Without minerals and vitamins, of no use to us are the protein, carbohydrate and fat we consume, nor do our bodies even have a structure. These nutrients that we consume in relatively small quantities are critical to our very existence, and adequate quantities of them are also critical to our quality of life. Knowing a little bit about the essential minerals and vitamins can help us ensure that we take in adequate amounts.

The first thing to know is that food processing removes or damages many of them. The purest food on Earth, white sugar, has lost 100% of the minerals and vitamins (and fibre) that were in the original sugar cane. White flour and white rice have lost approximately half to three-quarters of the minerals and vitamins that were in the original whole grains. Then there are the effects of heating food. Vitamin C and folic acid are particularly susceptible to heat damage. Exposing finely ground food to air allows some of these nutrients to be oxidised, and if the food is also heated – as in cooking – the process is hurried along.

An enormous amount could be written about the various minerals and vitamins. To keep the subject brief (and readable!), only the most prominent points will be mentioned.

**PART 1 – The Minerals**

Minerals are part of every structure in the plant and animal body. They are more concentrated in the harder structures, including the bones, teeth, nails and hair. They are the main factors in maintaining the correct alkalinity of the blood and tissue fluids and in maintaining proper fluid balance. Various minerals are key ingredients in many biochemicals in the body, including enzymes and hormones.

The body cannot make minerals, they must be consumed in the diet. They occur as mineral salts or attached to protein (chelated).

**GENERAL FUNCTIONS OF MINERALS**

- **Structural.** For example, calcium and phosphorous give structure and hardness to bones and teeth.
- **Regulate fluid balance and electrical activity in the body, mainly potassium, sodium, magnesium and calcium.**
- **Regulate the acid-alkali balance of the blood and tissue fluids.**
- **Are part of some hormones, for example, zinc is part of insulin.**
- **Activate enzymes, for example, magnesium and manganese.**
- **Are key components in the chemistry of life – biochemistry.** For example, iron in haemoglobin, cobalt in vitamin B12 and magnesium in the chlorophyll in green plants.

The number of essential minerals in the human body is seven major minerals and 14 trace minerals.

**The major minerals are:**
- potassium
- phosphorous
- magnesium
- sulphur
- calcium
- chlorine
- sodium

**The trace minerals are:**
- iron
- selenium
- zinc
- silicon
- copper
- molybdenum
- manganese
- nickel
- iodine
- tin
- cobalt
- vanadium
- chromium
- fluorine

**POTASSIUM**

**Functions**

Provides important alkalinity. Because it is excreted in large quantities, we require a large intake daily. Regulates fluid balance – holds fluid inside cells. Calms nerves – deficiency caused nerves to be over-active. Necessary for insulin production. Necessary for manufacture of proteins. Necessary for converting glucose to glycogen for storage.

**Excretion**

Passed out with bowel motions and excreted in urine. Because large reserves are not stored in the body, potassium is easily depleted and must be consumed abundantly and regularly in the diet.

**Deficiency signs and symptoms**

Muscular weakness, inability to build muscle despite exercise. Irritability, nerve disorders, tingling in hands and feet, racing of the heart (tachycardia) or abnormal heart rhythm. Blood sugar level disturbances.

**Sources**

(All sources are roughly in descending order of content. Lower level foods not included.)

Legumes, nuts, sunflower seeds, wheatgerm, parsley, English spinach, avocado, pumpkin, potato, rye flour, Brussels sprouts, cauliflower, cabbage, broccoli, banana, apricot, coconut, beetroot, kiwi fruit, silverbeet, carrot, celery.

Potassium is widespread in foods – virtually all plant and animal foods contain substantial quantities.
**MAGNESIUM**

**Functions**
Provides alkalinity – along with potassium and calcium.

Part of bone – approximately 50% of total body magnesium is in bone.

Magnesium is needed to activate thousands of enzymes for many biochemical reactions in the body.

Calms nerves – deficiency caused nerves to be over-active, to 'fire' too easily.

Protects heart muscle from lack of oxygen and keeps heart rhythm steady.

Magnesium and vitamin B₆ reduce kidney stone formation.

Essential for potassium metabolism.

Essential for converting amino acids into other amino acids.

Supports a healthy immune system.

Helps regulate blood sugar levels.

**Excretion**
Passed out with bowel motions and excreted in urine.

**Deficiency signs and symptoms**
Weakness.

Increased excitability of nerves – cramps, tremor, increased reflexes, vertigo, convulsions, tetany.

Heart muscle damage and abnormal heart rhythm.

Atherosclerosis and ischaemic heart disease.

Mental symptoms – hallucination, confusion, disorientation.

Magnesium deficiency causes deficiencies of calcium and potassium.

**Sources**
Sunflower seeds, sesame seeds, nuts, legumes, oats, brown rice, rye flour, wheaten flour, coconut, English spinach, parsley, green peas, beetroot, silverbeet, avocado.

Green vegetables are green because magnesium makes chlorophyll green.

[Meats contain magnesium, but at lower levels than nuts, seeds and grains.]

**CALCIUM**

**Functions**
The most abundant mineral in the body. Is the main mineral in bone, giving it strength. Bones in turn act as a reservoir of calcium.

Calms nerves in the same way as potassium and magnesium – deficiency causes nerves to be over-active, to 'fire' too easily.

Necessary for maintaining normal alkalinity of blood.

Essential for blood clotting.

Protects against toxic cadmium and lead by preventing their absorption.

Absorption and excretion
Calcium is poorly absorbed because the kidneys tend to retain it, so we don't need a lot. Absorption is regulated by vitamin D and parathyroid hormone. Absorption in intestine requires a small amount of fat (or oil), so skim milk is partly self-defeating. Absorption is inhibited by oxalic acid (in rhubarb, bitter spinach, chocolate, coffee, tea) and phytic acid (in grains and sesame seeds).

Deficiency signs and symptoms
Rickets typically in very young children is result of deficiencies of calcium, vitamin D and/or phosphorous.

Adult 'rickets' is known as osteomalacia.

Osteoporosis ('porous bone') is partly due to lack of calcium and oestrogen, but more importantly acidity of the bodily fluids.

Extreme deficiency causes tetany, in which there is spasm in hands, feet, larynx, etc. and/or convulsions.

**Sources**
Cheese, yoghurt, milk, almonds and other nuts, parsley, soya beans and other legumes, sunflower seeds, sesame seeds, silverbeet and English spinach, wholemeal bread, rolled oats, rye flour.

**PHOSPHOROUS**

**Functions**
Part of protein and RNA and DNA.

Key part of lecithin and also of the compounds that transport cholesterol and fat in the bloodstream (HDL, LDL and VLDL).

Part of the high-energy compounds that release energy to cells.

Part of protein and RNA and DNA.

**Absorption and excretion**
Absorption is regulated by vitamin D, calcium and acidity of bodily fluids.

Excretion is via urine.

**Deficiency and excess**
Deficiency is rare, but can be caused by vitamin D deficiency or prolonged use of antacids.

Excess is generally due to consuming too much protein. It can induce calcium depletion and high acidity of bodily fluids.

**Sources**
Seeds, nuts, eggs and dairy products.

[Meats and fish are also high sources.]

**SODIUM**

**Functions**
It is the main mineral in the fluids outside bodily cells, drawing water to the tissues and into blood vessels; it is balanced by potassium which holds water inside cells.

Sodium contributes to the alkalinity of the blood and to nerve function.

It is essential for the production of hydrochloric acid in the stomach.

**Excretion**
Most is re-absorbed in the kidneys, so intake needs to be low.

**Deficiency and excess**
Deficiency of sodium is very rare. Main causes are excessive sweating, vomiting or diarrhoea.

Excess is very common, almost the norm in the Western world. Likely consequences are fluid retention (oedema), high blood pressure, hardened arteries (atherosclerosis), kidney damage and arthritis.

**Balance of sodium and potassium**
These two minerals work together in balancing fluids outside and inside the cells respectively, and their balance in the diet is critical to good health.

Because the kidneys normally retain sodium and excrete potassium, we require much more potassium than sodium, and, accordingly, every natural food contains more potassium than sodium.

However, the typical Australian diet contains about five times as much sodium as potassium, which is the wrong way around. This is solely due to the use of refined salt (sodium chloride) and is a major reason why we have a lot of degenerative disease in Australia. The best amount of refined salt to consume is none, but if some is required for flavour or to retain water in the body, it is tolerable to use small quantities of unrefined sea salt.

**Sources**
Natural sources of sodium are sea kelp, silverbeet, egg, celery, tahini, yoghurt, beetroot, carrot, honeydew melon, dried fig, lettuce, broccoli, English spinach, cucumber.

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**Green vegetables** are green because magnesium makes chlorophyll green.

[Meats contain magnesium, but at lower levels than nuts, seeds and grains.]
SULPHUR

Functions
The key mineral in the 'sulphur-containing' essential amino acids (methionine and cysteine).
A mineral in the enzyme, glutathione peroxidase, which stops the chain reaction of damage caused by free radicals.
Helps liver to detoxify cyanide and mercury compounds.
A key mineral in connective tissue in skin, hair, nails, bone and cartilage.

Deficiency
No known deficiency.

Sources
Legumes, eggs, cabbage, onions, garlic [meat high also].
The smell of rotten egg gas is due to sulphur.

CHLORINE

Functions
Is intimately related to sodium in the body. Like sodium, it is found outside cells.
Has roles in fluid balance and in contributing acidity for acid-alkali balance.
Necessary for production of hydrochloric acid (HCL) in stomach.

Deficiency and excess
Deficiency is rare. Main causes are excessive sweating or vomiting or protein deficiency.
Excess may result from the chlorination of tap water. It can destroy vitamin B12 in the intestine and kill off some of the 'friendly' gut bacteria.

Sources
Sea kelp, eggs, legumes, 'salty' vegetables like celery and zucchini.

IRON

Functions
Iron has a major and critical role in the body in that it is the key mineral in haemoglobin, the red pigment in red blood cells that carries oxygen to every cell in the body so that energy production can occur. (Haemoglobin manufacture also depends on copper, vitamin B6, B9, B12 (folic acid) and B1.) Iron is also necessary for the production of a number of enzymes.

Absorption
Because the body tends to recycle iron, only about 10% of the iron in the diet is absorbed. If the body is deficient in iron, absorption can rise to 25%. Absorption depends on hydrochloric acid in the stomach and vitamin C, and is enhanced by calcium and chelating agents that include proteins, glucose, citrate and vitamin C. ('Chelated' means that the iron is attached to protein molecules.)
Iron absorption is inhibited by oxalic acid, phytates and phosphates that are common in some plant foods, high intakes of tannin (in tea), copper or cadmium, intestinal parasites and tumours.

Iron in the animal foods is much better absorbed than the iron in plant foods, but this can lead to iron overload and be dangerous. Surplus iron in the non-chelated (ionic) form is a powerful generator of toxic free radicals. All iron in the body should be in the chelated form. This mineral is stored in the liver, spleen and bone marrow.

Deficiency
Shortage of iron means lack of haemoglobin and lack of oxygen in bodily cells, resulting in lack of energy in both body and mind. This is anaemia, in which the skin looks pale an anaemic - unless masked by the skin pigment, melanin, in which case the better guide is the colour of the lips, mouth, tongue, fingernails, eyelid linings and creases in the palms of the hands.
Deficiency may be due to lack in the diet or to factors such as poor absorption, copper deficiency or excessive bleeding - as in women having heavy periods.

Sources
Pepitas (Mexican pumpkin seeds), soya beans, lentils, lima beans, kidney beans, parsley, sesame seeds, cashews, pine nuts, almonds, pistachio nuts, hazel nuts, sunflower seeds, egg yolk, rye flour, rolled oats, whole-wheat flour, English spinach, silverbeet [and red meat].
Iron supplements in the form of (inorganic) iron sulphate provide iron so soluble that it produces toxicity, the symptoms being nausea, vomiting, diarrhoea and/or constipation. These are also the symptoms of morning sickness in pregnancy, so it is possible that some morning sickness may be the result of iron toxicity rather than iron deficiency or other causes.

ZINC

Regarded as an antioxidant mineral because it has so many protective functions.

Functions
At least thirty enzymes require zinc, including those that digest proteins, process carbohydrates, digest milk sugar (lactose) in the small intestine, metabolise calcium, break down alcohol in the liver, produce hydrochloric acid in the stomach, and buffer acidity in the blood.
White blood cells contain large amounts of zinc.
The hormone, insulin, which prevents diabetes, contains zinc.
Smell, taste and fertility all depend on adequate zinc, and zinc is needed for vitamin A to be properly used.

Absorption
Absorption is inhibited by phytates and high levels of lead, cadmium, copper and calcium.

Deficiency signs and symptoms
Deficiency fairly easily induced. In children the effects include retarded growth, dry flaky skin and acne; in adults weight loss, poor wound healing, hair loss and white spots on nails.
Delayed puberty, lack of ovulation, low sperm count and low libido.
Diarrhoea, lactose intolerance, decreased senses of taste and smell and poor appetite.
Build-up of copper, lead and cadmium in the body.
Increased tendency to infectious diseases.

Sources
Sunflower seeds, sesame seeds, all nuts, soya beans, kidney beans, lentils, peanuts, lima beans, cheddar cheese, egg yolk, brown rice, rye flour, oats, whole-wheat flour, parsley, green peas,
COPPER
Copper is strongly related to iron metabolism in the body.

Functions
Has a role in energy production. Needed for iron absorption and haemoglobin production. Part of enzymes that scavenge harmful free radicals and enzymes that process adrenaline, serotonin and dopamine. Needed for the production of the skin pigment, melanin.

Absorption and excretion
The organic form in living tissue is more easily absorbed than the inorganic form as from copper water pipes. Absorption is inhibited by mercury, cadmium, phytates and excessive zinc or vitamin C.

Deficiency
Primarily results in hypochromic anaemia (meaning lack of colour). Possibly associated with MS and emphysema.

Excess
The classic result is Wilson’s disease, in which there is a build-up of copper caused by a genetic lack of an enzyme required for copper elimination; there is damage to liver, kidneys and brain. Excess can contribute to PMS, schizophrenia and hyperactivity. Also can be associated with rheumatoid arthritis, systemic lupus erythematosus and poriariosis.

Excess copper generates free radicals and is strongly associated with atherosclerosis and possibly other conditions.

Sources
Sunflower seeds, sesame seeds, mushrooms, almost all nuts, cheddar cheese, spinach.

MANGANESE
Functions
Required for numerous functions – for blood clotting, protein digestion, converting surplus protein to urea, for carbohydrate metabolism, and for enzymes that enable absorption of vitamin C and some B-vitamins. Manganese is needed for lipid distribution in the body and synthesis of cholesterol, for building bone, for synthesis of thyroid hormone and for enzymes that destroy free radicals.

Absorption
Competitive with iron – the more iron in the diet, the less manganese absorbed, and vice versa.

Deficiency
Deficiency does not always have adverse effects because other minerals can take its place. If damage is done, it can include bone defects, growth retardation, brain and nerve malfunctions, problems with balance, disturbance to lipid metabolism, and possibly glucose intolerance.

Sources
Sea kelp is a rich source of iodine. Other seafoods have significant chromium content. There is a deficiency of chromium in Europe and North America, due to the soil’s content and lack of wholemeal products. Food refining greatly reduces chromium content. Grain products are generally good sources. [Green potatoes have excessive chromium in a toxic form.]

SELENIUM
Selenium is one of the two great antioxidant minerals (the other being zinc) because of its potent role in preventing free radical damage.

Functions
It is the key mineral in an enzyme produced in the body to block the chain reaction of free radical damage, the enzyme being called glutathione peroxidase. In particular, this enzyme protects fat and cholesterol from oxidation inside our bodies. Oxidised fat and cholesterol are toxic. Where selenium levels in the blood are low, there are more cancers. Selenium also helps protect against toxicity from mercury and cadmium. Because of its antioxidant property, selenium reduces the requirement for vitamin E.

Absorption
Selenium is absorbed in the chelated form, attached to the amino acid, methionine.

Deficiency and toxicity
Increased risk of tumours, muscular dystrophy and cataracts. Oxidation of fat and cholesterol can lead to fatty liver. We only require approximately 200 micrograms per day. If supplements are taken mistakenly at the level of 200 milligrams, which is 1,000 times too much, this is very toxic.

Sources
The richest of all foods is Brazil nuts, although the levels vary widely. The levels of selenium in other foods depend on the soil content.

CHROMIUM
Functions
Part of glucose tolerance factor, which enables cells to respond to insulin. If this is missing, cells cannot take up glucose from the bloodstream, leading to high blood sugar levels.

Deficiency
High intakes of carbohydrates and alcohol can lead to deficiency. Deficiency leads to increased blood sugar levels and risk of type-2 diabetes. Impaired growth.

Sources
Food refining greatly reduces chromium content. Grain products are generally good sources. [Green potatoes have excessive chromium in a toxic form.]

PART 2 – THE VITAMINS
Will be in the next issue or soon after.