IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

Study of Some Biologically Important Trace Elements

Prashant N. Ubale[1], Sandeep G. Sontakke[2], Sambhaji P. Vartale[3]
Department of Chemistry, Late Babasaheb Deshmukh Gorthekar College, Umri, MS, India[1]
Department of Chemistry, Dr. B. N. Purandare Arts, Smt.S.G.Gupta Commerce and Science College, Lonavala, India[2]
P.G. Research Centre, Department of Chemistry, Yeshwant Mahavidyalaya, Nanded, (MS), India[3]
pupatil2015@gmail.com

Abstract: *The Trace elements are biological active elements present in all living beings and play a very important role in a living organism, these are chemical elements that can be found in almost any living particle. Within living beings they remain in balanced form and both their absence and their excess amount can cause problems in the organism. Trace elements fulfil various functions within living organisms. Some of them are needed to participate in the biological reactions needed for life. They intervene in functions such as respiratory, digestive, muscular, etc. They participate in the synthesis of specific end products and control various actions in biological processes. Iron is used in haemoglobin, Cobalt found in vitamin B12, Manganese found several enzymes, zinc is important component in cellular metabolism.*

Keywords: Trace elements, biological process, Iron, Cobalt, Vitamin B12.

I. Introduction

Trace elements are inorganic compounds present in living tissues in very small amounts. These elements plays vital role in metabolism of living beings. Some of them are known to be nutritionally essential, others may be essential and the remaining are considered to be nonessential. Trace elements function primarily bio stimulators, catalysts in enzyme systems; some metallic ions, such as copper and iron, participate in oxidation-reduction reactions in energy metabolism. Iron, as a constituent of haemoglobin and myoglobin, also plays a vital role in the transport of oxygen. Cobalt is found in vitamin B12 as cyanocobalamin. Boron is essential for synthesis of nucleic acid. Deficiency of silicon inhabits the growth of bones.

All trace elements are toxic if consumed at high levels than required amount for long enough periods. The difference between toxic intakes and optimal intakes to meet physiological needs for essential trace elements is great for some elements but is much smaller for others.

The amount that can be consumed of the trace elements is very small, but through a healthy and balanced diet. It is essential to get to consume the recommended daily amount of these products. Each trace element has minimum concentration range, and many of them produce disease when excess and by default.

II. Chemistry and Biological Importance of Trace Elements

2.1 Boron (B)

Boron is an ultra-trace element essential for healthy plants especially for human and animal health. Boron shows the vital role in physiological system. It is involved in the metabolism of carbohydrates, synthesis of nucleic acids, hormones, and membrane formation. It also beneficial for reproduction and development, brain function, and immunity. Boron also shows anti-inflammatory effects.

- **Sources:** Boron is a trace mineral that is naturally found in many plant foods, such as fruits and legumes. Boron is also taken from Beans, Peanuts, Peanut Butter, Pears, apple, Grape Juice, Peaches, Raisins and Prune Juice Avocado.
- **Deficiency:** Boron deficiency in humans may affect bone metabolism, brain function and plasma levels of steroid hormones. Deficiency symptoms include decreased brain electrical activity, loss of bone mass (osteoporosis), impaired reproductive function and increased oxidative stress.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

2.2 Fluorine (F)

Fluorine plays an important role in the hard tissues of the body such as bone and teeth. Fluorine mostly found in bone and teeth where fluoride ion partially substituted the hydroxide ion in hydroxyapatite. It prevents the decay of tooth enamel. Excess fluoride causes fluorosis.

- **Source:** Common sources of fluoride include **tea, grape juice, wine, raisins, some sea foods, coffee, and tap water** that has been fluoridated.
- **Deficiency:** Fluoride deficiency can lead to tooth decay and possibly osteoporosis. Consuming enough fluoride can make tooth decay less likely and may strengthen bones. The addition of fluoride to drinking water that is low in fluoride or the use of fluoride supplements significantly reduces the risk of tooth decay.

2.3 Silicon (Si)

Silicon act a macro element and plays vital role in plant life cycle. In animals, silicon is mainly involved in the structure and growth of bone, cartridge, skin, and connective tissues. Silicon also involved in proteoglycans in the connective tissues of animals. The deficiency of silicon can inhabits the bone growth of animals.

- **Source:** Silica is also found naturally in various foods, and it is added to many food products and supplements. It is commonly used in the form of silicon dioxide as an anti-caking agent in foods and supplements to keep ingredients from clumping up or sticking together, and it's sometimes added to liquids and beverages to control foaming and thickness. Silicon also found in green beans, bananas, leafy greens, brown rice, cereal, lentils beer etc.
- **Deficiency:** Silicon deficiency detected when the deterioration of the skin, hair and nails occurs. The hair becomes brittle, loses shine and falls out, nails are brittle, skin becomes thinner, wrinkles occur, person experiences from slower wound healing, bones are weaker and they break more easily; Sleep disturbance (insomnia) may occur; Disturbances in digestion

2.4 Selenium (Se)

It is an essential trace element and essential for human health but high levels will be toxic to animals. Selenium replaces sulphur in the amino acid residues of proteins and enzymes. The enzymes are effective for protecting lipids in cell membranes. It also protects the animals from carcinogenic chemicals. It is well known for its antioxidant activity and catalytic role in production of thyroid hormone.

Selenium is also important for brain health, deprivation can lead to cognitive decline, potentially Alzheimer's disease, and depressed moods and more hostile behaviour.

- **Sources:** The daily requirement of selenium for healthy adults are 55 micrograms. It is very important for gestating women. During pregnancy period its requirement increases up to 60 micrograms and 70 micrograms during lactation period. Selenium mainly found in plethora. It also found in whole grains, nuts, beans milk and milk product, sea food eggs and mushrooms etc.
- **Deficiency:** Deficiency of selenium produces many complications. Daily intake lower than 55 micrograms affect on thyroid functioning which lead to mental capabilities and immunity. Selenium deficiency shows the symptoms like hair loss, fatigue, weakness in muscle, infertility in men and women.

2.5 Iodine (I)

Iodine is one of the trace elements of our bodies to catalyse enzymatic reaction produce hormones, carries the cellular communication. Iodine requirement for full growth of the human body contains about 20 mg iodine. Most of iodine are bound to the protein thyroglobulin in the thyroid gland. It is also present in the muscle, salivary gland and ovaries.

- **Source:** The daily requirement of iodine for normal healthy person to maintain thyroid function is 150 micrograms. In pregnant women its requirement increases up to 220 micrograms and during breast feeding it up to 290 micrograms per day. There is abundant natural source of iodine is salt water or sea water. As it is also present in high concentration in salt water, it is also an essential nutrient for most life forms, including human beings. The other sources of iodine is milk, yoghurt, cheese, eggs, seafood vegetables such as cabbage, cauliflower, broccoli.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

- **Deficiency:** Deficiency of iodine causes mental sluggishness, lack of energy, and other health disorders. The main deficiency of iodine causes hypothyroidism raised due to low intake of iodine. When iodine supplied from diet is low as 10 to 20 micrograms per day, the thyroid stimulating hormone cannot perform its bodily tasks. This is characterised by a significant swelling in the thyroid gland called it as goitre.

2.6 Iron (I)

Iron is essential to all living organism which plays an important role in cellular processes, including cell cycle regulation, oxygen transport, DNA synthesis and repair etc. Generally, it is a ligand in protein units. About seventy five percent of the iron in our bodies is present in the erythrocytes in the blood which is a constituent of haemoglobin. 20% percent is stored in non-heme iron proteins in ferritin, hemosiderin, transferrin, etc. The rest of iron in the human body is present in the myoglobin of muscle, cytochrome, xanthine, oxidase, peroxidase, etc.

Iron is a mineral that is required for our bodies to function properly. Iron plays an important role in brain function, synthesis of neurotransmitters, Treat anaemia and muscle function.

- **Sources:** Iron is mainly supplemented through diet. It is found in both vegetarian and non-vegetarian foods. The rich vegetarian sources of iron include legumes, whole grains, sprouts, broccoli, spinach, dry fruits, green leafy vegetables, and cereals. Other non-vegetarian sources of iron include chicken liver, seafood, lean red meat, chicken, and eggs.
- **Deficiency:** Iron deficiency anaemia is a common type of anaemia. As the name implies, iron deficiency anaemia is due to insufficient iron. Lack of enough iron, your body can't produce sufficient amount of haemoglobin in red blood cells that enables them to carry oxygen. Symptoms of deficiency of irons are extreme fatigue, weakness, pale skin, chest pain, headache, cold hands and feet soreness of your tongue etc.

2.7 Copper (Cu)

Copper is an important trace elements in living beings. Copper is an essential constituent of various proteins and enzymes. It plays an important role in oxygen metabolism and electron transfer reaction. Therefore, Cu is involved in central nervous system development and a number of metabolic functions in living organisms.

- **Sources:** Approximately 1100 mcg / day for women and 1400 mcg / day for men absorbed in the small intestine through diet. The main source of copper is food derived from plants and animals. Other sources are – seafood, whole grains, fruits, vegetables, meat products, nuts and seed and cocoa etc.
- **Deficiency**: In medical term copper deficiency referred as hypocupraemia, a rare disease in healthy person. The other copper deficiency includes fatigue, anaemia and discolouration in the skin weakness in bones and thyroid related complications.

2.8 Zinc (Zn)

It is one of the essential nutrient part of several enzymes. It is also involved in various cellular metabolism. The zinc is stored in the kidney, and liver in metallothionein. The prostate gland is very rich with zinc metal. The biochemical functions of zinc are based on the concept of Lewis acid character. It strongly favours to form tetrahedral biochemical complexes. The fact is used in stabilizing many biological structures.

- **Sources:** Main source of zinc is animal and plant foods. The other sources includes – **Shellfish, meat, poultry, fish, legumes, dairy products, eggs, certain vegetables, whole grains, nuts and seeds,** Pumpkin seeds, cashews, hemp seeds, etc.
- **Deficiency:** Generally severe zinc deficiency is rarely found, it can occur in people with rare genetic mutations, breastfeeding infants whose mothers don't have enough zinc, people with alcohol addictions and anyone taking certain immune-suppressing medications.

Symptoms of severe zinc deficiency include impaired growth and development, chronic diarrhoea, delayed sexual maturity, skin rashes, impaired wound healing and behavioural issues.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

2.9 Manganese (Mn)

Manganese is a trace elements widely found in nature. It plays an important role in biological function of the body like enzyme activator, component in metalloenzymes. It is mostly found in bones. It is an important constituent several enzymes such as arginase, superoxide dismutase, pyruvate carboxylase, and peptidase. It is also required for the growth of bone in the human body. Manganese is also involved in various biological processes such as reproduction, proper functioning of the nervous system, haemoglobin synthesis, cholesterol biosynthesis,

- **Sources:** Normally 10 mcg per day required for healthy person. Manganese occurs in a wide variety of foods, including whole grains, clams, oysters, mussels, nuts, soybeans and other legumes, rice, leafy vegetables, fruits nuts green leafy vegetables, coffee, tea, and many spices, such as black pepper. Drinking water is the best source of manganese.
- **Deficiency:** Manganese deficiency is rare in humans, and signs and symptoms of deficiency have not been confirmed. The very limited evidence in humans suggests that manganese deficiency may be bone demineralization and poor growth in children, skin rashes, hair depigmentation, decreased serum cholesterol, and increased alkaline phosphatase activity in men, and altered mood and increased premenstrual pain in women. Manganese deficiency might also alter lipid and carbohydrate metabolism and cause abnormal glucose tolerance

2.10 Cobalt (Co)

The element cobalt is essential constituents for normal functioning of pancreas and growing tissues in all animals. It is the main constituent of cyanocobalamin also called vitamin B12 required for normal function of nervous system and brain. It also helpful in development of haemoglobin. Cobalt is also best option to body in place of zinc.

- **Sources:** Small amount of cobalt are found in the human body due to the consumption of vegetables and **meat dishes**. Cobalt also found in legumes and whole grains, fruits, animal product seafood etc.
- **Deficiency:** The deficiency of cobalt in the human body results to decreases in the production of RBCs which responsible to causes anaemia which shows following symptoms – loss of blood, infections in the gastrointestinal tract, deficiency of vitamin B12 dysfunction in metabolic processes, mental fog, weakness, dystonia etc.

III. Conclusion

Trace elements play a vital role in biological system of living beings. These trace elements required in very small concentrations but their deficiency alters the normal functioning of the body. These components full fill all functions of the body. A sufficient amount of Trace elements required to regulate the digestive, nervous, respiratory system function as well as various metabolism reaction in the body. These trace elements normally found in wide variety of food such as grains, fruits, seafood, milk and milk product plants and animal body, nuts and seeds.

References

[1]. Essential Trace Elements and Their Vital Roles in Human Body; Falah S. Al-Fartusie, Saja N. Mohssan; Indian Journal of Advances in Chemical Science 5(3) (2017) 127-136.
[2]. A review on role of essential trace elements in health and disease; Lingamaneni Prashanth, Kiran Kumar Kattapagari, Ravi Teja Chitturi, Venkat Ramana Reddy Baddam , Lingamaneni Krishna Prasad; http://www.jdrntruhs.org on Sunday, April 24, 2022, IP: 117.229.169.224.
[3]. What are Trace Elements? 14 Examples | Life Persona
[4]. JNTRUnivHealthSci4275-5640375_154003.pdf jdrntruhs.org
[5]. https://www.healthline.com/health/selenium-foods
[6]. The importance of selenium to human health - PubMed (nih.gov)
[7]. *https://www.netmeds.com/health-library/post/selenium-functions-food*
[8]. Review on iron and its importance for human health; Nazanin Abbaspour, Richard Hurrell and Roya Kelishadi; J. Res Med. Sci, Vol. 19(2), 2014.
[9]. Selenium: Significance, and outlook for supplementation; M. Kieliszek, S. Błażejak; PubMed, 2013 May; 29(5):713-8.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

[10]. Zinc and its importance for human health: An integrative review; Nazanin, Roohani, Richard Hurrell,[1] Roya Kelishadi,[2] and Rainer Schulin; J Res Med Sci. 2013 Feb; 18(2): 144–157.

[11]. https://www.netmeds.com/health-library/post/cobalt-functions-food.

[12]. Cobalt: An Essential Micronutrient for Plant Growth; Xiu Hu, Xiangying Wei, Jie Ling and Jianjun Chen; Front. Plant Sci., 16 November 2021

[13]. Cobalt toxicity in humans - A review of the potential sources and systemic health effects; Laura Leyssens , Bart Vinck, Catherine Van Der Straeten , Floris Wuyts , Leen Maes; Toxicology, 2017 Jul 15;387:43-56.

[14]. Nickel: Human Health and Environmental Toxicology; Giuseppe Genchi, Alessia Carocci, Graziantonio Lauria, Maria Stefania Sinicropi , Alessia Catalano; Int. J. Environ. Res. Public Health; 2020 Jan 21;17(3): 679.