

Nutrition Glossary

This nutrition glossary includes definitions for common nutritional terms.

Adenosine Tri-phosphate (ATP): ATP is a molecule that serves as the universal energy source for all plants and animals. In your body, ATP breaks down into adenosine diphosphate plus a separate phosphate group. This releases energy, which is used to power your body's cells. During periods of inactivity, the reverse reaction takes place, and the phosphate group is reattached to the molecule using energy obtained from food. In this way, the ATP molecule is continuously being recycled by your body.

Antioxidant: Antioxidants are chemical substances that help protect against cell damage from free radicals. Well-known antioxidants include vitamin A, vitamin C, vitamin E, carotenoids, and flavonoids.

Body Mass Index (BMI): Body Mass Index is a standardized ratio of weight to height, and is often used as a general indicator of health. Your BMI can be calculated by dividing your weight (in kilograms) by the square of your height (in meters). A BMI between 18.5 and 24.9 is considered normal for most adults. Higher BMIs may indicate that an individual is overweight or obese.

Calcium: Of all the essential minerals in the human body, calcium is the most abundant. Calcium helps the body form bones and teeth and is required for blood clotting, transmitting signals in nerve cells, and muscle contraction. Calcium helps prevent osteoporosis; of the two to three pounds of calcium contained in the human body, 99% is located in the bones and teeth.

Calcium also seems to play a role in lowering blood pressure, and has been shown to reduce the risk of cardiovascular disease in postmenopausal women.

Calorie: Calorie is a unit of measurement for energy. One calorie is formally defined as the amount of energy required to raise one cubic centimeter of water by one degree centigrade. For the purpose of measuring the amount of energy in food, nutritionists most commonly use kilocalories (equal to 1,000 calories), and label the measurement either as "kcal" or as "Calories" with a capital "C." One kcal is also equivalent to approximately 4.184 kilojoules.

Carotenoids: Carotenoids are natural fat-soluble pigments found in certain plants. Carotenoids provide the bright red, orange, or yellow coloration of many vegetables, serve as antioxidants, and can be a source for vitamin A activity.

Cholesterol: Cholesterol is a soft, waxy substance present in all parts of the body including the nervous system, skin, muscles, liver, intestines, and heart. It is both made by the body and obtained from animal products in the diet. Cholesterol is manufactured in the liver for normal body functions including the production of hormones, bile acid, and vitamin D. It is transported in the blood to be used by all parts of the body.

In the blood stream, cholesterol combines with fatty acids to form high-density (HDL) and low-density (LDL) lipoproteins. LDLs are considered the "bad cholesterol," since they can stick together to form plaque deposits on the walls of your blood vessels, leading to atherosclerosis.

One-fourth of the adult population in the U.S. has high blood cholesterol levels. More than half of the adult population has blood cholesterol levels that exceed the desirable range, as specified by the medical community. Elevated cholesterol often begins in childhood. Some children may be at higher risk than others due to a family history of high cholesterol.

Copper: Copper is a trace element that is essential for most animals, including humans. It is needed to absorb and utilize iron. The influence of copper upon health is due to the fact that it is part of enzymes, which are proteins that help biochemical reactions occur in all cells. Copper is involved in the absorption, storage, and metabolism of iron. The symptoms of a copper deficiency are similar to iron-deficiency anemia. Copper may be absorbed by both the stomach and small-intestinal mucosa, with most absorbed by the small intestine. Copper is found in the blood bound to proteins.

Daily Values (DV): Daily Values are the dietary reference values that are used on all current U.S. Nutrition Facts labels. These values were determined by the FDA to best represent the minimum needs of the general population. For many nutrients, DVs will exceed your actual minimum needs, since they conservatively allow for the minimum needs of more demanding conditions, such as pregnancy or lactation. Most DVs are derived from Dietary Reference Intakes (DRI) and other recommendations made by the Food and Nutrition Board, Institute of Medicine (IOM).

Dietary Fiber: Dietary fiber comes from the thick cell walls of plants. It is an indigestible complex carbohydrate. Fiber is divided into two general categories: water-soluble and water-insoluble.

Soluble fiber has been shown to lower cholesterol. However, in many studies, the degree of cholesterol reduction was quite modest. For unknown reasons, diets higher in insoluble fiber (mostly unrelated to cholesterol levels) have

been shown to correlate better with protection against heart disease in human trials. Soluble fibers can also lower blood-sugar levels, and some doctors believe that increasing fiber decreases the body's need for insulin—a good sign for diabetics.

Insoluble fiber acts as a stool softener, which speeds digestion through the intestinal tract. For this reason, insoluble fiber is an effective treatment for constipation. The reduction in "transit time" has also been thought to partially explain the link between a high-fiber diet and a reduced risk of colon cancer.

Enzyme: Enzymes are complex proteins that assist in or enable chemical reactions to occur. "Digestive" enzymes, for example, help your body break food down into chemical compounds that can more easily be absorbed. Thousands of different enzymes are produced by your body.

Essential Amino Acids: Essential Amino Acids are amino acids that your body does not have the ability to synthesize. Hundreds of different amino acids exist in nature, and about two dozen of them are important to human nutrition. Nine of these—histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine—are considered essential, since they must be supplied by your diet.

While the essential amino acids requirements vary among different individuals, the Food and Agricultural Organization of the United Nations (FAO) has proposed a standard that specifies the minimum amount of each essential amino acid that should be supplied per gram of protein consumed. This standard is the reference by which protein quality is determined. By comparing the limiting (i.e., lowest level) amino acid in a food with this standard, the amino acid score is determined. A score of 100 or above indicates a complete or high-quality protein; a score below 100 indicates a lower-quality protein.

Fatty Acids: Fatty acids are individual isomers of what we more commonly call "fats". There are potentially hundreds of different fatty acids, but just a few dozen that are commonly found in the foods we eat.

Flavonoids (bioflavonoids): Flavonoids are a class of water-soluble pigments that are found in many plants. A few thousand different flavonoids have so far been identified. While not labeled as essential nutrients, many of these compounds serve as antioxidants or play other important roles in maintaining the health of your body.

Some researchers break flavonoids down into subclasses that include isoflavones, anthocyanidins, flavans, flavonols, flavones, and flavanones. However, these subclassifications are not universally recognized.

Glycemic Index (GI): The Glycemic Index is a dietary index that's used to rank carbohydrate-based foods. The Glycemic Index predicts the rate at which the ingested food will increase blood sugar levels.

Glycemic Load (GL): Glycemic Load is equal to the Glycemic Index of a food times the number of grams of carbohydrates in the serving of food that's being eaten. Glycemic Load is believed to correlate more directly to blood-sugar level changes than Glycemic Index..

Insulin: Insulin is a hormone that's secreted by your pancreas to help regulate blood-sugar level and promotes glycogen storage. Individuals with diabetes mellitus supplement insulin to make up for their body's inability to produce sufficient amounts.

International Unit (IU): IU is a measurement unit that is primarily used on nutrition labeling for vitamin A. One IU is equivalent to 0.3 mcg of retinol, 0.6 mcg of beta-carotene, or 1.2 mcg other provitamin-A carotenoids.

Iron: Iron is one of the human body's essential minerals. It forms part of hemoglobin, the component of the blood that carries oxygen throughout the body. People with iron-poor blood tire easily because their bodies are starved for oxygen. Iron is also part of myoglobin, which helps muscles store oxygen. With insufficient iron, adenosine triphosphate (ATP; the fuel the body runs on) cannot be properly synthesized. As a result, some iron-deficient people can become fatigued even when they are not anemic.

Isomer: An isomer is a variation in the arrangement of atoms in two or more otherwise similar chemical compounds.

Lipid: A general classification to denote water-insoluble compounds, such as fatty acids and sterols.

Macronutrient: Nutritionists often group nutrients into two subclasses, called macronutrients and micronutrients. Macronutrients refer to those nutrients that form the major portion of your consumption and contribute energy to your diet. Macronutrients include carbohydrates, fats, protein, and alcohol. Sometimes water is also considered to be a macronutrient. All other nutrients are consumed in smaller amounts, and are labeled as micronutrients.

Magnesium: Magnesium is an essential mineral for the human body. It is needed for protein, bone, and fatty acid formation, making new cells, activating B vitamins, relaxing muscles, blood clotting, and forming adenosine triphosphate (ATP). The production and use of insulin also requires magnesium.

Under certain circumstances magnesium has been found to improve vision in people with glaucoma. Similarly, magnesium has demonstrated an ability to lower blood pressure.

Manganese: Manganese is an essential trace mineral that is required in small amounts to manufacture enzymes necessary for the metabolism of proteins and fat. It also supports the immune system and blood-sugar balance and is involved in the production of cellular energy, reproduction, and bone growth.

Manganese works with vitamin K to support normal blood clotting. Working with the B-complex vitamins, manganese helps promote a positive outlook when faced with stress, frustration, and anxiety.

Microgram (mcg): A microgram is a unit of measure equal to one one-millionth of a gram (g).

Milligram (mg): A milligram is a unit of measure equal to one one-thousandth of a gram (g).

Monosaccharides: Monosaccharides are simple carbohydrates that consist of a single sugar molecule. Examples include glucose, fructose, and galactose.

NLEA Serving: An NLEA Serving is a standardized serving size that arose from the U.S. government's Nutrition Labeling and Education Act. The NLEA regulations are governed by the FDA, and restrict the typical serving size that can be claimed on a U.S. Nutrition Facts label. The intent of this regulation is to deter food manufacturers from misleading the public by using serving sizes that are unrealistically small or large. Food manufacturers must now report serving sizes that are reasonably close to the NLEA standard. This standard is different for each type of food, and applies to virtually all foods except meats.

Nutrient Density: Nutrient density is the measurement of the amount of a nutrient per fixed portion of food. If you know the nutrient density of a food, you can better compare its nutritional value to that of other foods, regardless of serving size.

Phosphorus: Phosphorus is an essential mineral that is usually found in nature combined with oxygen as phosphate. Most phosphate in the human body is in bone, but phosphate-containing molecules (phospholipids) are also important components of cell membranes and lipoprotein particles, such as good (HDL) and bad (LDL) cholesterol. Small amounts of phosphate are engaged in biochemical reactions throughout the body.

The role of phosphate-containing molecules in aerobic exercise reactions has suggested that phosphate loading might enhance athletic performance, though controlled research has produced inconsistent results.

Phytosterol: Phytosterol is any plant-derived sterol.

Polysaccharides: Polysaccharides are complex carbohydrates, made up of multiple sugar molecules. Examples of polysaccharides include cellulose, starch, and dextrin.

Potassium: Potassium is an essential mineral that helps regulate heart function, blood pressure, and nerve and muscle activity. Potassium is also required for carbohydrate and protein metabolism and helps maintain the proper pH within the body. Those with higher potassium intakes tend to have lower blood pressure and people with low blood levels of potassium who are undergoing heart surgery are at an increased risk of developing heart arrhythmias and an increased need for cardiopulmonary resuscitation. Excessive sodium intake can increase your body's requirements for potassium.

Protein: Protein is one of the basic components of food and makes all life possible. Amino acids are the building blocks of proteins. All of the antibodies and enzymes, and many of the hormones in the body, are proteins. They provide for the transport of nutrients, oxygen, and waste throughout the body. They provide the structure and contracting capability of muscles. They also provide collagen to connective tissues of the body and to the tissues of the skin, hair, and nails.

Retinol Activity Equivalent (RAE): The Retinol Activity Equivalent is a relatively new unit for expressing vitamin A activity. One mcg of RAE is equivalent to 1 mcg of all-trans-retinol, 12 mcg of all-trans-beta-carotene, or 24 mcg of other provitamin A carotenoids. These RAE conversion factors are based on recent studies that show that the conversion of provitamin A carotenoids to retinol is only half as great as previously thought.

SAMe (S-adenosyl-L-methionine): SAMe, a natural metabolite of the amino acid methionine, plays a key role in dozens of chemical reactions in the body.

Satiety: Satiety refers to the feeling of satisfaction or "fullness" produced by the consumption of food.

Saturated Fat: A saturated fat is a fat or fatty acid in which there are no double bonds between the carbon atoms of the fatty acid chain. Saturated fats are usually solid at room temperature. Diets high in saturated fat have been shown to correlate with an increased incidence of atherosclerosis and coronary heart disease. Dehydrogenation converts saturated fats to unsaturated fats, while hydrogenation accomplishes the reverse.

Common saturated fats include butter, lard, palm oil, coconut oil, cottonseed oil, and palm kernel oil. Saturated fat is found in dairy products, especially cream and cheese, and in meat, as well as in many prepared foods. Some studies

suggest that replacing saturated fats in the diet with unsaturated fats will increase one's ratio of HDL to LDL serum cholesterol.

Alternatives to saturated fats include monosaturated fats such as olive oil and polyunsaturated fats such as canola oil and corn oil.

Selenium: Selenium is an essential trace mineral. Selenium activates an antioxidant enzyme called glutathione peroxidase, which may help protect the body from cancer. Yeast-derived forms of selenium have induced "apoptosis" (programmed cell death) in cancer cells in test tubes and in animals. One study found that men consuming the most dietary selenium developed 65% fewer cases of advanced prostate cancer than did men with low levels of selenium intake.

Selenium is also essential for healthy immune functioning. Even in a nondeficient population of elderly people, selenium supplementation has been found to stimulate the activity of white blood cells. Selenium is also needed to activate thyroid hormones.

In a placebo-controlled study, selenium supplementation indicated a reduction in disease activity in people with autoimmune thyroiditis (thyroid inflammation). In a double-blind trial, selenium supplementation of infertile men improved the motility of sperm cells and increased the chance of conception.

Sodium: Sodium is a mineral, an essential nutrient. It helps to maintain blood volume, regulate the balance of water in the cells, and keep nerves functioning. The kidneys control sodium balance by increasing or decreasing sodium in the urine. One teaspoon of salt contains about 2,300 milligrams of sodium, more than four times the amount the body requires per day.

Most Americans consume far more sodium than their bodies need. Many foods contain sodium naturally, and it is commonly added to foods during preparation or processing or as a flavoring agent. Sodium is also found in drinking water, prescription drugs, and over-the-counter medications.

In the United States, about one in four adults have elevated blood pressure. Sodium intake is only one of the factors known to affect high blood pressure, and not everyone is equally susceptible. The sensitivity to sodium seems to be very individualized. Usually, the older one is, the more sensitive one is to salt.

Sterol: A sterol is any of a class of solid cyclic alcohols, found in both plants (e.g., campesterol, stigmasterol, beta-sitosterol) and animals (e.g., cholesterol).

Sugar Alcohol: Sugar alcohols, sometimes called polyols, are a class of carbohydrates that are more slowly or incompletely absorbed by the human digestive system than sugars. Common sugar alcohols include sorbitol, mannitol, maltitol, and xylitol. Sugar alcohols contribute less Calories to the diet than most other types of carbohydrates, but may cause digestive discomfort.

Theobromine: Theobromine is an alkaloid compound with a molecular structure similar to caffeine. Theobromine has a mild stimulating effect on humans, and is found in certain foods, such as cocoa and chocolate. Theobromine can be lethal to some animals, including dogs and horses, which metabolize theobromine much more slowly than humans.

Unsaturated Fat: An unsaturated fat is a fat or fatty acid in which there are one or more double bonds between carbon atoms of the fatty acid chain. Such fat molecules are monounsaturated if each contains one double bond, and polyunsaturated if each contains more than one.

Hydrogenation converts unsaturated fats to saturated fats, while dehydrogenation accomplishes the reverse. Unsaturated fats tend to melt at lower temperatures than saturated fats, which tend to be solid at room temperature.

Both kinds of unsaturated fat can replace saturated fat in the diet. Substituting unsaturated fats for saturated fats helps to lower levels of total cholesterol and LDL cholesterol in the blood.

Vitamin A (Retinol): Vitamin A is a fat-soluble vitamin with multiple functions in the body. It helps cells differentiate, an essential part of cell reproduction. Cells that are not fully differentiated are more likely to undergo precancerous changes. It is a central component for healthy vision; vitamin A nourishes cells in various structures of the eye and is required for the transduction of light into nerve signals in the retina. It is required during pregnancy, stimulating normal growth and development of the fetus by influencing genes that determine the sequential growth of organs in embryonic development. It influences the function and development of sperm, ovaries, and placenta and is a vital component of the reproductive process.

Vitamin B1 (Thiamin): Vitamin B1 is a water-soluble vitamin that the body requires to break down carbohydrates, fat, and protein. Every cell of the body requires vitamin B1 to form adenosine triphosphate (ATP). Vitamin B1 is also essential for the proper functioning of nerve cells.

Vitamin B2 (Riboflavin): Vitamin B2 is a water-soluble vitamin that helps the body process amino acids and fats, activate vitamin B6 and folic acid, and convert carbohydrates to adenosine triphosphate (ATP). Under some conditions, vitamin B2 can act as an antioxidant.

Vitamin B3 (Niacin): Vitamin B3 is required for cell respiration and helps release the energy in carbohydrates, fats, and proteins. It also supports proper circulation and healthy skin, functioning of the nervous system, and normal secretion of bile and stomach fluids. It is used in the synthesis of sex hormones, treating schizophrenia and other mental illnesses, and as a memory-enhancer.

Nicotinic acid (but not nicotinamide) supplementation improves the blood cholesterol profile, and has been used to flush the body of organic poisons, such as certain insecticides. People report more mental alertness when this vitamin is in sufficient supply.

A shortage of niacin may be indicated with symptoms such as canker sores, depression, diarrhea, dizziness, fatigue, halitosis, headaches, indigestion, insomnia, limb pains, loss of appetite, low blood-sugar, muscular weakness, skin eruptions, and inflammation.

Vitamin B5 (Pantothenic Acid): Vitamin B5 is a water-soluble vitamin involved in the Krebs's energy production cycle and is needed for the production of acetylcholine, a neurotransmitter. Vitamin B5 also triggers the adrenal glands, is essential in transporting and releasing energy from fats, and enables the synthesis of cholesterol, vitamin D, and steroid hormones. Pantethine—a vitamin B5 byproduct—has been shown to lower cholesterol and triglycerides in the blood.

Vitamin B6: Vitamin B6 is a water-soluble vitamin and is part of the vitamin B complex. Vitamin B6 plays a role in the synthesis of antibodies by the immune system, which are needed to fight many diseases. It helps maintain normal nerve function and also acts in the formation of red blood cells. Vitamin B6 is also required for the chemical reactions needed to digest proteins. The higher the protein intake, the more the need for vitamin B6.

Large doses of vitamin B6 can cause neurological disorders and numbness. Deficiency of this vitamin can cause mouth and tongue sores, irritability, confusion, and depression. Vitamin B6 deficiency is uncommon in the United States.

Vitamin B9 (Folate): Vitamin B9, also known as folic acid, is a B vitamin necessary for cell replication and growth. Folic acid helps form building blocks of DNA, which holds the body's genetic information, and building blocks of RNA, needed for protein synthesis. Folic acid is most important, then, for rapidly growing tissues, such as those of a fetus, and rapidly regenerating cells, like red blood cells and immune cells. Folic acid deficiency results in an anemia that responds quickly to folic acid supplements.

The need for folic acid increases considerably during pregnancy. Deficiencies of folic acid during pregnancy are associated with low birth weight and an increased incidence of neural tube defects in infants. Most doctors, many other health-care professionals, and the March of Dimes recommend that all women of childbearing age supplement with 400 mcg per day of folic acid. Such supplementation may protect against the formation of neural tube defects during the time between conception and when pregnancy is discovered.

Vitamin B12 (Cobalamine): Vitamin B12 is a water-soluble vitamin needed for normal nerve cell activity, DNA replication, and production of the mood-affecting substance SAMe (S-adenosyl-L-methionine). Vitamin B12 acts with folic acid and vitamin B6 to control homocysteine levels. An excess of homocysteine has been linked to an increased risk of coronary disease, stroke, and other diseases such as osteoporosis and Alzheimer's.

Vitamin B12 deficiency causes fatigue. A small trial reported that even some people who are not deficient in B12 showed a marked increase in energy after vitamin B12 injections. However, the relationship between B12 injections and the energy level of people who are not vitamin B12-deficient has been rarely studied. Oral B12 supplements are unlikely to achieve the same results as injectable B12, because the body has a relatively poor absorption rate for this vitamin.

Vitamin C (Ascorbic Acid): Vitamin C is an essential water-soluble vitamin that has a wide range of functions in the human body.

One of vitamin C's important functions is acting as an antioxidant, protecting LDL cholesterol from oxidative damage. When LDL is damaged, the cholesterol appears to lead to heart disease, but vitamin C acts as an important antioxidant protector of LDL. Vitamin C may also protect against heart disease by reducing the stiffness of arteries and the tendency of platelets to coagulate in the vein.

The antioxidant properties also protect smokers from the harmful effects of free radicals. Small doses of vitamin C taken by nonsmokers before being exposed to smoke have been shown to reduce the free radical damage and LDL cholesterol oxidation associated with exposure to cigarette smoke.

Vitamin C has a range of additional functions. It is needed to make collagen, a substance that strengthens many parts of the body, such as muscles and blood vessels, and plays important roles in healing and as an antihistamine. Vitamin C also aids in the formation of liver bile, which helps to detoxify alcohol and other substances. Evidence indicates that vitamin C levels in the eye decrease with age and that vitamin C supplements prevent this decrease, lowering the risk of developing cataracts.

Vitamin C has been reported to reduce activity of the enzyme aldose reductase, which theoretically helps protect people with diabetes. It may also protect the body against accumulation or retention of the toxic mineral lead. People with recurrent boils (furunculosis) may have defects in white-blood-cell function that are correctable with vitamin C supplementation.

Vitamin D (Cholecalciferol): Vitamin D is a fat-soluble vitamin that helps maintain blood levels of calcium, by increasing absorption from food and reducing urinary calcium loss. Both functions help keep calcium in the body and therefore spare the calcium that is stored in bones. Vitamin D may also transfer calcium from the bone to the blood, which may actually weaken bones. Though the overall effect of vitamin D on the bones is complicated, some vitamin D is certainly necessary for healthy bones and teeth.

Vitamin D is also produced by the human body during exposure to the ultraviolet rays of the sun. However, seasonal changes, latitude, time of day, cloud cover, smog, and sunscreen can all affect UV exposure. Vitamin D deficiency is more common in northern latitudes, making vitamin D supplementation more important for residents of those areas.

Vitamin D plays a role in immunity and blood cell formation and also helps cells differentiate—a process that may reduce the risk of cancer. From various other studies, researchers have hypothesized that vitamin D may protect people from multiple sclerosis, autoimmune arthritis, and juvenile diabetes. Vitamin D is also necessary to maintain adequate blood levels of insulin. Vitamin D receptors have been found in the pancreas, and some evidence suggests that supplements may increase insulin secretion for some people with adult-onset diabetes.

Vitamin E (Tocopherol): Vitamin E is an antioxidant that protects cell membranes and other fat-soluble parts of the body, such as LDL cholesterol (the “bad” cholesterol), from damage. Several studies have reported that supplements of natural vitamin E help reduce the risk of heart attacks.

Vitamin E also plays some role in the body’s ability to process glucose. Some trials suggest that vitamin E may help in the prevention and treatment of diabetes.

In the last decade, the functions of vitamin E have been further clarified. In addition to its antioxidant functions, vitamin E has now been shown to directly affect inflammation, blood cell regulation, connective tissue growth, and genetic control of cell division.

Vitamin K (Phylloquinone): Vitamin K is necessary for proper bone growth and blood coagulation. Vitamin K accomplishes this by helping the body transport calcium. Vitamin K is used to treat overdoses of the drug warfarin. Also, doctors prescribe vitamin K to prevent excessive bleeding in people taking warfarin but requiring surgery.

There is some evidence that vitamin K2 (menadione), not vitamin K1 (phylloquinone; phytonadione), may improve a group of blood disorders known as myelodysplastic syndromes (MDS). These syndromes carry a dramatically increased risk of developing acute myeloid leukemia. Comprehensive trials of K2 for MDS are needed to confirm these auspicious early results.

Zinc: Zinc is an essential mineral with a wide variety of functions within the human body. Zinc is a component of over 300 enzymes needed to repair wounds, maintain fertility in adults and growth in children, synthesize protein, help cells reproduce, preserve vision, boost immunity, and protect against free radicals, among other functions.

In some trials, zinc lozenges have reduced the duration of colds in adults, though they have not been demonstrated to be effective in children. The ability of zinc to shorten colds may be due to a direct, localized antiviral action in the throat. A small, preliminary trial has also shown zinc sulfate to be effective for contact dermatitis, a skin rash caused by contact with an allergen or irritant.

Zinc can reduce the body’s ability to utilize copper, another essential mineral. The ability to interfere with copper makes zinc an important therapy for people with Wilson’s disease, a genetic condition that causes copper overload. In healthy individuals, however, this effect is best offset by copper supplementation.