



# Vitamins and minerals

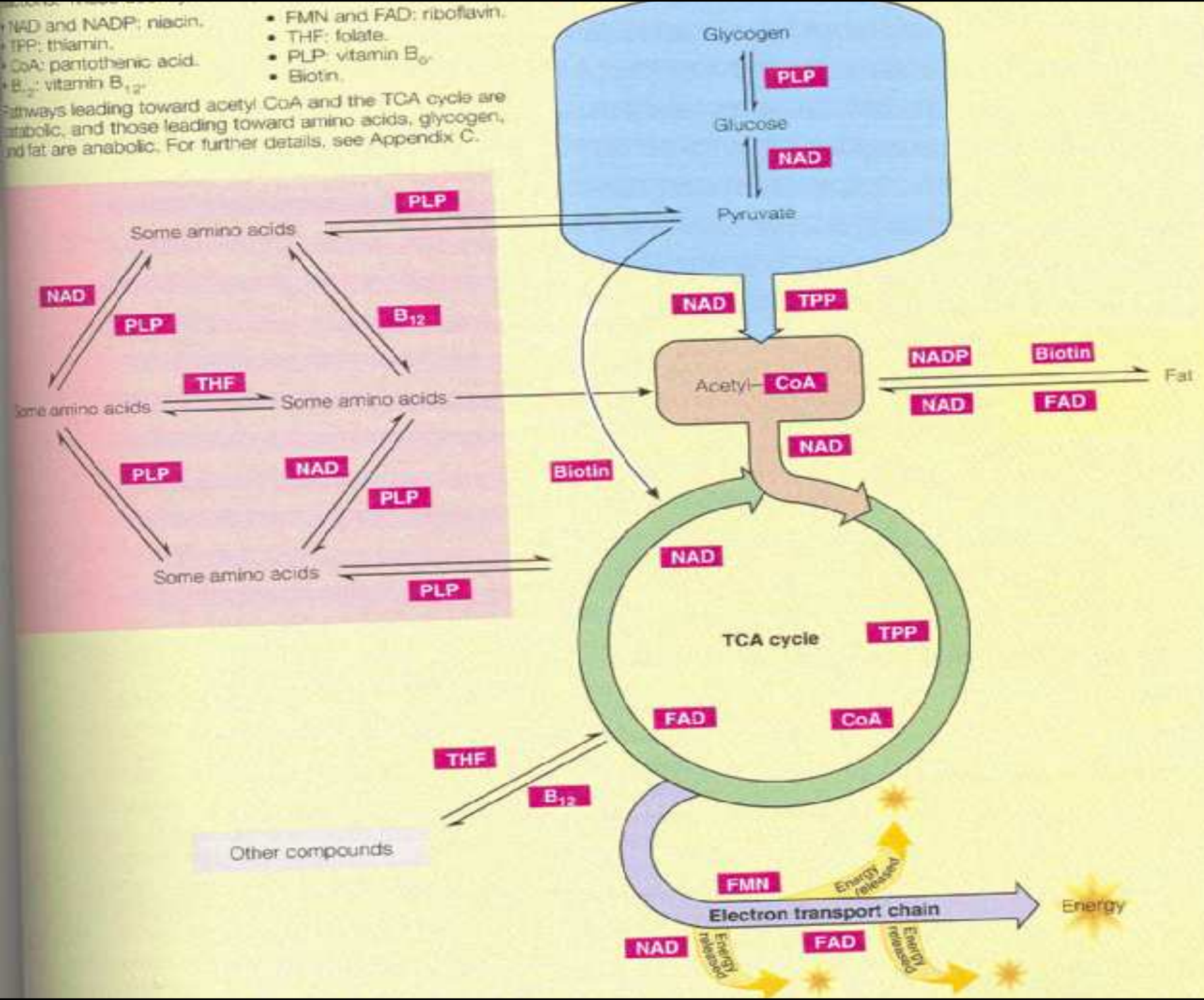


# Vitamins

- Organic molecules that function in a wide variety of capacities within the body
  - as cofactors for enzymatic reactions
  - as antioxidants
  - in energy metabolism
- They are necessary for our growth, vitality, and general well-being
- They generally cannot be synthesized by mammalian cells and, therefore, must be supplied in the diet
- They are needed by the body in small amounts
- **Hypovitaminosis**
- **Avitaminosis**

- NAD and NADP: niacin.
- TPP: thiamin.
- CoA: pantothenic acid.
- B<sub>12</sub>: vitamin B<sub>12</sub>.
- FMN and FAD: riboflavin.
- THF: folate.
- PLP: vitamin B<sub>6</sub>.
- Biotin.

Pathways leading toward acetyl CoA and the TCA cycle are catabolic, and those leading toward amino acids, glycogen, and fat are anabolic. For further details, see Appendix C.



# Two distinct types of vitamins

- **Water soluble vitamins**
  - Thiamin (B1)
  - Riboflavin (B2)
  - Niacin (B3)
  - Pantothenic Acid (B5)
  - Pyridoxal, Pyridoxamine, Pyridoxine (B6)
  - Biotin
  - Cobalamin (B12)
  - Folic Acid
  - Ascorbic Acid (vitamin C)
- **Fat soluble vitamins**
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin A (Retinol)</b>	Cod-liver oil, liver, kidney, milk products, butter, yolk, as provitamine A in carrots	Normal growth, function and protection of skin, eyes and mucous membrane	Growth stop, night blindness
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
Impaired visions, headache, nausea, vomitus, tiredness, skin change	Smoker, vegetarian, in case of high alcohol consumption, intake of cathartic, birth control pill, antibiotics	Fat-soluble, light and oxygen-sensitively	approx. 1 - 5mg



Name	Main occurrence	Effectiveness	Lack
<b>Vitamin B1 (Thiamin)</b>	Wheat germs, wholemeal cereals, peas, heart, pork, barm, oatmeal, liver, brown rice	Important for the nerve system, liver damage, inefficiency, pregnancy, mosquito protection (high-dosed), production of energy, affects the carbohydrates metabolism, important for the thyroid function	Heavy muscle- and nerve disturbances, tiredness, dyspepsias, dropsy, cardiac insufficiency, cramps, paralyses, prickle in arms and legs
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
None	Diet, youth, pregnant and nursing women, alcohol consumption, intake of birth control pill, antibiotics, chemotherapy	Water-soluble, Thiamin gets destroyed by heat and long storage, but not by freezing. Daily intake of vitamin B1 is important, because the body can't store B1, which comes over the food	approx. 2mg (At carbohydrates-packed nutrition some more)

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin B2 (Riboflavin)</b>	Milk products, Meat, wholemeal cereal, cheese, eggs, liver, sea-fish, green leafy vegetables, whey powder	Important for body growth, utilization of fats, protein and carbohydrates, well for skin, eyes and nails, important energy bringer, oxygen transport	(rarely) skin inflammation, brittle nails, anaemia, callus attrition
Overdosing	Increased need	Characteristics	Daily need
not known	Pregnancy, intake of birth control pill and antibiotics, chemotherapy, fever, smoker, old people	Water-soluble, food with Vitamin B2 should be stored cool and dark.	approx. 2 mg

Name	Main occurrence	Effectiveness	Lack
Vitamin B3 (Niacin, Nicotine acid)	Barm, peanuts, peas, liver, poultry, fish, lean meat	Building and degradation of fat, protein and carbohydrates, good sleep	Skin and mucosa inflammation, headache, trembling, vertigo, sleep disturbance, depressions, feeling of prickle and deafness in the limbs
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
(with over 100mg a day) pruritus, nausea, allergies	Labor, fever, nursing women	Water-soluble, effect is outweighed by sugar and alcohol	13 - 16 mg



Name	Main occurrence	Effectiveness	Lack
Vitamin B5 (Pantothen acid)	Liver, vegetable, wheat germs, asparagus, crabs, meat, sunflower cores, Pumpnickel	Against turning grey, hair loss, hair and mucous membrane illnesses, necessarily for the dismantling of fat, proteins and carbohydrates	Nerve malfunctions, bad healing of wounds, early turning grey, weakened immune system
Overdosing	Increased need	Characteristics	Daily need
Over urine excreted	Old people, pregnant and nursing women, burden, drinking much coffee and tea	Water-soluble, heat-sensitive	approx. 10 mg

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin B6 (Pyridoxin)</b>	Bananas, nuts, wholemeal products, yeast, liver, potatoes, green beans, cauliflower, carrots	Travel sickness, neuralgia, liver damage, premenstrual syndrome, digestion of protein, most important hormone in pregnancy together with folic acid, detoxication	(rather rarely) intestine problems, bad skin, tiredness, rough corners of the mouth
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
With intake of this for a longer time in form of tablets it can deposit in the body tissue and lead to nerve damages.	Period of growth, intake of birth control pill, cortisone, during physical and mental load, before the menstruation	Water-soluble, neither heat nor light-resisting	approx. 2 mg

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin B7 (Biotin)</b>	Liver, cauliflower, champignons, wholemeal products, eggs, avocado, spinach, milk	Skin diseases, loss in growth of hairs, liver damage, assists metabolism, carbohydrate and fatty acid activity, together with vitamin K it is needed for building up the clotting factors	States of exhausting, skin inflammations, muscular pains, hair loss, nausea
Overdosing	Increased need	Characteristics	Daily need
not known	Intake of birth control pill, antibiotics and cathartics	Water-soluble	approx. 0,5 mg

Name	Main occurrence	Effectiveness	Lack
Vitamin B9 (Folic acid)	Liver, wheat germs, cucurbit, champignons, spinach, avocado	Liver damage, cell division, healing and growth of muscles and cells, protein metabolism	Anaemia, digesting disturbances, disturbances of hair -, bone and cartilage growth
Overdosing	Increased need	Characteristics	Daily need
Allergies, sleep disturbances and bad moods (with more than 15 mg a day)	Pregnant and nursing women, smoker, youth	Water-soluble, do not tolerate with heat, light or oxygen	approx. 160 µg

Name	Main occurrence	Effectiveness	Lack
Vitamin B12 (Cobalamin)	Liver, milk, yolk, fish, meat, oysters, quark, barm	Building substance of cytotblast and erythrocyte, nerve pains, skin and mucosa inflammation, liver damage	Aenaemia, nerve disturbances, nervous disturbances, changes in the lung and the spinal marrows
Overdosing	Increased need	Characteristics	Daily need
Not possible, because it will be excreted by the body	Diabetics, pregnant and nursing women, vegetarian, vegan, intake of birth controll pill, antibiotics and anti cramp means, chemotherapy	Water-soluble, heatproof	approx. 5 $\mu$ g

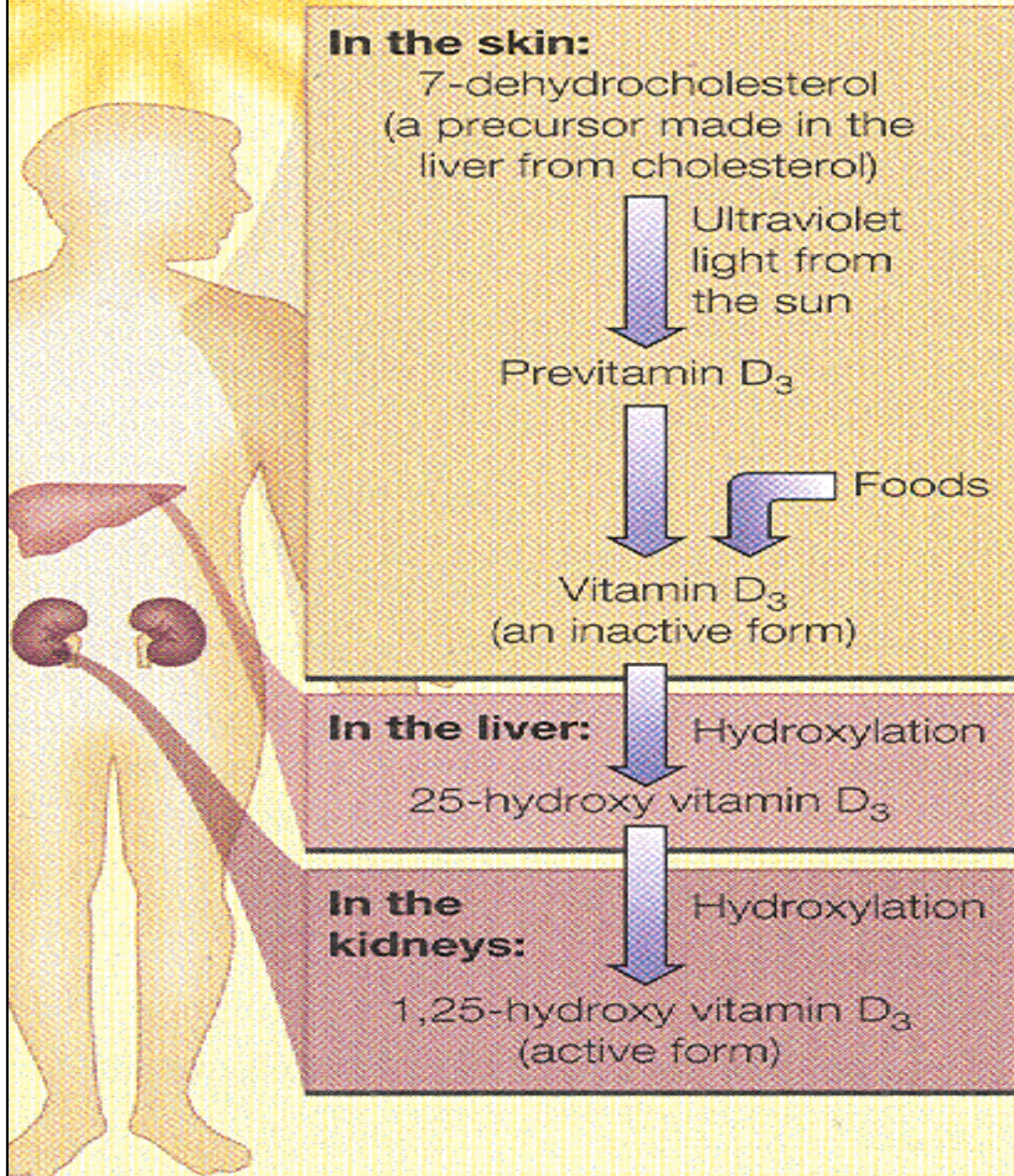


Name	Main occurrence	Effectiveness	Lack
<b>Vitamin C (ascorbic acid)</b>	Dogroses, sea buckthorn, citric fruits, black currants, potatoes, paprika, tomatoes, collard, spinach, vegetables, radish	Inflammation and bleeding-restraining, assists the body's defences, protects cells against chemical destruction, activates enzymes, structure of connective tissue, bones and dental enamel, faster healing of wounds, stabilisation of psyche	Gum-bleed, tiredness, joint pain and headache, bad healing of wounds, lack of appetite, scurvy, inefficiency
Overdosing	Increased need	Characteristics	Daily need
In the case of overdosing in form of powder and pills nausea, vomiting and urine stones can be the result.	Smoker, pregnant and nursing women, older people, diets, alcohol consumption, intake of birth control pill, antibiotics, cortisone, analgesics and barbiturates	Water-soluble, oxygen and dryness-sensitively, not for a long time store	approx. 75 mg - 200 mg

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin D (Calciferol)</b>	Cod-liver oil, liver, milk, yolk, butter, sea fish, herring, champignons, avocado	Regulation of calcium- und phosphat household, structure of bone, assits admission of calcium	Bone curvature and softening, increased infection sensitivity, amyasthenia
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
(only with man- made Vitamin D) Calcium deposits in bones, heart muscle, blood vessels, stomach, headache, vomiting, swindle, gastro-intestinal diseases	Babies, older humans, intake of birth control pill, cathartic, antibiotics, barbiturate	Fat-soluble, light sensitively, heatproof	approx. 5 $\mu$ g



# Synthesis and activation of vitamin D



The precursor of vitamin D is made in the liver from cholesterol (see Figure 5-10 on p. 137 and Appendix C). The activation of vitamin D is a closely regulated process. The final product, active vitamin D, is also known as 1,25-dihydroxycholecalciferol (or calcitriol).



Name	Main occurrence	Effectiveness	Lack
<b>Vitamin E</b> (Tocopherole)	Sunflowers -, corn -, Soja and wheat germ oil, nuts, flaxseed, salsify, peperoni, collard, avocado	Stabilization of the immune system, anti-inflammatory, cell replacement, protection from radicals, modulates cholesterol level and hormone household, important for blood vessels, muscles and reproduction organs	(rarely) amblyopia, tiredness, amyotrohia, dislike, reproduction problems
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
(particularly by synthetically manufactured caps) bad healing of wounds, deficiency symptoms, swindle, nausea	intake of cathartics and blood-fat-lowering medicines, high consumption of alcohol	Fat-soluble, it is destroyed by open storage, deep-freezing or cooking with much fat	10 - 30 mg (with fat-enrich nutrition more)

Name	Main occurrence	Effectiveness	Lack
<b>Vitamin K (Phyllochinone)</b>	Eggs, liver, green collard, green vegetable, bulbs, oatmeal, kiwi, tomatoes, cress	Necessary for formation of the blood clotting factors	High doses of vitamin A and E work against vitamin K.
<b>Overdosing</b>	<b>Increased need</b>	<b>Characteristics</b>	<b>Daily need</b>
With intake for a longer time, it can become toxic, bleedings, hot flashes, renal diseases	Babies, high consumption of alcohol, intake of birth control pill, antibiotics and cathartics	Fat-soluble, food with Vitamin K should be stored darkly	approx. 2 mg



# Minerals and trace elements

- Inorganic elements that always retain their chemical identity
- They can not be change in the body
- They can not be destroyed be heat, air or acid
- The main roles
  - Help to maintain the body's fluid balance (sodium, potassium, chloride)
  - Bone growth and health (calcium, phosphorus, magnesium)
  - Antioxidant (selenium, zinc)

## ■ The minerals

- Sodium
- Calcium
- Phosphorus
- Potassium
- Sulfur
- Chloride
- Magnesium



## ■ The trace elements

- Iron
- Zinc
- Iodine
- Selenium
- Copper
- Manganese
- Fluoride
- Chromium
- Molybdenum



Mineral	Use in body	Adult daily requirement	Food source	Effect of too little
<b>Calcium</b>	hardens bones and teeth, needed for muscles, helps blood to clot.	about 700 mg	dairy products, eggs, fish, soya beans, leaves of sweet potato, cocoyam	Weak or brittle bones
<b>Fluorine</b>	hardens bones and teeth	0.7 parts per million in water	milk, toothpaste	tooth decay
<b>Iron</b>	helps the blood to transport oxygen	13 - 16 mg	liver, eggs, red meat, beans, groundnuts, plantain, raisins, cocoa	anaemia
<b>Magnesium</b>	bone structure, control of nerve and muscle action	about 13 mg	green vegetables, milk, meat	muscles do not work properly
<b>Potassium</b>	needed for muscles and nerves	1 - 2 mg	all foods, especially meats, vegetables, milk	heart and other muscles may not work properly
<b>Sodium</b>	needed for nerves to work, controls the amount of water in cells and blood.	about 6 g	most foods, table salt	dehydration, muscle cramps, kidney failure.

# Vitamins and athletes

- Inadequate vitamin status is associated with impaired capacity for exercise
  - Supplying additional amounts of vitamins = beneficial
- Increase utilization of vitamins in exercise metabolism
- Athletes
  - higher intake of energy = higher intake of vitamins
- Supplementation with vitamins
  - not enhance performance

# Important vitamins for athletes

## ■ Antioxidants - vitamin C and E

- A sudden increase in training stress - increase of training load, exposure to altitude or a hot environment
- Very hard training => muscle damage, free radical-induced damage



# Minerals and athletes

- **Iron and calcium**
  - Important role in the health and performance of athletes
- **Sodium, potassium, chloride**
  - Water homeostasis
  - Distribution of water between the ICF and ECF
  - Sodium- regulation of blood pressure
- **Magnesium**
  - Regulation of energy metabolisms
  - A cofactor and activator for a number of enzymes
  - Involved in calcium metabolism
  - Maintaining of electric gradients across cell membranes
  - Lost in sweat => deficiency = muscle cramps

# Minerals and athletes

## ■ Zinc

- A cofactor in many enzymatic reactions
- The promotion of tissue repair processes
- Enhancing immune function
  - Increasing resistance to minor illness and infection

## ■ Selenium

- Antioxidant (glutathione peroxidase)
- Protection against some cancer

# Iron

- In 1970s athletes - lower concentration of hemoglobin (a sign of anemia)
  - Unfavorable for the performance
  - Later - false or dilutional anemia, sports anemia
- Athletes - a high risk group for deficiency of iron
  - Causes:
    - Iron requirement and/or losses exceed iron intake
    - Increased requirements: during periods of growth, female in reproductive
    - Losses - prolonged and heavy training - increase iron turnover
      - mechanical trauma
      - gastrointestinal blood loss

# Calcium

- Regular exercise = increase mineralization of bones
- Inadequate intake of calcium - can interfere with optimal bone health
- **Female athletes**
  - Lower bone density
  - An increase risk of stress fractures
  - Causes: a complex interrelationship between hormonal status (estrogen) and bone health
    - Irregular menstruation, secondary or primary amenorrhea - gymnastics (chronic energy deficit, psychological stress, low body fat)