Magnesium - the spark that sets us alight; Magnesium-diet - a new Magnesium Preparation

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Introduction

Many of us still remember from our chemistry lessons that impressive phenomenon - the experiment in which Magnesium burns brightly under water. This circumstance shows us how easily this light metal oxidises. However, it has only been known for a few decades that - precisely for this reason - Magnesium not only has many uses in technology, but also controls vital functions within our bodies. Thus, it is rewarding to get to study Magnesium's occurrence and actions.

Magnesium has been known to mankind since antiquity, with Magnesium carbonate being known as Magnesia alba and Magnesium oxide as Magnesia. In 1755, the physicist and chemist Joseph Black discovered the difference between Calcium and Magnesium carbonate, which had previously always been confused. Admittedly, he did not produce pure Magnesium, but he explained that various elements formed compounds with Carbonic acid in suitable types of rock. Around 1860, various researchers then developed processes for producing pure Magnesium.

Occurrence

Because Magnesium reacts so readily, it does not occur freely in nature. We come across this light metal in mineral form as carbonates, silicates, sulphates, chlorides and so on. The carbonate known as Dolomite is even the basis of mountains (The Dolomites). Pure Magnesium is obtained from such compounds on the one hand by fused-salt electrolysis in Down's cells and, on the other hand, by thermal reduction in the so-called Pidgeon process. The chemical symbol for Magnesium is Mg, and its atomic number in the periodic table is 12. Freshly produced Magnesium powder in the open air may heat up to the point where it spontaneously combusts.

Because of these properties, it is used in industry and chemistry, if bright light or rapid combustion are required (flash in photography, incendiary compounds, flares), or if a powerful reducing agent is needed for production of metals or to protect precious metals from corrosion. Because Magnesium is lighter than Aluminium and is also superior to synthetic material with regard to weight and its load-bearing capacity, Magnesium alloys are increasingly employed in vehicle production, both on the ground and in the air. As these components exhibit a high degree of attenuation, they are suitable for minimising the transfer of vibration and oscillation. Recently, successful attempts have been made regarding the use of Magnesium materials in implantology. Such materials could provide a sensible temporary solution, because they dissolve safely, thus rendering subsequent operations to remove the implant superfluous.

Magnesium is also found in the plant and animal kingdoms. It is necessary for life. It is particularly significant in the plant kingdom, as it constitutes up to 2% of chlorophyll, constituting its central atom. Without Magnesium, the plant is unable to build up this green substance, would not be capable of photosynthesis, and would therefore wither away. Animal organisms obtain their Magnesium from mineral Magnesium compounds, water and food of vegetable or animal origin. Magnesium is found in the human body as an organic compound, mainly in the bones (60%), in the connective tissue - especially liver and musculature - (30%), or it occurs in the bodily fluids as a free electrolyte or bonded with protein (2%). The amount of Magnesium in the body is ca 20-30g in an adult, and is thus substantially less than the amount of Calcium (ca 1000g).

Among our foodstuffs, the following are outstanding sources of Magnesium in descending order: cereals (whole wheat, rice), nuts and seeds, cocoa, green leafy vegetables (spinach, mangel-wurzels, types of cabbage), legumes (soya beans, peas), fruits and berries, meat, fish, dairy products. Cooking renders Magnesium less easily absorbed via the gut, which means that it is preferable to take it in the form of raw foods, if these are tolerated!

Magnesium requirement

The human daily requirement of Magnesium is around 300 mg for women and around 350 mg for men. It is estimated that we consume approximately between 7.5 and 25 mg of Magnesium per 100 kcal of food; thus, if we consume 2000 kcal, this would mean a maximum daily dose of 500 mg Magnesium. Sadly, this amount is only achieved very rarely, as is shown below.

Supply and absorption

Our uptake of Magnesium is via the gut, with absorption unfortunately being very incomplete. Only about

30% of the Magnesium we consume really gets into our bodies. This percentage can be reduced still further, if a large amount of protein and fat is consumed at the same time, or if the food is very high in phytates. This means that our dietary consumption nowadays is no longer sufficient, because foodstuffs very high in Magnesium, such as nuts and seeds, are only eaten in small quantities because of their high energy content; the remainder of our food intake only contains small quantities because the soil is increasingly treated with fertilisers rich in potash, whereas Magnesium replenishment is lacking. At the same time, our Magnesium consumption is reduced by the increased intake of fat and protein in Western civilization and the „refining" of foodstuffs (e.g. white flour). As well as this, the rising tide of alcohol consumption adversely affects Magnesium absorption via the gut. In the course of weight reduction, the consumption of Magnesium can also be cut off. A shortage of Magnesium can also result from immoderate consumption of coffee (more than two cups a day).

Reasons for inadequate provision

- reduced consumption (convenience foods, unbalanced diet)
- reduced intestinal absorption (poor digestion, malabsorption, intolerances, absorption inhibited by too high a calcium intake, alcohol, coffee, protein, fat, phytates)
- increased need (pregnancy, growth, loss via sweat, stress)
- increased losses (vomiting, diarrhœa, kidney disease, chemotherapy)
- endocrine disorders (hyperthyroidism, parathyroid, adrenal)
- long-term use of diuretics

Laboratory determination

The level of Magnesium in the body is determined in the laboratory via a blood sample. The normal blood serum level is between 0.8 and 1.1 mmol/l. If the serum level falls below 0.65 mmol/l, then acute convulsions occur.

The plasma level thus determined is not necessarily reliable, because the body attempts to maintain the optimum serum level constant for a lengthy period. It therefore makes more sense to determine the level in the blood-cell components, because then, the actual intracellular content can be measured. It is even possible for the plasma level to be normal or elevated, although the patient is suffering from an intracellular Magnesium deficiency, with corresponding symptoms. That is the case when, because of a deficient supply of Magnesium, the cation is dissolved out of the skeleton in order to maintain correct serum levels. If the level is determined from the serum, then care must be taken to ensure that the blood is prepared in the centrifuge no later than two hours after the sample has been taken, because otherwise Magnesium escapes from the erythrocytes, resulting in a false serum reading.

As elimination of Magnesium is largely regulated by the kidneys and takes place via the urine, then, following an intravenous dose of a certain quantity of Magnesium, it is possible to determine whether - in the case of deficiency - it is being retained or, in the event of the level being normal, whether it is being eliminated. If the supply is adequate, then 70% or more of the infused Magnesium solution will be eliminated.

According to Blaurock, hair mineral analysis reproduces the precise Mg-tissue levels. Here too, it must be borne in mind that both high and low levels can be a sign of deficiency. In the case of a deficiency, we must think of poor absorption or nutrition; an elevated level when the Ca/Mg balance is normal, indicates loss from the bones. In such cases, an excess of Magnesium can be more or less excluded. Elevated hair mineral levels are frequently encountered where osteoporosis, chronic renal insufficiency or Calcium deficiency are present.

Biological action

After Potassium (monovalent), Magnesium (bivalent) occurs as the second most common cation in the cell (ionic concentration in mVal/l in the serum of Sodium 142, Potassium 4, Calcium 5 and Magnesium 2; in the cell: Na 10, K 160, Ca 2 and Mg 26). Nevertheless, the intracellular portion of Magnesium is only 39% of the total amount. There is a strong dualism between Magnesium and Calcium, which is also bivalent.

Magnesium is able to enter into reversible, chelate-like compounds with organic substances, and therefore, various biochemical reactions become possible because of the interaction.

1. Magnesium is required for all metabolic processes, in which

phosphorylated substrates (ADP, ATP) play a role. It forms a stable complex with ATP. Thus, if Mag-nesium is not present in sufficient quantity, then all processes which contribute to energy provision are slowed down. Magnesium in the body contributes to the control of sugar, lipid and protein metabolism, plus the synthesis of Nucleic acid synthesis, since these are dependent on the supply of ATP. All processes, which provide and use energy, finally are dependent on Mag-nesium, which activates ca 300 enzymes. For this reason, it has a powerful influence on the regeneration of connective tissue and (heart) musculature, and on immune function. Since cell res-piration is disordered in cancer, Magnesium should always be thought of in this connection. The same is true of toxic stress of blocked cell membranes.

2. Calcium and Magnesium are physiological antagonists in the muscle-cells - especially those of the heart. Both compete for the same ion channels in the cell membrane, and the same combining sites on the contractile apparatus. In order to prevent increased incursion of Calcium ions into the mitochondria of the (muscle-) cells, a sufficient quantity of Magnesium - the regulatory cation - is needed in the cell.

3. Like Calcium and Phosphorus, Magnesium is an important com-ponent of the bony substance, and is stored there. Of the 60% contained in the bones, however, 20-30% can be mobilised, so that initially, a shortage in supply remains concealed for a long time.

4. Sodium and Potassium deter-mine the stability of the cell membrane and its electrical charge. Here, Magnesium is an important co-factor in regulating the permeability of the cell membrane with regard to these two cations (Sodium-Potassium pump).

5. In the nervous system, Mag-nesium has a deciding influence on the polarisation of the mem-branes and stimulation of the cells. Acetylcholine is released in neuro-muscular transmission by an inflow of Calcium. Mag-nesium has a regulating action.

6. If there is a shortage of Mag-nesium, then in stress situations, there is an increased release of catecholamines (adrenalin, nor-adrenaline) which, in their turn, give rise to lipolysis. The fatty acids thus freed can combine with Magnesium in a soapy compound: Magnesium stearate. In this way, free Mg ions are additionally bound, which makes the shortage and the suscepti-bility to stress more acute.

We can summarise by saying that, because of its significance in ATP synthesis, Magnesium is important for the fat, carbohydrate and protein metabolisms, as well as for the building up of Nucleic acids. Be-cause of its membrane-stabilising properties, it is involved in nerve stimulation and the transmission of impulses to the musculature.

Symptoms of Magnesium Deficiency

When there is a shortage of Mag-nesium, the following occur:

- increased irritability of nerves and muscles, with a Vit B6 deficiency often being present at the same time (muscular tremors, cramps)
- cardiac dysrhythmias, tachy-cardia, arrhythmias, increased susceptibility to thrombosis, headaches, circulatory disor-ders; in this context, there is often a shortage of Magnesium and Calcium
- autonomic nervous disorders with sensory errors, prickling sensations, slight paraesthesias
- illnesses of the gastro-intestinal tract and its associated glands (pancreas, liver) with concomi-tant symptoms such as nausea, vomiting, spasms, diarrhoea, constipation
- bronchial and uterine spasms, eclampsia
- epileptic attacks or muscle contractions (tetanus), with a Vitamin B6 deficiency often predominating here too; accor-ding to Adelle Davis (in Blau-rock), such attacks can frequently be treated by Mag-nesium plus Vitamin B6 supple-mentation, to the extent that no other medication is required
- disorientation, mild mental confusion, memory and powers of concentration disordered, hallucinations, episodes of depression
- elevated cholesterol and trigly-ceride levels
- sodium and water storage in the tissues
- disordered Vit D activity

Because of the large number of symptoms, it is easy to see that a wide-ranging examination with differential diagnosis is necessary in order to reach a definite diagnosis.

Treatment of Magnesium Deficiency

Magnesium can be substantially better absorbed from both inorganic and organic supplements than from the diet. Treatment should always be considered, should the appropriate symptoms, as mentioned above, occur, or if people complain in general terms of chronic exhaustion or reduced physical resistance.

With the preparation **Magnesium-diet** from the BIOFRID company, a dietetic foodstuff for particular medical purposes (balanced diet) is available. Each capsule contains 208.4 mg of Magnesium oxide and 100 mg of RRR alpha-tocopherol. Recommended consumption is two capsules a day with meals.

The Vitamin E contained in the capsules is the natural RRR alpha-tocopherol. This form of the vitamin is the one most easily transported and stored by the human body. This is due to the strong affinity of this form of Vitamin E to the alpha-tocopherol transfer protein (alpha-TTP) found in the liver. Since RRR alpha-tocopherol is so easy to store, its action, when it is taken, is long-lasting. As there are no adequate observations of its use by pregnant and lactating women with regard to its high Vitamin E content, consumption of the product by these groups is not advised. (Annex 6, German Dietary Regulation)

At the same time, where there is a Magnesium deficiency, care should be taken to keep up the intake of Vitamin B, e.g. VITAMIN B COMPLEX SANUM N, consisting of 2 ml of injectable solution, containing 10 mg Vit B1 and 5 mg Vit B6. Initially, the preparation can be injected on a daily basis, either intramuscular or intravenous. Later, its use is reduced to 2-3 times a week.

Seeger refers to the influence on hyperthyroidism of doses of Magnesium and glutamate.

A balanced diet rich in Magnesium, an intestinal cleansing and reduction of stress also assist in long-term correction of a deficiency situation or, even better, in avoiding it.

Symptoms of a Magnesium overload

In a healthy person, taking 1 g Magnesium a day is tolerated without any problem. However, in patients with chronic renal failure, urinary excretion of Magnesium is impeded. The same applies if laxatives and antacids containing Magnesium are taken over an extended period of time, or if hypothyroidism is present. In that case, the levels in the blood can become unphysiologically elevated, giving rise to the following symptoms:

- uraemia
- renal disease (nephritis)
- adrenal insufficiency
- icterus
- depression, mental impairment
- disordered glucose metabolism
- nausea, vomiting
- low blood pressure and arrhythmias

In these cases too, precise checking and aetiological investigation are required, if the problems are to be eliminated.

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