DIETARY MINERALS

Minerals are an important part of healthy diet. Inorganic simply means that minerals are found naturally in non-living things such as water, rocks or soils. Another name of minerals that are necessary for human health is dietary element. Dietary elements (commonly known as dietary minerals) or mineral nutrients are the chemical elements required as essential nutrients by organisms, other than carbon, hydrogen, nitrogen oxygen and Sulphur present in organic molecules. Minerals are actually inorganic substances. They are naturally occurring chemicals we need to live- excluding, nitrogen, hydrogen and carbon.

There is no such thing as essential minerals because all dietary minerals are essential. We have major minerals (macrominerals) and trace or minor minerals.

This episode deals with

Major Minerals
Minor minerals
Toxic metal contaminants
Metal uptake in canned foods
Conclusions

Major Minerals

The important major minerals are a) Calcium b) Magnesium c) Potassium d) Sodium e) Sulphur f) Phosphorous and g) Chloride

Minor Minerals

Minor Minerals are a) Zinc b) Iron c) Copper d) Iodine e) selenium f) Manganese g) Chromium h) Fluoride i) Molybdenum

Calcium: Calcium is one of the most important and plentiful mineral found in human body. The teeth and bones contains about 99% of calcium while nerve cells, body tissue, blood and other body fluids contain the rest. Calcium helps our body with building strong teeth and bones, clotting blood, sending and receiving nerve signals, relaxing muscle, releasing hormones and keeping normal heartbeat.

Dairy products are the best source of calcium. Milk and its products such as yoghurt, cheeses and buttermilk contains a form of calcium which body can easily absorb. Milk also a good source of phosphorous and magnesium which helps the body to use and absorb calcium

Other source of calcium includes, green leafy vegetables such as Broccoli, collard, mustard green, turnip greens and Chinese cabbage.

Magnesium: Magnesium rich foods are essential for cellular health and over 300 biochemical functions in the body. It helps in protein synthesis, nerve function, blood sugar control, neurotransmitter release, blood pressure regulation and energy metabolism.

Green leafy vegetables are the richest source of magnesium and chlorophyll. Apart from that, pumpkin seeds, yoghurt, almond, Black beans, avocado, figs and banana are also good source.

Potassium: Eating more of potassium rich foods can reduce risk of high blood pressure, stroke and heart disease. Sweet potatoes, tomato paste and sauces, beet greens, beans, yoghurt, carrot juice, soybean bananas and milk are the richest sources of potassium.

Sodium: Sodium occurs naturally in many foods and the most common form of sodium is sodium chloride. The body uses sodium to control blood pressure and also aids in muscle and nerve function.

Sulphur: It is very vital to health. It is found in all body tissue and plays several important role. It helps resist bacteria and protect against toxic substances. It also helps in development of connective tissues and helps skin maintain structural integrity.

Cruciferous vegetables such as cabbage, broccoli, turnip, are the rich sources of sulphur containing substances known as glycosinolates.

Allium vegetables such as garlic, onion, leeks contain organo-sulphur compound that contain Sulphur.

Phosphorous: Phosphorus is an essential nutrient required for proper cell functioning, regulation of calcium, strong bones and teeth, and for making ATP (adenosine triphosphate) a molecule which provides energy to our cells. A deficiency in phosphorus can lead to lowered appetite, anemia, muscle pain, improper bone formation (rickets), numbness, and a weakened immune system. Phosphorus is found in almost every food, and as such, deficiency is rare. Conversely

consuming too much phosphorus causes the body to send calcium from the bones to the blood in an attempt to restore balance. This transfer of calcium weakens bones, and can cause calcification of internal organs, increasing risk of heart attack and other vascular diseases. Some scientific research suggests that phosphorus is more easily absorbed from meat products, and you can only absorb half of the phosphorus contained in plant foods. The amount of phosphorus absorbed differs from person to person, nutrients from plant sources to be optimal for health.

Sunflower seeds, chia seeds, Sesame seeds, watermelon seeds, and Flax seeds are the highest in phosphorous. Other sources includes, nonfat yoghurt, cheese, Almond, soya foods, Potato, grapes, kiwi fruits, banana, Blackberry etc.

Chloride: Chlorine is an electrolyte and works with other electrolyte such as potassium, sodium and carbon di oxide. Chloride is found when the elemental chloride gains an electron or when a compound such as hydrogen chloride is dissolved in water or other polar solvents. Chloride salts such as sodium chloride are often very soluble in water.

The electrolytes chloride helps to ensure heart function, muscle contraction and helps nerve to transmit important massages throughout our body.

MINOR MINERALS

Minor minerals are the trace elements needed in amounts of less than few mg per day and includes, zinc, iron, copper, iodine, selenium, manganese, chromium, fluoride and molybdenum

Zinc: Zinc promotes strong immune system. It also helps in maintaining our sense of smell and vision and for normal growth and development. Meat and beans are good source. We can also get it from whole grains, spinach and cocoa. Fruits and vegetables are not good source because zinc in plant proteins is not as available as for use by the body as the zinc from animal proteins. Therefore, low protein diet and vegetarian diets tend to be low in zinc.

Iron: Iron is an essential mineral in our body. It is required to carry oxygen from lungs to every cell in our body. In addition to its vital role in oxygen movement and storage, iron is also needed to regulate the growth. Two third of our bodies iron is hemoglobin (the oxygen carrying protein in Red blood Cell). Iron is also found in myoglobin, a protein that helps store oxygen in our muscle. Iron is a component of healthy blood, helps in transporting oxygen throughout our body

and helps carry carbon di- oxide out. Iron deficiency in body leads to a condition called “Anemia”.

High iron foods include liver, sunflower seeds, nuts, lamb, beans whole grains, dark leafy greens (spinach), dark chocolates and tofu. Iron from meat (heme iron) is more easily absorbed than iron from plant (non-heme iron).Iron is absorbed in our intestine. Absorption is greatly improved by taking Vit C. Dark leafy greens contain both Iron and Vit C

Copper: Copper is an essential mineral required by the body for bone and connective tissue production, and for coding specific enzymes that range in function from eliminating free radicals to producing melanin. A deficiency in copper can lead to osteoporosis, joint pain, lowered immunity, and since copper is essential for the absorption of iron, anemia will never set in. Conversely, over-consumption of copper will lead to cramps, diarrhea, and vomiting in the short term, and can lead to depression, schizophrenia, hypertension, and insomnia in the long term. Copper in large amounts can even be poisonous. The stomach needs to be acidic in order to absorb copper and thus antacids interfere with the absorption of copper, as do milk and egg proteins.

Dried prunes, avocadoes, beans, nuts, mushrooms, and sea foods are the rich source of copper.

Iodine: Iodine is a mineral found in some foods. The body needs iodine to make thyroid hormone. These hormones control the body’s metabolism and many other important functions. The body also needs thyroid hormone for proper bone and brain development during pregnancy and infancy. Getting enough iodine in important for everyone especially infants and woman who are pregnant. Too much or too little iodine can lead to the condition known as Hyperthyroidism and Hypothyroidism

Iodine is found naturally in some foods and also added to salt that is labelled as Iodized. Fish, Seaweed, shrimp are generally rich in iodine. Dietary products such as milk, yoghurt, cheese are also a good source of iodine.

Selenium: Selenium is required by the body for proper functioning of the thyroid gland, and may help protect against free radical damage and cancer. A deficiency in selenium can lead to pain in the muscles and joints, unhealthy hair, and white spots on the fingernails. In long term cases it may even lead to Hashimoto's disease, a condition in which the body’s own immune system

attacks the thyroid. An excess of selenium can lead to bad breath, diarrhea, and even hair loss. It is important to note that the amount of selenium in any product varies greatly by the amount of selenium in the soil in which it was produced/grown/raised.

Brazil nut, Fish, chicken and turkey, Lamb, whole wheat bread, mushrooms and whole grains are the rich source of selenium.

Manganese: Manganese is required by the body for proper enzyme functioning, nutrient absorption, wound healing, and bone development. Manganese deficiency is rare and can been seen expressed in poor bone health, joint pain, and fertility problems. Manganese toxicity from food sources is also rare, but can adversely affect the neurological system. Health benefits of manganese includes strengthening weak bones, anti-oxidant protection, alleviating premenstrual syndrome (PMS), anemia, arthritis, alopecia (spot baldness), and prevention of epileptic seizures

Tuna fish, mussels, nuts, seeds such as pumpkin, chia, sesame and flax, bread, tofu, beans are the rich source of manganese.

Chromium: A key role of chromium in the body is related to control of blood sugar. There is a simple molecule called low molecular weight chromium binding substance (LMWCr) involved in blood sugar control. There is a clear evidence of chromium deficiency leading to abnormally high blood sugar as well as evidence of restoring chromium supply back towards normal or higher can enhance blood sugar control even in diabetic persons.

Broccoli, barley, oats, green beans, tomatoes, lettuce are the excellent source of chromium.

Fluoride: Fluoride is a normal constituent of human body, involved in mineralization of both teeth and bone. The fluoride concentration in bones and teeth is about 10,000 times than in body fluid and soft tissues. Nearly 99% of the body's fluoride is bound strongly to calcified tissues. Fluoride in bone appears to exists in both rapidly and slowly exchangeable pool. Because of its role in dental caries, fluoride has been classified as essential to human health.

Fluoride intake from most food is low. Foods generally have concentration well below 0.05mg per 100g.However, water in fluoridated areas, as well as beverages, tea, some marine fish and some infant's formulas, especially those that are made or reconstituted with fluoridated water, generally have high concentration.

Molybdenum: Molybdenum is essential in trace amounts for humans, animals and plant health. In humans and animals, molybdenum serves mainly as an essential cofactor of enzyme and aids in metabolism of fat, carbohydrate and some amino acid.Molybdenum combines with the sulphite oxidase to catalyze Sulphur containing amino acids that are crucial for human health. Although cases of molybdenum deficiency are rare, signs of deficiency includes defects in uric acid production as well as decrease metabolism of Sulphur containing amino acid.

The amount of molybdenum found in foods depend upon the soil in which the food grows. Legumes such as beans, lentils and peas as well as cereals and leafy vegetables are considered good source of molybdenum. Liver is a good source but animal source is poor.

Toxic metal contaminant

Food contains a wide range of metallic elements (metals) such as sodium, potassium, iron, calcium, boron, magnesium, selenium, copper and zinc. These elements are essential in trace quantities for maintenance of cellular processes. Other metallic elements have no functional effects in the body and can be harmful to health if foodstuffs containing them are consumed regularly in the diet. The majority of metals are natural components of the earth's crust.Mercury, lead, cadmium, tin and arsenic are in that category. Mercury and lead are often referred to as "heavy metals". The toxicity of these metals is in part due to the fact that they accumulate in biological tissues, a process known as bioaccumulation. This process of bioaccumulation of metals occurs in all living organisms as a result of exposure to metals in food and the environment, including food animals such as fish and cattle as well as humans. Metals and other elements can be naturally present in food or can enter food as a result of human activities such as industrial and agricultural processes. Chemically, metallic elements can exist as the pure metal, e.g. tin or lead, or compounds formed by combination of a metallic element with a non-metallic element such as the combination of sodium with chlorine (giving a salt such as sodium chloride, common salt) or oxygen (giving an oxide).

The metals of particular concern in relation to harmful effects on health are: mercury (Hg), lead (Pb),cadmium (Cd), tin (Sn) and arsenic (As).Large a number of metals have been associated with health effects in individuals exposed to them in the workplace, for example beryllium and nickel. The harmful effects of the latter group of metals are associated with the inhalation of

metal dusts, causing lung injury, and these elements are not normally found in food at levels that could cause toxicity.

The main concern in relation to the toxicity of **mercury** in the general population is the potential effect of organic forms of mercury, e.g. methylmercury, on the brain and intellectual development in young children. **Lead** also has an effect on brain and intellectual development in young children, while long-term exposure in both children and adultscan cause damage to the kidneys, reproductive and immune systems in addition to effects on the nervous system. **Cadmium** is toxic to the kidney, while exposure to high levels of tin from, e.g. canned food in incorrectly manufactured tins can cause gastrointestinal irritation and upsets. Exposure to inorganic arsenic is of concern because of its cancer-causing properties. Given the wide spectrum of effects on health and the fact that these toxic metals accumulate in the body, it is essential to control levels in foodstuffs in order to protect human health.

Lead, arsenic, and cadmium are each present in the environment, including the water, air, soil, and foods, either as naturally occurring substances or as a result of contamination from human activity. Each has been associated with negative health effects when consumed at high levels, such as cancer and/or developmental effects. Arsenic may be present as inorganic arsenic (generally considered the more toxic form of arsenic) or organic arsenic.

The toxic effects of **lead**, like those of mercury, have been principally established in studies on peopleexposed to lead in the course of their work. Short-term exposure to high levels of lead can cause braindamage, paralysis (lead palsy), anemia and gastrointestinal symptoms. Longer-term exposure can cause damage to the kidneys, reproductive and immune systems in addition to effects on the nervous system. The most critical effect of low-level lead exposure is on intellectual development in young children and, like mercury, lead crosses the placental barrier and accumulates in the fetus. Infants and young children are more vulnerable than adults to the toxic effects of lead, and they also absorb lead more readily. Even short-term low-level exposures of young children to lead is considered to have an effect on neurobehavioral development. Consumption of food containing lead is the major source of exposure for the general

The principal toxic effect of **cadmium** is its toxicity to the kidney, although it has also been associated with lung damage (including induction of lung tumors) and skeletal changes in

occupationally exposedpopulations. Cadmium is relatively poorly absorbed into the body, but once absorbed is slowly excreted, like other metals, and accumulates in the kidney causing renal damage. The kidney of food animals is a major source of cadmium in the diet although lower levels are found in many foods

The most toxic form of **mercury**, methylmercury, is found at significant levels only in fish and seafood. Individuals consuming a diet containing a high content of predatory fish and/or shellfish. The major potential dietary sources of exposure to methylmercury are fish and shellfish, in particular top predatory fish such as swordfish as a consequence of industrial releases of inorganic mercury into marine environments, followed by uptake into marine microorganisms which then convert the less toxic inorganic mercury into the more toxic methyl mercury. This then accumulates through the food chain due to its low rate of breakdown, reaching potentially toxic levels in species at the top of the food chain, such as swordfish and marlin, which may then form part of the human diet.

Metal uptake in canned foods

Tinis relatively less toxic than mercury, cadmium and lead. The principal concern in relation to tin in food is the possibility of high levels potentially present in canned food in incorrectly manufactured tins, where tin present in the can has leached into the food.

Canned foods may take up metals from container, tin and iron from tin plate and lead from solder.

Rapid detinning is one of the most serious problem of can corrosion. Tin forms the anode of the tin –iron couple with majority of acid foods in the absence of oxygen. Under these conditions tin leaches into the solution at an extremely slow rate.This has been shown to occur in the case of acidic foodstuffs such as canned tomatoes, and consumption of the affected foodstuff has resulted in gastrointestinal irritation and upsets due to the acute toxic effects of tin. These short-term effects may occur in some individuals at concentrations above 200mg/kg. Only limited data are available on the toxicological effects of inorganic tin present in canned food, resulting from the dissolution of the tin coating.

Another corrosion problem is sulphide staining. This id due to the presence of sulphur containing amino acid cysteine, Cystine and metheonin in food. When the food is heated, results in the formation of sulphide ions which can then react with tin and iron to form SnS andFnS. Corrosion of the tin can depend on the nature of the canned food as well as the type of tin plate used.

In some cases dissolution of tin into food may have a beneficial effect on food colour, with iron having opposite effect.

The uptake of tin and iron from canned foods is a common occurrence.

Conclusions

Minerals are an important part of healthy diet. Another name of minerals that are necessary for human health is dietary element. Dietary elements (commonly known as dietary minerals) or mineral nutrients are the chemical elements required as essential nutrients by organisms, other than carbon, hydrogen, nitrogen oxygen and Sulphur present in organic molecules. Minerals are actually inorganic substances. They are naturally occurring chemicals we need to live- excluding, nitrogen, hydrogen and carbon. A majority of major and minor dietary nutrients are essential for the proper function of various body organs

Heavy metal accumulation in soils and plants is of increasing concern because of the potential human health risks. This food chain contamination is one of the important pathways for the entry of these toxic pollutants into the body of the human. Vegetables cultivated in wastewater-irrigated soils take up heavy metals in large enough quantities to cause potential health risks to the consumers. In order to assess the health risks, it is necessary to identify the potential of a source, estimate the amount of risk agents that come into contact with the human-environment.This will help in formulating appropriate measures to control the risk factors.