Food Chemistry I

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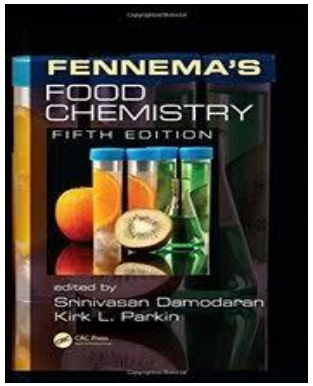
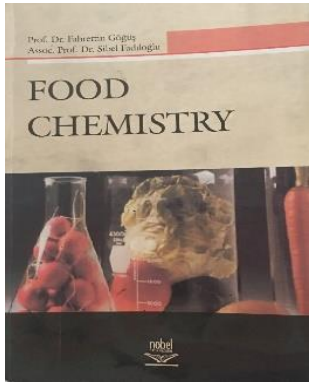
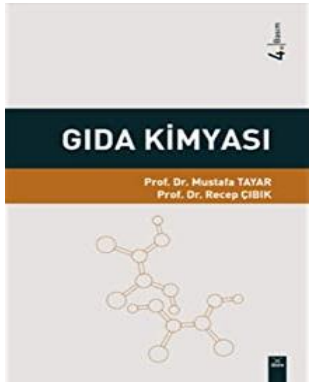
1. 

2. 

3. 

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2. Göğüş F. and Fadıloğlu S. 2006. *Food Chemistry*, Nobel Akademik Yayıncılık, Ankara.
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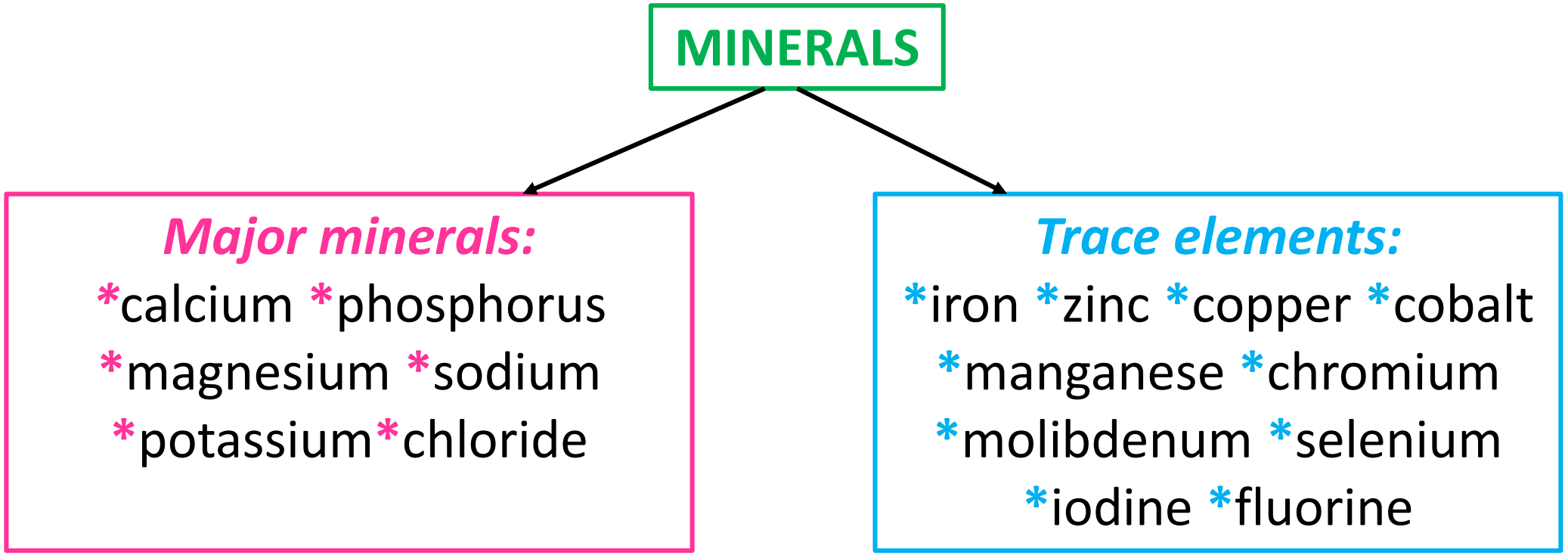
* Essential minerals
* Nonessentials
* Contaminants

Mineral as it applies to food and nutrition, the term usually refers to elements other than C, H, O, and N that are present in foods.



PRINCIPLES OF MINERAL CHEMISTRY

* **Solubility of Minerals in Aqueous Systems**
* **Minerals and Acid/Base Chemistry**
* **Chelate Effect**

Mineral elements are present in foods in many different chemical forms. These forms are commonly referred to as “species” and include compounds, complexes, and free ions.

It is very difficult to isolate and characterize mineral species in foods.

Nutritional Aspects of Essential Minerals - Overview

The process of mineral nutrient digestion and absorption may be described as follows:

* To start, the food is masticated in the mouth where salivary amylase begins the process of starch digestion.
* Next, the food is swallowed and enters the stomach where the pH is gradually lowered to about 2 by gastric acid. At this stage, dramatic changes occur in mineral species.
* In the next stage of digestion, the partially digested food in the stomach is emptied into the proximal small intestine where pancreatic secretions containing sodium bicarbonate and digestive enzymes raise the pH and continue the process of protein, lipid, and starch digestion.

Nutritional Aspects of Essential Minerals - Individual Minerals

For various reasons, deficiencies are common for some mineral elements and rare or nonexistent for others. Moreover, there are large variations in prevalences of specific deficiencies across geographical and socioeconomic divisions.

Calcium

Calcium, the most abundant mineral in the body is widely distributed in the throughout the body totally about 1500 g in adults. Besides its structural role, calcium plays major regulatory roles in numerous biochemical and physiological processes in both plants and animals. For example, calcium is involved

* in photosynthesis *oxidative phosphorylation

* blood clotting *muscle contraction *cell division

* transmission of nerve impulses * enzyme activity

* cell membrane function * intercellular adhesion * hormone secretion

Low intakes of calcium are a factor in several chronic diseases including osteoporosis, hypertension, and some forms of cancer.

Taking calcium supplements can increase risk for cardiovascular events, kidney stones, and gastrointestinal problems.

There is no evidence that high calcium intakes from food sources are associated with these adverse health outcomes.

Phosphorus

Phosphorous is ubiquitous in all living systems due to the vital role it plays in the structure of cell membranes and virtually all metabolic processes.

In the skeleton in the form of hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$

Phosphorous is required for cell reproduction, cell integrity, transport of nutrients across membranes, energy metabolism, and regulation of metabolic processes.

Magnesium

Magnesium is an activator of many enzymes including conversion of energy rich phosphates. Magnesium compounds also are involved in intracellular and plasma membranes. Membrane involved in many life supporting metabolic functions and thus deficiency can be very serious. Magnesium is widely distributed in plant and animal foods.

Sodium, Potassium, and Chloride

Sodium and potassium are classified as alkali metals and they exist naturally only as salts.

Sodium, potassium, and chloride are essential nutrients but deficiencies are rare because intakes are almost always greater than requirements.

For adult males and females, AIs for Na, Cl, and K are 1.5, 2.3, and 4.7 g/day, respectively.

Iron

Iron is the fourth most abundant element in the earth's crust and is an essential nutrient for nearly all living species. In biological systems, it is present almost exclusively as chelates with porphyrin rings or proteins.

Functional iron plays many key roles in biological systems, including oxygen transport, respiration and energy metabolism, destruction of hydrogen peroxide, and DNA synthesis.

Iron deficiency is a major cause of anemia.

Zinc

Zinc is involved in a wide range of metabolic functions. It functions as an antioxidant, presumably as a cofactor of the metalloenzyme Cu/Zn superoxide dismutase. It is also a key player in the regulation of gene expression.

Plasma zinc concentrations in the range of 12–18 µmol/L are considered normal.

Zinc deficiency in humans and animals causes an impaired immune response, delayed wound healing, and poor appetite.

Copper

Copper is present in foods as part of several copper-containing enzymes, including the polyphenolases. Copper is a very powerful prooxidant and catalyzes the oxidation of unsaturated fats and oils as well as ascorbic acid. The normal daily diet contains from 2 to 5 mg of copper, more than ample to cover the daily requirement of 0.6–2 mg.

Cobalt

Cobalt is an integral part of the only metal containing vitamin B12. The level of cobalt in foods varies widely, from as little as 0.01 ppm in corn and cereals to 1 ppm in some legumes. The human requirement is very small and deficiencies do not occur.

Manganese

Manganese is present in a wide range of foods but is not easily absorbed. This metal is associated with the activation of a number of enzymes. In wheat, a manganese content of 49 ppm has been reported. This is mostly concentrated in the germ and bran; the level in the endosperm is only 2.4 ppm. Values range from a low of 1.1 ppm in salmon to a high of 42 ppm in oyster.

Molybdenum

Molybdenum plays a role in several enzyme reactions. This metal is found in cereal grains and legumes; leafy vegetables, especially those rich in chlorophyll; animal organs; and in relatively small amounts, less than 0.1 ppm, in fruits. The molybdenum content of foods is subject to large variations.

Selenium

Selenium has recently been found to protect against liver necrosis. It usually occurs bound to organic molecules. Different selenium compounds have greater or lesser protective effect. The most active form of selenium is selenite, which is also the least stable chemically. Many selenium compounds are volatile and can be lost by cooking or processing. Milk, most fruits and vegetables, grain products, meat and seafood contain selenium.

Chromium

The dietary intake of chromium is in the order of 50 µg/day. Refining and processing of foods may lead to loss of chromium. Cereal products, meat, fish and seafood, fruits, vegetables, nuts, dairy products, eggs, margarine, beverages, confectionery, sugar, and condiments contain chromium. No foods are known to contain higher-than-average levels of chromium.

Fluorine

Fluorine is a constituent of skeletal bone and helps reduce the incidence of dental caries. The fluorine content of drinking water is usually below 0.2 mg/L but in some locations may be as high as 5 mg/L. The optimal concentration for dental health is 1 mg/L. The fluoride content of vegetables is low, with the exception of spinach. Milk contains 20 µg/100 g and beef about 100 µg/100 g. Fish foods may contain up to 700 µg/100 g and tea about 100 µg/g.

Iodine

Iodine is not present in sufficient amounts in the diet in several areas of the world; an iodine deficiency results in goiter. The addition of iodine to table salt has been extremely effective in reducing the incidence of goiter. The iodine content of most foods is in the area of a few mg/100 g and is subject to great local variations. Fish and shellfish have higher levels. Saltwater fish have levels of about 50–150 mg/100 g and shellfish may have levels as high as 400 mg/100 g.