Chapter 1

Composition of Food

The **foods** that we consume contain various substances called nutrients, which provide nutrition to our bodies. Six main types of nutrients have been identified:

1. Carbohydrates
2. Proteins
3. Fats
4. Vitamins
5. Minerals
6. Water

Carbohydrates, proteins and fats are needed in large amounts, and all of them supply energy to keep the body going.

Vitamins and minerals are required in very small amount. They do not supply energy but are very important to make sure that the thousands of processes going on in the body function smoothly and efficiently.

Water, often referred to as the elixir of life, also does not supply energy, but keeps the body hydrated, and refreshed and is a vital component of important processes going on in the body.

ENERGY

Energy is needed by our body to function efficiently and for us to lead active lives**.**

The source of this energy is the variety of foods we consume. Our body burns food for energy. Even when the individual is at rest, some organs of the body continue to work; the heart is beating, the lungs are breathing and the digestive system is working. Thus, some basic energy is always required. Once awake we need more energy to perform our routine. The harder the physical work, the greater the need for energy and the more food needed.

Body energy is measured in kilocalories. Usually, these are simply called calories. Carbohydrates and protein supply 4 kcal/g while fats supply 9 kcal/g energy to the body.

The major components of food supplying energy are discussed below.

CARBOHYDRATES

Carbohydrates are a necessary and major part of a healthy diet, supplying the body with nutrients it can convert to glucose, a currency of energy. Carbohydrates can be classified into

1. Simple carbohydrates
2. Complex carbohydrates
3. Dietary fibre.

Carbohydrate molecules are composed of oxygen, hydrogen and carbon atoms. All carbohydrates are composed of units of sugar, the difference in the units differentiates one carbohydrate from another.

Simple carbohydrates: These carbohydrates have only one or two units of sugar.

Monosaccharide (mono = one; saccharide = sugar): A carbohydrate with one unit of sugar. Examples are fructose (fruit sugar), glucose (blood sugar) and galactose (derived from digested lactose—**milk sugar**).

Disaccharide (di = two): A carbohydrate with two units of sugar. Sucrose (table sugar) is glucose + fructose.

Complex carbohydrates/polysaccharides (poly = many): With more than two units of sugar linked together. Specifically, carbohydrates with three to ten units of sugar are called **oligosaccharides (oligo = few).**

Raffinose is a **trisaccharide (tri = three)** found in potatoes, beans, and beets (galactose + glucose + fructose).

Stachyose is a **tetrasaccharide (tetra = four)** found in potatoes, beans and beets (fructose + glucose + 2 galactose).

Starch, a complex carbohydrate in potatoes, pasta and rice, is made up of many units of glucose.

Complex carbohydrates being made up of many sugar units, take longer to be digested by the body when compared with simple carbohydrates, as a result slowly and evenly releasing glucose into the bloodstream.

Dietary fibre is a third kind of carbohydrate, unlike any other, often referred to as roughage.

The bonds that hold its sugar units together cannot be broken by human digestive enzymes. Although the bacteria living

naturally in the intestines convert very small amounts of dietary fibre to fatty acids, dietary fibre is not considered a source of energy.

Like the complex carbohydrates, dietary fibre (cellulose, hemicellulose, pectin, β-glucans, gum) is a polysaccharide. Lignin, a different kind of chemical, is also called a dietary fibre.

Some kinds of dietary fibre also contain units of soluble or insoluble uronic acids, compounds derived from the sugars fructose, glucose, and galactose. For example, pectin—a soluble fibre in apples—contains soluble galacturonic acid.

PROTEIN

Proteins are essential nutrients for the human body. They are one of the building blocks of body tissue, and can also serve as a fuel source. They are needed by the human body for growth and maintenance. Besides water, proteins are the most abundant kind of molecules in the body. They are the major structural component of all cells of the body, especially muscle, including body organs, hair and skin. Proteins are also used in membranes, enzymes, hormones, blood cells and co-enzymes in the body.

Proteins are polymer chains made of amino acids linked together by peptide bonds. Our body needs these amino acids to perform the various tasks efficiently. There are 20 known amino acids, which are classified as below.

1. Essential amino acids which are needed by the body, are obtained through the diet consumed since the body cannot synthesise them on its own. They are essential to prevent protein–energy malnutrition. The 9 essential amino acids are:
   a. Phenylalanine
   b. Valine
   c. Threonine
   d. Tryptophan
   e. Methionine
   f. Leucine
   g. Isoleucine
   h. Lysine
   i. Histidine
2. **Conditionally essential amino acids:** There are six conditionally essential amino acids whose synthesis can be limited under special pathophysiological conditions, such as

prematurity in the infant or individuals in severe catabolic distress.

a. Arginine
b. Cysteine
c. Glycine
d. Glutamine
e. Proline
f. Tyrosine

3. **Non-essential amino acids:** There are five dispensable amino acids which humans can synthesize in the body.
   a. Alanine
   b. Aspartic acid
   c. Asparagine
   d. Glutamic acid
   e. Serine

Nutritionally speaking proteins can be classified into:

- Complete protein
- Incomplete protein

Complete proteins refer to those food sources of protein, which are composed of all the essential amino acids in a definite proportion needed by the body. Meat, products from milk, eggs, soy, and fish are sources of complete protein. Vegan sources of protein include whole grains, pulses, legumes, soy, and nuts. Vegetarians and vegans can get enough essential amino acids by eating a variety of plant proteins.

Incomplete proteins refer to those food sources, which are deficient in one or more essential amino acids. Whole grains and cereals tend to be limited in the amino acid lysine or threonine, which are available in other vegetarian sources and meats. This can be compensated by mixing pulses and legumes into cereals.

Protein Sources

Animal sources of protein include meats, eggs, fish, milk and milk products (yoghurt, cheese, etc.). These are loaded with all essential amino acids.

Vegetarian sources of proteins include legumes/pulses, nuts and seeds. Legumes/pulses have higher concentrations of amino acids and are more complete sources of protein than whole grains and cereals. Good protein sources include:

1. Pulses/legumes
   a. Soybeans

b. Lentils
c. Kidney beans
d. White beans
e. Mung beans
f. Chickpeas
g. Cowpeas
h. Lima beans
i. Pigeon peas

2. Nuts and seeds
   a. Almonds
   b. Brazil nuts
   c. Cashews
   d. Pecans
   e. Groundnuts/peanuts
   f. Walnuts
   g. Sesame seeds
   h. Pumpkin seeds
   i. Sesame seeds
   j. Sunflower seeds

Poor sources of proteins include:

1. **Roots and tubers:**
   a. Yams
   b. Cassava
   c. Sweet potato
   d. Colocasia
2. **Fruits:** Although powerhouses of vitamins, minerals and sugars, they are poor in proteins:
   a. Banana
   b. Apple
   c. Oranges
   d. Strawberry

A good source of protein is often a combination of various foods because different foods are rich in different amino acids. Healthy people eating a balanced diet rarely need protein supplements.

FATS AND OILS

These are one of the three macronutrients found in our foods. Fats, also known as triglycerides, are esters of three fatty acid chains and the alcohol, glycerol. Fats serve both structural and metabolic

functions. They are a necessary part of the diet. Fats are broken down to release their constituents, glycerol and fatty acids. They are the most energy-dense, providing 9 kcal/g. Thus, fat is a concentrated form of energy, and its inclusion will raise the calorific value of the diet without much increase in its bulk. Fats are also the sources of essential fatty acids, an important dietary requirement. Vitamins A, D, E, and K are fat-soluble, meaning they can only be digested, absorbed, and transported in conjunction with fats.

Fats play a vital role in maintaining healthy skin and hair, insulating body organs against shock, maintaining body temperature, and promoting healthy cell function.

Fat is solid at room temperature.

Oil is a fat with short or unsaturated fatty acid chains that is liquid at room temperature.

Essential fatty acids: Fatty acids are set free by the digestion of ingested fats because they cannot be synthesized in the body from simpler constituents. Two essential fatty acids are alpha-linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega-6 fatty acid).

Classification of fats based on the number and bonding of the carbon atoms in the aliphatic chain.

1. **Saturated fats:** Have no double bonds between the carbons in the chain.
2. **Unsaturated fats:** Have one or more double-bonded carbons in the chain.
    a. Monounsaturated fats (MUFA): Have one double-bonded carbon in the chain.
    b. Polyunsaturated fats (PUFA): Some oils and fats have multiple double bonds.
    c. In *cis* fats, which are the most common in nature, the chains of carbon atoms are on the same side of the double bond. These are good for health.
    d. In *trans* fats, which are rare in nature, hydrogen atoms are on the opposite side of the double bonds of the carbon chain, making the fat molecule straight. These are detrimental to health.

Hydrogenation: The process by way of which unsaturated fats can be altered, by reaction with hydrogen in the presence of a catalyst. This reaction tends to break all the double bonds and makes a fully saturated fat. Margarine, butter-like spread from

plant sources, and vegetable shortenings are all formed by this process.

However, trans fats are generated during hydrogenation as contaminants. Consumption of such trans fats has been shown to increase the risk of coronary heart disease.

Foods generally contain one main group of fat. For example:

- **Saturated fats:** Sources include fatty cuts of meat, full-fat milk, cheese, butter, cream, most commercially baked products such as biscuits and pastries, most deep-fried fast foods, coconut and palm oil.
- **Monounsaturated fats:** Sources include avocado and nuts such as peanuts, hazelnuts, cashews and almonds, margarine spreads such as canola or olive oil-based choices, and oils such as olive, canola and peanut.
- **Polyunsaturated fats:** Sources include fish, seafood, polyunsaturated margarine, vegetable oils such as safflower, sunflower, corn or soy oils, nuts such as walnuts and Brazil nuts, and seeds.
- **Omega-3 fats:** Plant food sources include canola and soy oils, and canola-based margarines. Marine sources include fish, especially oily fish such as Atlantic salmon, mackerel, Southern bluefin tuna and sardines.
- **Omega-6 fats** are found primarily in nuts, seeds and plant oils, such as corn, soy and safflower.

VITAMINS

They are organic components in food that are needed in very small amounts for growth and for maintaining good health. The word 'vitamin' was coined in 1911 by the Warsaw-born biochemist Casimir Funk (1884–1967). At the Lister Institute in London, Funk isolated a substance that prevented nerve inflammation (neuritis) in chickens raised on a diet deficient in that substance. He named the substance 'vitamine' because he believed it was necessary to life and it was a chemical amine. The 'e' at the end was later removed when it was recognized that vitamins need not be amines.

They are required in small quantities to correct what are called deficiency diseases, as distinct from illnesses caused by infections. Vitamins are also very important for the proper functioning of the body since they take part in many vital body processes.

Vitamins can be classified into:

Fat-soluble vitamins: These are those vitamins which are soluble in fats. Vitamins A, D, E, and K fall in this category. They tend to be stored in the body in moderate amounts compared to water-soluble vitamins and they are not normally excreted in the urine.

Water-soluble vitamins: Water-soluble vitamins are all the vitamins that are soluble in water. The water-soluble vitamins are excreted in the urine. The other main difference between the two groups is that water-soluble vitamins are not stored in the body in any appreciable amount. Since these are not stored in the body, they must be replenished. Vitamin C (ascorbic acid), vitamin B_1 (thiamine), vitamin B_2 (riboflavin), vitamin B_3 (niacin), vitamin B_5 (pantothenic acid), vitamin B_9 (folic acid), vitamin B_6 (pyridoxine), vitamin B_{12} (cobalamin), choline and biotin (vitamin B_7 or vitamin H) all fall in this category.

Interesting Facts

Choline is not technically a vitamin, but rather an essential nutrient. It is often grouped with B vitamins due to its similar functions and properties, but it is not officially recognized as a vitamin. Choline is water-soluble, meaning it dissolves in water and can be easily excreted from the body if consumed in excess. It plays important roles in functions such as cell membrane structure, neurotransmitter synthesis, and lipid metabolism.

The 'H' in vitamin H stands for '*Haar und Haut*,' which is German for '*hair and skin*,' reflecting its importance for healthy hair, skin, and nails. Biotin, or vitamin H, plays a crucial role in various metabolic processes in the body, particularly in the metabolism of carbohydrates, fats, and proteins. It acts as a coenzyme in carboxylation reactions and is essential for the synthesis of fatty acids, glucose metabolism, and the production of certain amino acids.

Fat-soluble Vitamins

Vitamin A: This group of vitamins is called retinol. The vitamins derived from plants are referred to as beta-carotene. This vitamin is essential for vision; lack of this might result in poor sight and even blindness.

Animal sources of vitamin A are ghee, milk, curds, egg yolk and liver.

Plant sources of vitamin A (beta-carotene) are primarily green, yellow and orange coloured vegetables like spinach, various forms

of greens, coriander leaves, mint, yellow pumpkin, bell peppers (capsicum) and fruits such as papayas, mangoes and tomatoes.

Vitamin D: This group of vitamins is essential for the intestinal absorption of minerals like calcium, iron, magnesium, phosphate and zinc. It is also important in bone formation and in further making sure that calcium reaches the bones. Vitamin D_3 (cholecalciferol) and vitamin D_2 (ergocalciferol) are the two most important vitamins of this group.

Cholecalciferol and ergocalciferol can be ingested from the diet and supplements. Very few foods contain vitamin D; it is found in butter, ghee and shark liver oil.

Predominantly, dermal synthesis of vitamin D from cholesterol is dependent on sun exposure. Individuals without adequate exposure to the sun develop deficiency. To produce vitamin D in this way, the body must also have enough calcium and phosphorus.

Vitamin E: These are a very important group of tocopherols and tocotrienols, which have varied functions; antioxidant function, enzymatic activities, gene expression, and neurological functions.

Vitamin E is found in a variety of nuts, oilseeds and other plant sources. Avocado, olives, asparagus, beet greens, mustard greens, almonds, sunflower seeds, safflower seeds, peanuts, fatty fish.

Vitamin K: Best known as the clotting vitamin, due to its vital role in clotting of blood. Deficiency of this vitamin results in cessation or malfunction of blood clot formation. The body needs it for the complete synthesis of certain proteins that are required for blood coagulation and those the body uses to control the binding of calcium in bone and other tissues. The group occurs in two forms:

Vitamin K_1 (phylloquinone, **phytomenadione**, or **phytonadione):** Vitamin K_1 is found chiefly in leafy green vegetables such as spinach, lettuce, kale, cabbage, cauliflower, broccoli and Brussels sprouts.

Vitamin K_2 (menaquinones): Vitamin K_2 is found in fermented or aged cheeses, eggs, meats such as chicken and their fat, livers, and organs, and in fermented vegetables (sauerkraut, kimchi and kefir).

Water-soluble Vitamins

As discussed earlier, these types of vitamins are soluble in water and any excess is excreted in the urine, protecting the body from overdose.

Vitamin B group: These vitamins are responsible for vital functions in the body; each vitamin in this group has a specific

function. These functions involve important mechanisms in the nervous system, promoting hair growth, maintaining the integrity of the tongue, smoothness of skin, formation of red cells in the blood, and proper cell growth. Pregnant and nursing women have a particular need for folic acid and vitamin B_{12}, both of which play a part in preventing anaemia. Their absence or low doses in the diet cause deficiency diseases.

- **Vitamin B_1 (thiamine):** Thiamine helps to extract energy by breaking down simple carbohydrates. Additionally, it boosts the immune system by making new cells, RNA and DNA. A deficiency of vitamin B_1 can lead to ailments such as beriberi and inflammation of the nerves (neuritis). Some of the best sources of thiamine are pork, ham, dark green leafy vegetables, fortified whole-grain cereals and baked goods, wheat germ, enriched rice, green peas, lentils and nuts such as almonds and pecans.
- **Vitamin B_2 (riboflavin):** Riboflavin is an antioxidant that reduces the damage done to the cells and DNA by free radicals, it also aids in the production of red blood cells and helps the body to grow. A deficiency can lead to aribo-flavinosis, which is a disease that affects the eyes, skin, blood and mouth. Milk and milk products such as yoghurt and cheese are rich in riboflavin. Asparagus, spinach and other dark green leafy vegetables, chicken, fish, eggs and fortified cereals also supply significant amounts of riboflavin to the diet.
- **Vitamin B_3 (niacin):** Niacin raises HDL cholesterol, it also plays a role in extracting energy during metabolism from glucose, alcohol and fats. A deficiency can lead to pellagra, which causes insomnia, aggression, dermatitis, and other ailments. Chicken, turkey, salmon and other fish including canned tuna packed in water are all excellent natural sources of niacin. Fortified cereals, legumes, peanuts, pasta and whole wheat also supply varying amounts.
- **Vitamin B_5 (pantothenic acid):** Pantothenic acid is found in a wide variety of foods. It is particularly abundant in animal-based foods, as well as in many plant-based sources. It breaks down fat and carbohydrates and converts them into energy. A deficiency can cause paresthesia, tingling and burning of the skin, and acne. Yoghurt and avocado are both excellent sources of pantothenic acid. Legumes including lentils and split peas, sweet potatoes, mushrooms and broccoli are also good sources.

- **Vitamin B_6 (pyridoxine):** Pyridoxine controls the quantities of homocysteine, an amino acid in the body. A deficiency can cause seborrhoeic dermatitis, which is a skin condition. Poultry, seafood, bananas, leafy green vegetables such as spinach, and potatoes and fortified cereals supply the body with the required vitamins.
- **Vitamin B_7 (biotin):** Biotin supports the health of the skin, nerves, digestive tract, metabolism and cells. Biotin may also help to treat some types of nerve pathology, such as peripheral neuropathy that can result from kidney failure or diabetes. Lack of biotin does not affect adults but can cause growth issues and neurological disorders in children. Liver and egg yolks are the richest dietary sources of biotin. Salmon, pork and avocado are good sources; most fruits and vegetables contain a little biotin, as do cheeses and grain foods.
- **Vitamin B_9 (folate):** Folate, or folic acid, is extremely important for pregnant women and infants, as it is essential for the proper growth and development of the baby, as well as preventing neurological defects. Folate also plays a role in the making of red blood cells. Pregnant women who do not have enough folic acid have given birth to children with birth defects. Leafy greens such as spinach, turnip greens and other fresh fruits and vegetables are all excellent sources of folate. All grain products such as bread, pasta and rice are fortified with folate.
- **Vitamin B_{12} (cobalamin):** Cobalamin not only creates red blood cells like some of the other B vitamins, but it also makes DNA and helps to make haemoglobin, a protein responsible for oxygen. Certain people, especially vegans, can have a deficiency of vitamin B_{12}, which can lead to anaemia. Animal foods are the only natural source of vitamin B_{12}, but many products, including soy products and cereals, are fortified with B_{12}, so it is widely available in the food supply. Other good natural sources include shellfish, such as clams, mussels crabs, and finfish.

Vitamin C (ascorbic acid): This vitamin is also referred to as the 'sour vitamin', due to its characteristic taste. The vitamin was discovered when a doctor treated sailors, suffering from scurvy, by administering oranges to them.

Vitamin C is required for the proper development and function of many parts of the body. It also plays an important role in

maintaining proper immune function. Administering vitamin C along with iron increases iron bioavailability in adults and children. It is advised to increase its intake when suffering from colds and infections, to boost immunity. Good sources of vitamin C are fresh fruits and vegetables, especially citrus fruits (lemon, lime, oranges, grapefruits, etc.). Indian gooseberries (amla) are one of the richest sources of the vitamin. It is also found in sprouted grams, cabbage, guava, and Java plum (jamun).

MINERALS

Besides the above-mentioned nutrients, the body needs minerals as much. They should form an indispensable part of the diet as they play a vital role in the numerous metabolic activities and processes going on in the body. Their absence or deficiency causes improper functioning of body systems. A balanced diet usually provides all of the essential minerals.

Based on their requirement for the body they are classified as macrominerals and microminerals.

Macrominerals

Major minerals

Mineral	*Function*	*Sources*
Sodium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, breads, vegetables, and unprocessed meats
Chloride	Needed for proper fluid balance, stomach acid	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, meats, breads, and vegetables
Potassium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Meats, milk, fresh fruits and vegetables, whole grains, legumes
Calcium	Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation, immune system health	Milk and milk products; canned fish with bones (salmon, sardines); fortified tofu and fortified soy milk; greens (broccoli, mustard greens); legumes
Phosphorus	Important for healthy bones and teeth; found in every cell; part of the system that maintains acid–base balance	Meat, fish, poultry, eggs, milk, processed foods

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Mineral	*Function*	*Sources*
Magnesium	Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health	Nuts and seeds; legumes; leafy, green vegetables; seafood; chocolate; artichokes; 'hard' drinking water
Sulphur	Found in protein molecules	Found in protein foods, meats, poultry, fish, eggs, milk, legumes, nuts

Trace Minerals (Microminerals)

Trace minerals

Mineral	*Function*	*Sources*
Iron	Part of haemoglobin found in red blood cells that carries oxygen in the body; is needed for energy metabolism	Organ meats; red meats; fish; poultry; shellfish; egg yolks; legumes; dried fruits; dark, leafy greens; iron-enriched breads and cereals; and fortified cereals
Zinc	Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal foetal development, production of sperm, normal growth and sexual maturation, immune system health	Meats, fish, poultry, leavened whole grains, vegetables
Iodine	Found in the thyroid hormone, which helps regulate growth, development, and metabolism	Seafood, foods grown in iodine-rich soil, iodized salt, bread, dairy products
Selenium	Antioxidant	Meats, seafood, grains
Copper	Part of many enzymes; needed for iron metabolism	Legumes, nuts and seeds, whole grains, organ meats, drinking water
Manganese	Part of many enzymes	Widespread in foods, especially plant foods
Fluoride	Involved in the formation of bones and teeth; helps prevent tooth decay	Drinking water (either fluoridated or naturally containing fluoride), fish, and most teas
Chromium	Works closely with insulin to regulate blood sugar (glucose) levels	Unrefined foods, especially liver, brewer's yeast, whole grains, nuts, cheeses
Molybdenum	Part of some enzymes	Legumes; breads and grains; leafy greens; leafy, green vegetables; milk; liver

WATER

Apart from these nutrients, the body also requires plenty of water everyday. Two-thirds of our bodies are made up of water. Water-soluble vitamins are carried about the body by water, and many chemical processes require water. It also regulates the body temperature. Water is procured both by drinking it and also from many food items which contain water. Thus milk is 80–90% water, meat, eggs and potatoes are 70% water and fruits and vegetables are mostly water.

Nutrients	*Purpose/Function*	*Sources*	*Deficiency symptoms*
Major Nutrients			
Carbohydrates (starches and sugars)	Supply energy (calories) for body activity	Rice, wheat, other cereals, potatoes, sugar, jaggery	Underweight, weakness, fainting
Proteins	Build and repair body tissues, also a source of energy, energy, when calories are deficient	Dals, nuts, milk, eggs, fish, meat	Retarded growth, underweight, loss of weight, oedema
Fats and oils	Provide concentrated calories for activity, carry certain vitamins (A, D, E)	Vegetable oils, vanaspati, ghee, groundnuts, oilseeds	Underweight, dry skin
Water-soluble vitamins			
Vitamin B_1: Thiamine	Needed for the metabolism, is crucial for the functioning of the nervous system. It also aids in the metabolism of carbohydrates, maintaining appetite and normal digestion	Muts, seeds, whole grain or enriched bread and cereals, pork, beans, wheat germ, pork and liver	
Vitamin B_2: Riboflavin	Necessary for metabolism, it is also vital for good vision and healthy skin. Supports the nervous and digestive systems	Milk and yoghurt, leafy green vegetables, whole grain cereals	
Vitamin B_3: Niacin	Required for the nervous system and digestive system and also for healthy skin	Tuna, dairy, whole grain or enriched bread and cereals, vegetables, meat and all protein products, as well as peanut butter	

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Pantothenic acid	Aids in supporting the body's metabolism	Animal liver, kidney, fish, legumes, mushroom, avocado, broccoli
Biotin	Fraction of enzyme needed for energy metabolism	Common in foods. Also produced bacterially in the intestinal tract
Vitamin B_6: Pyridoxine	Part of an enzyme needed for protein metabolism. It also helps in the production of red blood cells. Significant function in protein metabolism	Fish, organ meats, starchy vegetables
Folic acid	Needed in the making of red blood and new blood cells. Instrumental for pregnant women, as it prevents neural defects	Leafy vegetables and legumes, orange juice, liver, and seeds
Vitamin B_{12}: Cobalamin	Part of the enzyme is crucial for new cell synthesis. It also aids in the maintenance of nerve cells	Animal products, eggs, poultry, seafood, milk and dairy products and eggs. It cannot be found in plant foods
Vitamin C: Ascorbic acid	Important for immune system health and invaluable in the absorption of iron. An essential element in collagen formation. It is an antioxidant	Abundant in most fresh fruits, but especially citrus fruits and vegetables from the cabbage family, as well as cantaloupe, strawberries, tomatoes, potatoes, peppers, lettuce, papayas, kiwifruit and mangoes

Fat-soluble vitamins

Nutrient	*Function or role*	*Sources*
Vitamin A (and beta-carotene)	Needed for maintaining good sight, especially night vision, aids in maintaining an effective immune system and resistance to infections, is vital for healthy skin, boosts the growth and repair of body tissues	Vitamin A can be found in animal sources: Dairy products, eggs and liver. Beta-carotene is found in plants: Leafy vegetables, fruits such as apricots and cantaloupe and a variety of yellow vegetables (e.g. winter squash, sweet potatoes, pumpkin, carrots). Also, yellow and orange fruits such as mangoes and cantaloupe
Vitamin D	Part of a group of vitamins which encourages bone formation and absorption of calcium and phosphorus for the bones	Egg yolks, fatty fish, fortified milk, margarine and liver. It is also made by the skin via sun exposure

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Nutrient	*Function or role*	*Sources*
Vitamin E	Antioxidant. It assists in maintaining cell membranes and protects vitamin A and fatty acids from the oxidation process	Found mostly in plant oils (e.g. soybean corn), leafy green vegetables, wheat germ, whole-grain products, liver and egg yolks, and mustard seeds
Vitamin K	Helps produce factors that boost proper blood clotting	Leafy green vegetables and milk