containing superoxide dismutase (Mn-SOD).
- The human body contains about 12 mg of manganese, which is stored mainly in the bones; in the tissue, it is mostly concentrated in the liver and kidneys. In the human brain, the manganese is bound to manganese metalloproteins, most notably glutamine synthetase in astrocytes.
- Manganese is also important in photosynthetic oxygen evolution in chloroplasts in plants. The oxygen-evolving complex (OEC) is a part of photosystem II contained in the thylakoid membranes of

## Zinc Metal ion;

- Zinc is an essential trace element for humans, animals and plants. It is vital for many biological functions and plays a crucial role in more than 300 enzymes in the human body. The adult body contains about 2-3 grams of zinc. Zinc is found in all parts of the body: it is in organs, tissues, bones, fluids and cells. Muscles and bones contain most of the body's zinc .
- Zinc is especially important during pregnancy, for the growing fetus whose cells are rapidly dividing. Zinc also helps to avoid congenital abnormalities and pre- term delivery. Zinc is vital in activating growth - height, weight and bone development - in infants, children and teenagers.
- Zinc plays a vital role in fertility and alleviate symptoms associated with premenstrual syndrome (PMS).
- Zinc – vital for the immune system ,Among all the vitamins and minerals, zinc shows the strongest effect on our all-important immune system. An increase of the zinc level has proven effective in fighting pneumonia and diarrhoea and other infections. Zinc can also reduce the duration and severity of a common cold.
- Zinc – vital for skin, hair and nails Zinc accelerates the renewal of the skin cells Zinc has also proven effective in treating acne, a problem that affects especially adolescents, and zinc has been reported to have a positive effect on psoriasis and neurodermitis. Zinc is important for healthy hair. Insufficient zinc levels may result in loss of hair. hair that looks thin and dull and that goes grey early. There are also a

- The major sources of zinc are (red) meat, poultry, fish and seafood, whole cereals and dairy products.
- A balanced diet is the best way to provide your body with zinc.
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- Zinc deficiency is ranked as the 5th leading risk factor in causing disease, especially diarrhoea and pneumonia in children, which can lead to high mortality rates in these underdeveloped regions..
- Early zinc deficiency also leads to impaired cognitive function, behavioural problems, memory impairment and problems with spatial learning and neuronal atrophy.
- The most common symptoms include , dry and rough skin dull looking hair , brittle finger nails , white spots on nails , reduced taste and smell loss of appetite , mood swings reduced adaptation to darkness frequent infections delayed wound healing dermatitis and acne.

## COBALT metal ion:



- Cobalt daily intake in adults is 5 µg where the content of cobalt is 0.012 µg . Cobalt gets into the body in a few ways. Firstly, with food; secondly by the respiratory system; thirdly, by skin.
- This essential element occurs in inorganic and organic forms. The first form is essential and necessary for the human body but its excess or deficiency will influence it unfavourably. The organic form of cobalt is present in green parts of plants, fish, cereals, and water .
- In the human body this element is present in amounts from 1 to 2 mg: we can find it in the heart, liver, kidney, and spleen, and considerably smaller quantities in the pancreas, brain, and serum .
- Cobalt is a necessary component of vitamin B12 (hydroxo cobalamin) and a fundamental coenzyme of cell mitosis. Moreover, cobalt is very important for forming amino acids and some proteins to create myelin sheath in nerve cells
- Cobalt also plays a role in creating neurotransmitters, which are indispensable for correct functioning of the organism . The salts of cobalt stimulate the synthesis of erythropoietin, which is the most important function in the activation of different stages of erythropoiesis, which, in turn, is connected with the formation of erythrocytes in bone marrow.

- The use of biomaterials in medical practice should meet several conditions, e.g. toxicity, biological compatibility, healing of tissues, and mechanical properties. The corrosion of metal is the main problem in the construction of implants.  
Inorganic forms of cobalt are toxic and can accumulate in tissues and evoke a chain of changes in cells. Cobalt ions released from the implant surface can cause toxic and immunological reactions.