CONSIDERATIONS ON THE ROLE OF MINERAL SUBSTANCES IN THE ORGANISM

Professor PhD Daniela CÎRŢÎNĂ
Assoc. Prof. Camelia CĂPĂŢÎNĂ
”Constantin Brâncuşi” University of Tg Jiu, Romania
danielacirtina@gmail.com, camelia_capatina@yahoo.com

Abstract: *Mineral substances play an important role in the development of normal life, known as the fact that osmotic pressure, acid-base balance, activity of some enzymes and hormones, neuro-muscular excitability depends largely on the presence in the cellular or extracellular environment of the substances minerals. They enter the structure of cells and tissues both in the form of saline solutions and in organic molecules. Like other components of the body, mineral substances are in a continuous process of renewal. The paper presents the role that mineral substances have on the body.*
Keywords: macroelements, microelements, metabolism, organism

1. Introduction

Some minerals are needed in the body in large quantities: sodium, potassium, chlorine, calcium, phosphorus, and magnesium, these being called macroelements. Others, called microelements or trace elements, are found in the body in very small quantities: iron, copper, fodder, iodine, cobalt, manganese, molybdenum, chromium, and selenium. Regardless of the existing quantity, all the mineral substances are essential because the body can not synthesize or replace them. A 70 kg body contains on average 250 g of potassium and 100 g of sodium and chlorine. Potassium is the main saline constituent of protoplasm and sodium and chlorine are found in extracellular fluids (plasma and interstitial fluid) [1,2].

Elements like calcium, phosphorus and magnesium are macroelements present in the body in relatively large quantities: 1100-1500 g calcium, 550-850 g phosphorus and approx. 35 g of magnesium for an adult of 70 kg. Magnesium is an essential element of life, whose biological importance is represented by two main behaviors: its participation in biochemical reactions with compounds containing phosphate ion and in phosphate metabolism, and the second is its binding to chlorophyll pigments [3,4].

Magnesium is found spread in sea and ocean water (5.10^{-2}M), and in a much lower concentration in freshwater ($<10^{-4}$M). In the human body, magnesium is found in a concentration of 0,04%. The largest amounts are found in the skeleton (60%) and the remaining 40% inside the cells, where the magnesium concentration is about 10^{-3}M. In soft tissues about half of the total magnesium is found. It is an intracellular cation, like potassium, and focuses mainly on mitochondria. Through some enzymes in which it enters (phosphorylase) or which it activates (alkaline phosphatase, carboxylase etc.), it intervenes in the carbohydrate and lipid mechanisms. Several studies have shown that magnesium deficiency favors increased cholesterol and atheromatosis. In the human body, iron is distributed in the following large components: in plasma as hemoglobin, in tissues like myoglobin, in bone marrow cells stored as ferritin in the form of Fe^{2+} - enzymes and Fe^{3+} - transferin, respectively. The iron exchange rates between these compartments give important indications about iron pathophysiology. Copper enters the constitution of several enzymes (cytochromes, uricase, dopa oxidase, etc.) and catalyses the use of iron. Hypochrome anemias have been described by copper failure. Ceruloplasmin inhibits the activity of microbial hyaluronidase and thereby influences the antiinfectious defense power [1,5].

2. Macroelements and their role in the body

The role of chemical elements: sodium, potassium, chlorine in biological systems is very important, namely:

a) ensures osmotic control;
b) maintains balance and circulation of electrolytes;
c) ensures the stability of polyelectrolytes in the membranes;
d) interact with organic metabolite interactions.

There is an interactive feed - back message system in many cellular processes, and in more developed organisms it extends to cell - cell and organ - organ communications, so that the (ad) processes are very well controlled by Na^+, K^+ and Cl^-. For example, Na^+ and K^+ ions are indispensable in: cell membrane phenomenon communication, the activity of many enzymes (ATP-aza, pyruvate kinase), glycogen formation reactions from glucose, protein synthesis [4,5].

Chlorine contributes to the formation of hydrochloric acid in the stomach juice, stimulates salivary amylase activity, facilitates the transport of carbon dioxide and oxygen, as well as the renal elimination of urea and uric acid (in severe deficiency or high chlorine losses azotemia may occur). Sodium is hydrophobic and its presence in larger amounts in plasma and tissues causes aqueous retention and edema.

The role of potassium in the body

- increases sodium removal and stimulates diuresis.
- interferes with acetylcholine formation and the transmission of excitation from nerve endings to effector organs.
- has a role in the synthesis of proteins and cellular glycogen.

When the body is in the stages of protein anabolism (growth, pregnancy, recovery from consumptive diseases, etc.), potassium needs increase. On the contrary, protein catabolism is accompanied by an increase in urinary potassium elimination.

In an adult's diet, the normal daily ration is 2-3 g sodium and potassium and 4-5 g chlorine. These quantities can be found in the natural composition of the food consumed. Due to the fact that man has used sodium chloride for a long time to preserve and spice the products, he has learned to eat salty and thus the sodium and chlorine intake often exceeds the physiological requirement. In healthy people, excess is eliminated relatively easily through the urine. However, as soon as a physiological or pathological cause determines the decrease in sodium elimination, there is a risk of aqueous retention and edema. This is how it can happen in renal pain, in pregnancy, in adrenal cortical hormone treatments. In these cases it is necessary to reduce the extra consumption of salt. Hypnosis is also indicated in heart failure. [1,5-7].

Calcium, phosphorus and magnesium - the role in food

These three mineral substances have an important plastic role, being the main constituents of the skeleton in which about 99% of the calcium in the body, 80% of the phosphorus and more than 50% of the magnesium is concentrated. Most calcium and phosphorus are inserted into the organic matrix as tricalcium phosphate (hydroxyapatite), along with lower amounts of calcium carbonate and magnesium phosphate. With aging, a more or less advanced degree of osteoporosis sometimes painful and disabling occurs.

In the body, Mg^{2+}, along with Ca^{2+}, Na^+ and K^+, has a fundamental role in the electrical conduction of heart pulses and cardiac cell contractility. The kinetics of Mg^{2+} and K^+ favors arrhythmias, and the deficiency of Mg^{2+} and Ca^{2+} causes an increase in nerve and muscle excitability, known as spasmophilia, with neurovegetative functional complications, as asthenia, depression etc. On the other hand, the entry of an excess of Ca^{2+} ions into the smooth and arterial smooth muscle is harmful, also causing an increase in their excitability, which leads to increased blood pressure and angina pectoris. Cell membrane channel blocking drugs (eg nifedipine) stop the entry and act as calcium antagonists (II) [1,4].

Calcium is a major component of bones, teeth and shells, largely due to the insolubility of calcium carbonates and phosphates at physiological pH. Biominerals can be produced inside or outside living organisms and may be crystalline or amorphous. The inorganic / organic constant composition is thus made by the bone tissue so as to determine the desired properties of stiffness and flexibility. The composition may vary during growth; for example, dental enamel in children is formed largely of a matrix protein, while in adults it contains about 90% of hydroxyapatite. The heart attack is caused (one of the causes) by a blood circulation that causes it to increase its pressure. This is the effect of Ca^{2+} precipitation in the blood in the form of calcium salts (II), which is deposited as a crust on the blood vessels or the heart, causing their narrowing. For the dissolution of these deposits, it was proposed to use the chelated EDTA ligand, which would replace the usual, by pass, surgical method. Chemical tests have also been carried out to solve bone fractures by injecting into a fractured place a apatite carbonate slurry that hardens in ten minutes. During healing, it is replaced by living bony tissue, which is formed along the way. During healing, it is replaced by living bony tissue, which is formed along the way. Biomineralization is a subject of great interest with implications in: geology, biology, inorganic chemistry and medical practice. At the scientific level, efforts are being made to understand and decipher the mechanisms that control biomineralization, so that ultimately synthetic materials are made to replace natural materials [4,7].

Phosphorus is required for the synthesis of nucleic acids, constitutive phospholipids and macroergic molecules (adenosine tri- and diphosphate, guanosine triphosphate and diphosphate, cytidine tri- and diphosphate, phosphoenolpyruvic acid, phosphocreatine, etc.). In many stages of oxidation of carbohydrates and lipids the presence of phosphate is obligatory, and most of the group B vitamins are active only after combining with phosphoric acid. Inorganic and organic phosphates participate in cell buffer systems to ensure that pH is kept constant. Phosphates play two central roles in biological systems. The first role is determined by the fact that there are important structural segments in the saccharide-phosphate interaction systems in nucleic acids and in bones like calcium phosphates. A second role of phosphates is that they are the universal source of energy in biological processes (such as membrane ions, muscle contraction and biosynthetic processes), the enzymatic hydrolysis of adenosine triphosphate acid (ATP) being exoergic. This reaction takes place in the presence of Mg (II) ion, which acts as enzymatic cofactor, the reaction taking place in two stages [1,4,11].

3. The role of microelements in the body (iron, copper, cobalt, zinc)

Exploring iron metabolism is done by methods such as:

- determination of Fe^{2+} concentration in serum;
- determining total Fe^{2+} fixation capacity (TFFC);
- determination of radioactive iron (^{59}Fe) from hemoglobin and
- determination of plasma clearance (clearance between Fe^{2+} concentration in blood plasma and urine).

Iron anemias, referred to as hyposidemia, are determined in the laboratory test when a decrease in TFFC and transferrin occurs and is corrected by using iron. Cases of hypersidemia occur because of the cessation of using the iron stored in the bone marrow, while still retaining it in the ferritin, so that an iron accumulation occurs, so an excess of the normal limit, an increase in TFFC.

Iron is introduced into organisms from the environment through food, mineral waters, etc. after which it is transported to the places of storage and to the places of metabolism [4,8,9].

Through hemoglobin and enzymes, iron plays a role in the transport of oxygen from the lung and tissues and to cellular respiration. The average life of a hematite is approx. 120 days. The iron released by decomposing hemoglobin is mostly stored and is reused for the synthesis of the pigment. In this way the body saves the metal.

Copper is the most well-known microelement. In living systems (plants, animals and humans), copper is involved in many biological functions such as: oxygen-carrying pigments (eg hemocyanin and citro- oxidases), copper blue proteins, electron transfer, enzymes redox, (e.g., ceruloplasmin and tyrosinase), is involved in the production of extracellular matrixes in eukaryotic organisms, in the form of copper oxidases, in the synthesis of hemoglobin and adrenaline, in the activation of certain biological processes, such as glycolysis.

In physiology of animal organisms, copper is involved in major metabolic activities such as: breathing, hematopoiesis, various activities of conjuctive tissues, pigmentation of skin, hair and wool, etc. In the liver, the central organ in copper metabolism, synthesis of cuproproteins, especially ceruloplasmin, by copper extraction of weak complexes with albumin and amino acids and its binding to proteins occurs. Over time, liver blood passes into blood. With the biological molecules, copper mainly participates in two types of reactions: redox and / or electron transfer reactions, which usually involve the Cu (II) / Cu (Cu) system and complex complex formation with physiological ligands [4,9-11].

Cobalt is an essential microelement whose biological activity is manifested through its role in the B_{12} cohesion series and B_{12} (a, b, c, d) vitamins with similar structures. Vitamin B_{12} is important in hematopoiesis, being indispensable in the synthesis of hemoglobin; is an anti-anemic, anti-pernicious factor. It is found in the liver, meat, milk. Bacteria in the intestinal flora can synthesize it and therefore vitamin B_{12} vitamin B vitamins are rare. In the human body zinc acts as a true "circulation agent" in the sense that it controls and regulates metabolic processes, enzyme activity and maintains cell integrity. It is comprised of many vital enzymes that catalyze numerous biochemical reactions, from those that contribute to cell development, to those involved in hormone synthesis (eg testosterone). All these specific functions can be included in the three major roles that zinc (II) fulfills, namely: Lewis acid catalyst, control ion (regulating) and structural ion. Zinc is the most common metal ion with catalytic function in cytoplasm, zinc enzymes being involved in a wide variety of cytoplasmic reactions. The structural role of zinc extends from filamentous structures (keratin-like structures) to the organization of chromosomes, a very widespread role within cells.

In humans, zinc deficiency is manifested by slowing child growth rates and delaying puberty (sexual infantilism). It also appears to say that stimulates and potentiates the activity of insulin. Zinc (II) is a major regulator ion in cell metabolism. This role is mainly determined by zinc (ll) proteins called "zinc fingers". By binding to desoxyribonucleic acid, a nucleotide or an amino acid, they impart to the new system specific properties: structural, dynamic and localization. In other words, zinc (II) proteins, depending on their concentration, can cause activation or inhibition of regulation in various biological processes, of which fertility and growth have been studied so far [4,8,12].

4. Conclusions

Many normal physiological processes of fundamental importance, such as a large part of metabolic processes, reproduction, development and proper functioning of living systems, require the presence of metal ions as such or are part of more or less complex molecules. In the evolution of life, the composition of living systems is assured by 52 elements from the total of the well defined elements, included in the periodical system at present. Of these, 25 elements, also called bioelements, are commonly found in living plant and animal organisms.

The major essential elements (macroelements) are the basis of the molecular edifice of living matter. Phosphorus is the fifth most important element in biological processes, such as carbon, hydrogen, oxygen and nitrogen, which usually take the form of orthophosphate ion derivatives. Phosphorus plays an important role in the structure of adenosine mono-, di- and triphosphate acid (AMP, ADP and ATP) which is the cell's power plant. Phosphorus is also present in some coenzymes and along with calcium, plays an important role in the formation of bones as $Ca_3(PO_4)_2$.

Cations and anions, Na^+, K^+ and Cl^- maintain the electrical neutrality of living matter and body fluids, and also play an important role in maintaining the constant volume of blood and plasma. They have an important role in maintaining the osmotic pressure, ie the balanced distribution of the ions between the interior and the exterior of the cell. The cell membrane is semipermeable, it allows the passage of ions and small molecules, but it does not allow the passage of macromolecules, so it acts as a physical barrier to the cell. Essential microelements are strongly involved in the development of biochemical processes, in which their essential roles are: catalytic, functional and structural.

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