

4 Topic: Minerals

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Relevance of the topic: Minerals are important for your body to stay healthy. Your body uses minerals for many different jobs, including keeping your bones, muscles, heart, and brain working properly. Minerals are also important for making enzymes and hormones. There are two kinds of minerals: macrominerals and trace minerals. You need larger amounts of macrominerals. They include calcium, phosphorus, magnesium, sodium, potassium, chloride and sulfur. You only need small amounts of trace minerals. They include iron, manganese, copper, iodine, zinc, cobalt, fluoride and selenium.

Aim of the topic: Give information to students about macrominerals, main functions of each macromineral in human body, their sources and the required amount of macrominerals per a day.

Questions for prepare:

1. What are minerals?
2. What are 2 types of minerals?
3. What minerals are macrominerals?
4. What are the main functions and sources of macrominerals?

7.1 Role of Minerals

The body requires a number of minerals in order to maintain its proper functioning; these are called essential minerals. The minerals are used for a variety of physiological processes such as building blood and bone, making hormones, regulating heartbeat, and more.

There are two types of minerals:

Major minerals (macrominerals) are needed in large amounts. Trace minerals (microminerals) are needed in very small amounts.

- **The macrominerals** are calcium, phosphorus, magnesium, sodium, potassium, chloride, and sulfur.

- **The microminerals** are iron, manganese, copper, iodine, zinc, cobalt, fluoride, and selenium.

7.2 Macrominerals: main functions and sources

Sodium

Function: Needed for proper fluid balance, nerve transmission, and muscle contraction.

Sources: Table salt, soy sauce; large amounts in processed foods; small amounts in milk, breads, vegetables, and unprocessed meats.

Sodium and chloride are critical life-sustaining minerals. Sodium chloride (salt) is a required part of the diet. With potassium, sodium and chloride maintain charge gradients across cell walls.

Sodium helps to maintain proper blood volume and blood pressure. School-aged children require between 1.0 and 1.5 grams of sodium chloride per day.

Age	Adequate intake (mg/day)
4–8 years	1,000
9–13 years	1,200
14–18 years	1,500

Chloride

Function: Needed for proper fluid balance, stomach acid.

Sources: Table salt, soy sauce; large amounts in processed foods; small amounts in milk, meats, breads, and vegetables.

Sulfur

Function:

- Forms part of proteins (it has a stabilising function)
- Forms part of the vitamin's biotin and thiamin, and the hormone insulin
- Is involved in body's detoxification processes

Sources: Occurs in foods as part of protein: meats, poultry, fish, eggs, milk, legumes, nuts.

Sulfur is an important component of two amino acids, cysteine and methionine, that are used in most proteins of the body.

Because sulfur is abundant in nature, it is not usually classed as a required nutrient in the diet.

Potassium

Function: Needed for proper fluid balance, nerve transmission, and muscle contraction.

Sources: Meats, milk, fresh fruits and vegetables, whole grains, legumes.

In addition to acting as an electrolyte in the body, potassium also functions as a cofactor for a number of enzymes. Low potassium levels can be dangerous, resulting in fatigue, muscle cramps, and abdominal pain. (Figure 3).

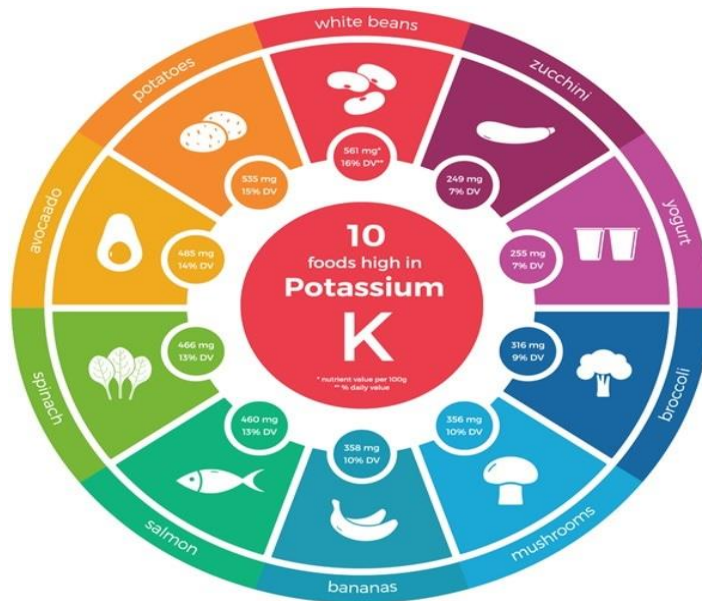


Figure 3 – Main food source of potassium

DRI for school-aged children

Life Stage	Recommended Amount
Birth to 6 months	400 mg
Infants 7–12 months	860 mg
Children 1–3 years	2,000 mg
Children 4–8 years	2,300 mg
Children 9–13 years (boys)	2,500 mg
Children 9–13 years (girls)	2,300 mg
Teens 14–18 years (boys)	3,000 mg
Teens 14–18 years (girls)	2,300 mg

Phosphorus

Function: Important for healthy bones and teeth; found in every cell; part of the system that maintains acid-base balance.

Sources: Meat, fish, poultry, eggs, milk, processed foods (including soda pop).

Phosphorus forms a part of the bones in the form of the mineral hydroxyapatite. It is also used in cell membranes, and is part of the energy molecules, adenosine triphosphate (ATP) and adenosine diphosphate (ADP). DNA and RNA also contain phosphate (Figure 4).

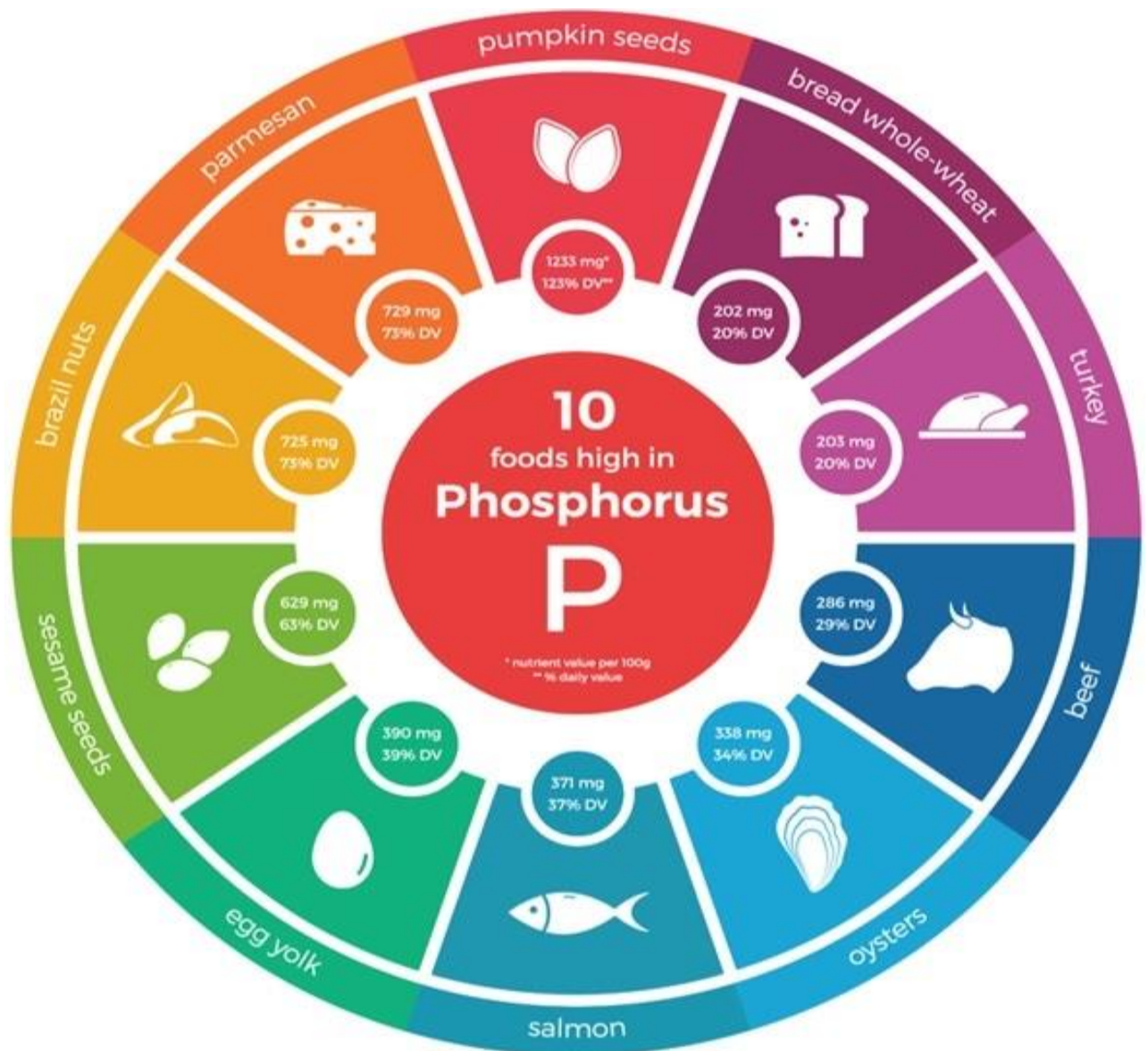


Figure 4 – Main food source of phosphorus

Calcium

Function: Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation, immune system health.

Sources: Milk and milk products; canned fish with bones (salmon, sardines); fortified tofu and fortified soy milk; greens (broccoli, mustard greens); legumes.

Calcium is the most abundant mineral in the body. It is used structurally, to build bones and teeth, and also as a messenger in cell signaling. In addition to forming the primary structure of our body, the bones also serve as a calcium reserve in case of dietary deficiency. Dietary calcium is therefore extremely important to prevent loss of bone. Calcium balance is maintained by parathyroid hormone.

Recommended daily allowance of calcium for school-aged children is 1200-1300 mg/day (Figure 5).

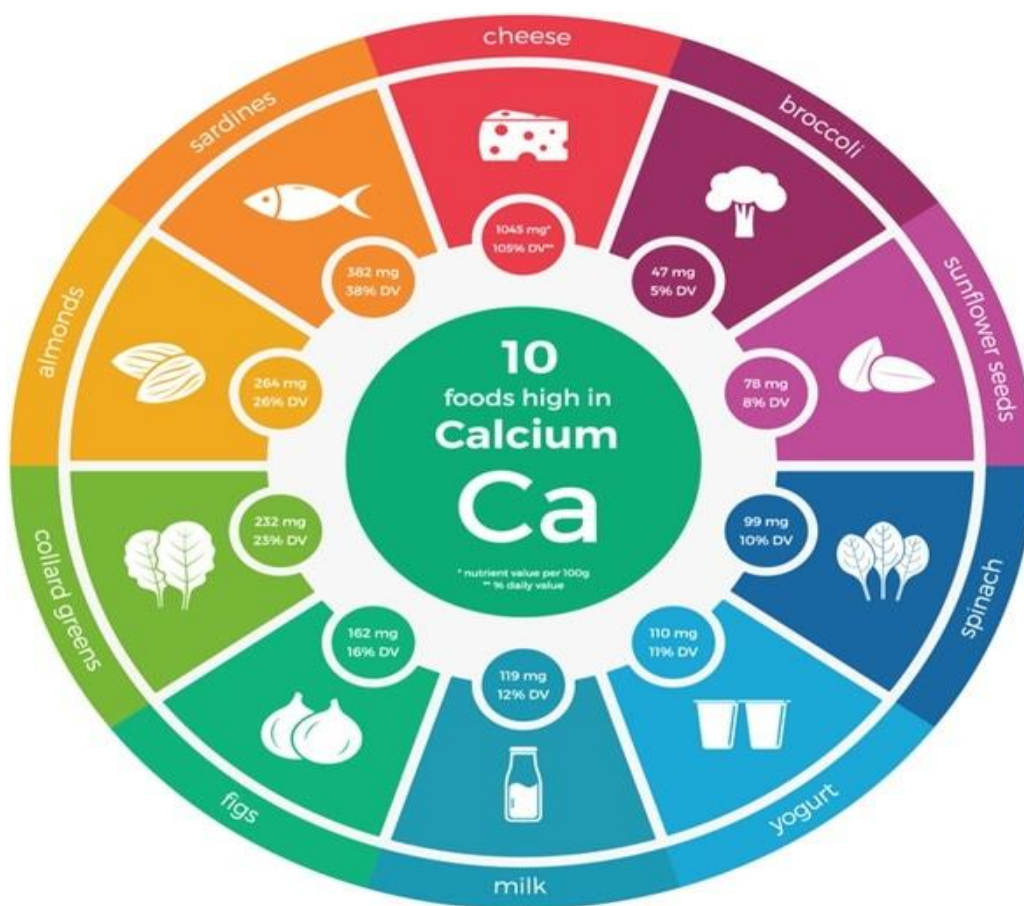


Figure 5 – Main food source of calcium

Magnesium

Function: Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health.

Sources: Nuts and seeds; legumes; leafy, green vegetables; seafood; chocolate; artichokes; "hard" drinking water.

Magnesium is widely used by the body for metabolic processes. Some of its main functions include energy production, synthesis of biomolecules, and as a structural component of cell membranes and chromosomes.

Magnesium is also used in ion transport, cell signaling, and cell migration. Recommended daily allowance of magnesium is 100-135 mg for school-aged children (Figure 6).

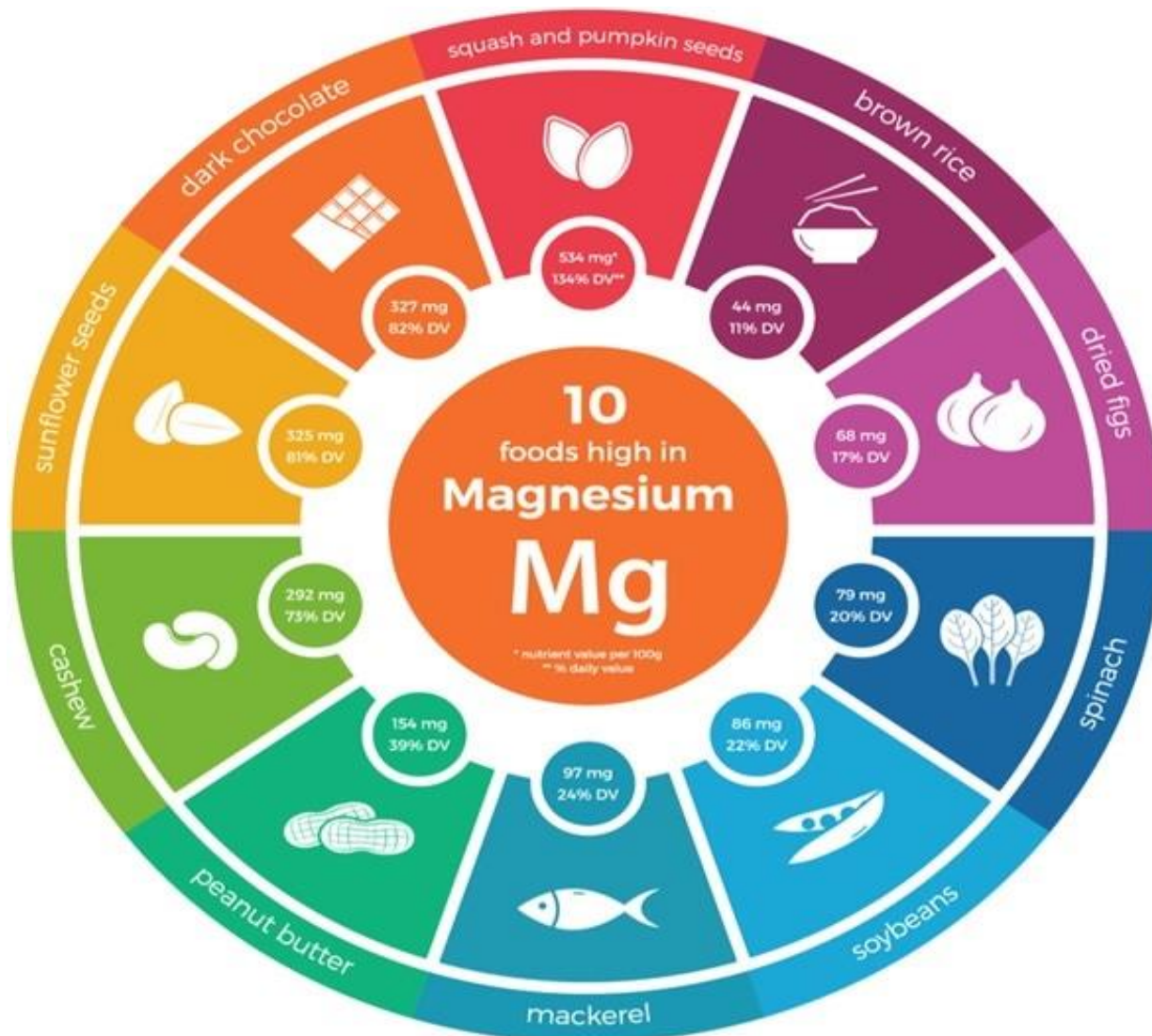


Figure 6 – Main food source of magnesium

References:

1. Macrominerals and Trace Minerals in the Diet By Dr. Catherine Shaffer, Ph.D. Reviewed by Dr. Liji Thomas, MD. <https://www.news-medical.net/health/Macrominerals-and-Trace-Minerals-in-the-Diet.aspx#:~:targetText=Macrominerals%20are%20needed%20in%20large,cobalt%2C%20fluoride%2C%20and%20selenium>.
2. Minerals: Their Functions and Sources - University of Michigan Health System (UMHS). <https://www.uofmhealth.org/health-library/ta3912>
3. <http://pi.oregonstate.edu/mic/minerals>

4. <http://www.livescience.com/3505-chemistry-life-human-body.html>

Microminerals

Relevance of the topic: Minerals are important for your body to stay healthy. Your body uses minerals for many different jobs, including keeping your bones, muscles, heart, and brain working properly. Minerals are also important for making enzymes and hormones. There are two kinds of minerals: macrominerals and trace minerals. You need larger amounts of macrominerals. They include calcium, phosphorus, magnesium, sodium, potassium, chloride and sulfur. You only need small amounts of trace minerals. They include iron, manganese, copper, iodine, zinc, cobalt, fluoride and selenium.

Aim of the topic: Give information to students about trace minerals, main functions of each trace mineral in human body, their sources and the required amount of trace minerals per a day.

Questions for prepare:

1. What are minerals?
2. What are 2 types of minerals?
3. What minerals are microminerals?
4. What are the main functions and sources of microminerals?

8.1 Microminerals: main functions, sources, deficiency and toxicity

The body needs trace minerals in very small amounts. Note that iron is considered to be a trace mineral, although the amount needed is somewhat more than for other microminerals.

Chromium

Function: Works closely with insulin to regulate blood sugar (glucose) levels.

Sources: Unrefined foods, especially liver, brewer's yeast, whole grains, nuts, cheeses.

Molybdenum

Function: Part of some enzymes.

Sources: Legumes; breads and grains; leafy greens; leafy, green vegetables; milk; liver.

Other trace nutrients known to be essential in tiny amounts include nickel, silicon, vanadium.

Cobalt

Cobalt is present in the body as a part of vitamin B12, which is involved in manufacture of blood cells and nervous system function.

Copper

Function: Part of many enzymes; needed for iron metabolism.

Sources: Legumes, nuts and seeds, whole grains, organ meats, drinking water.

Manganese

Function: Part of many enzymes.

Sources:Widespread in foods, especially plant foods.

Zinc

Function:Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health.

Sources:Meats, fish, poultry, leavened whole grains, vegetables.

Zinc plays multiple roles in the body. It is involved in many cellular metabolic processes and is used in growth and development, the immune system, neurological function, and reproduction.

It also forms a structural part of cell membranes and is a component of the zinc finger proteins, which act as transcription factors.

Recommended daily allowance of zinc is 11 mg for men and 8 mg for women (Figure 7).



Figure 7 – Main food source of zink

Iodine

Function: Found in thyroid hormone, which helps regulate growth, development, and metabolism.

Sources: Seafood, foods grown in iodine-rich soil, iodized salt, bread, dairy products.

Iodine is a critical mineral in the body. It is a component of the thyroid hormone and is required for normal thyroid function.

Iodine is found naturally in seafood, dairy products, grains, eggs, and poultry.

Additionally, in many other countries, salt is fortified with iodine to prevent deficiencies in the population.

Iodine deficiency can cause brain damage, mental retardation, hypothyroidism, goiter, and other health problems. Recommended daily allowance of iodine is 150 micrograms (Figure 8).

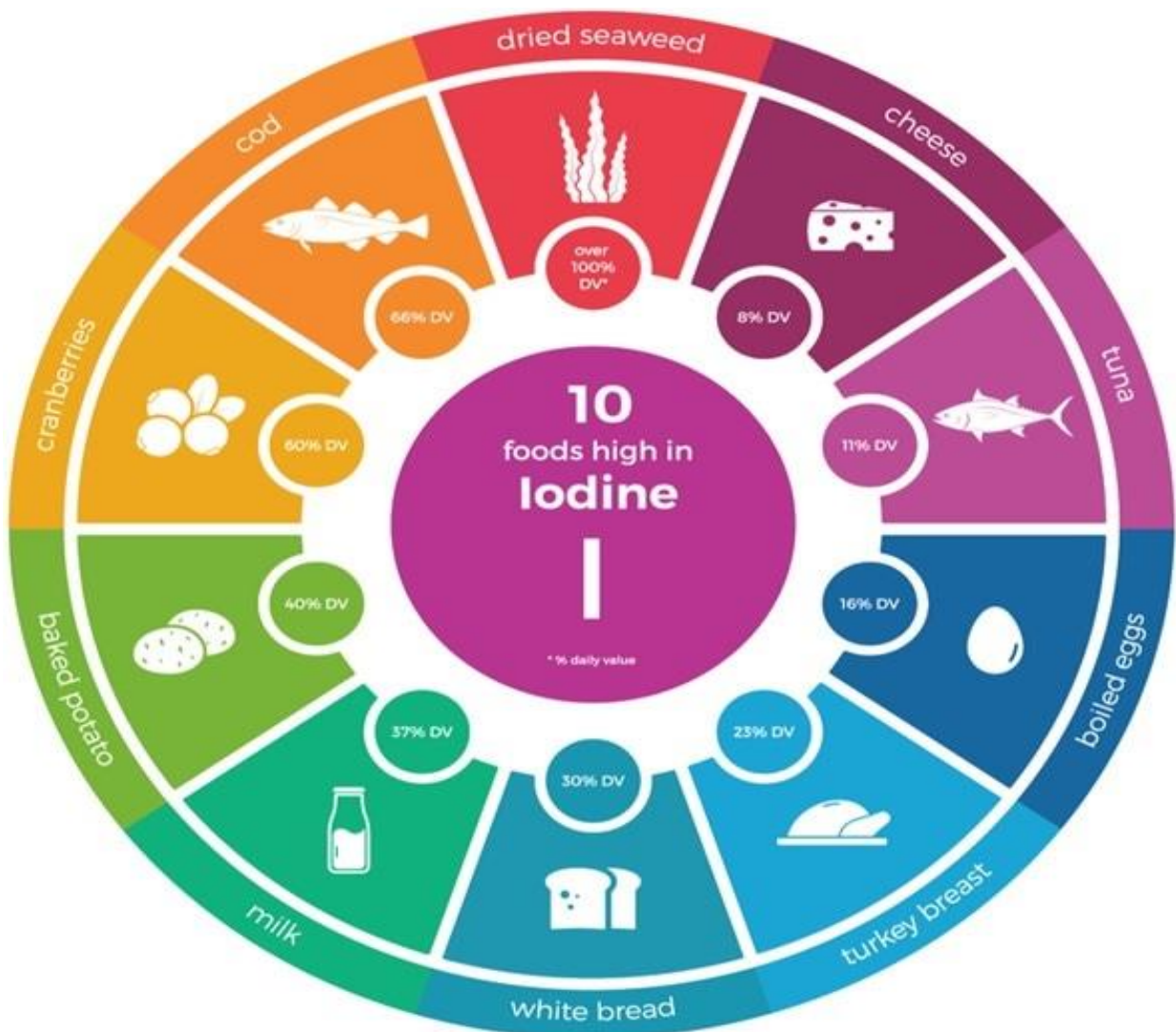


Figure 8 – Main food source of iodine

Selenium

Function:Antioxidant.

Sources:Meats, seafood, grains.

Selenium functions in the body in the form of selenoproteins, which have many metabolic functions.

Recommended daily allowance of selenium is 55 micrograms. Foods rich in selenium include Brazil nuts, tuna, oysters, pork, beef, chicken, whole wheat bread, and milk.

Deficiency of selenium does not usually result in obvious clinical illness, but may contribute to Keshan disease and Kashin-Beck disease.

Fluoride

Function:Involved in formation of bones and teeth; helps prevent tooth decay.

Sources:Drinking water (either fluoridated or naturally containing fluoride), fish, and most teas.

Fluoride hardens tooth enamel and stabilizes the mineral in bones. Natural sources of fluoride include tea, fish consumed with the bones, and some fruit juices.

However, the major source of dietary fluoride in the US is fluoridated drinking water.

The average fluoride intake per day in areas with fluoridated drinking water is 1.4 to 3.4 mg. In areas without fluoridated water, it is 0.3 to 1 mg per day.

Iron

Function:Part of a molecule (hemoglobin) found in red blood cells that carries oxygen in the body; needed for energy metabolism.

Sources:Organ meats; red meats; fish; poultry; shellfish (especially clams); egg yolks; legumes; dried fruits; dark, leafy greens; iron-enriched breads and cereals; and fortified cereals.

Iron is used in red blood cells to carry oxygen to the tissues, and is also a critical component of many metabolic proteins and enzymes.

Iron is found in the body in the form of heme iron and non-heme iron.

Heme iron is bound within a ring-like molecule called porphyrin. Heme iron is present in red blood cells.

Non-heme iron such as iron-sulfur cluster proteins are used in energy production and other metabolic functions. Recommended daily allowance of iron for men is 8 mg, for women 18 mg, and for pregnant women 27 mg.

References:

1. Macrominerals and Trace Minerals in the Diet By Dr. Catherine Shaffer, Ph.D. Reviewed by Dr. Liji Thomas, MD. <https://www.news-medical.net/health/Macrominerals-and-Trace-Minerals-in-the-Diet.aspx#:~:targetText=Macrominerals%20are%20needed%20in%20large,cobalt%2C%20fluoride%2C%20and%20selenium>.
2. Minerals: Their Functions and Sources - University of Michigan Health System (UMHS). <https://www.uofmhealth.org/health-library/ta3912>
3. <http://ipi.oregonstate.edu/mic/minerals>
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