

FAT SOLUBLE VITAMINS

VITAMIN A

Definition	<ul style="list-style-type: none">• A fat soluble vitamin found in high sources in animal tissues—liver, organ meats, and fish liver oil• Biologically active vitamin A can take the form of retinol, retinal or retinoic acid.• Carotenoids, particularly beta carotene, are a precursor for vitamin A.• Beta carotene can be converted in the body into vitamin A, yielding 2 molecules of retinol.
Functions	<ul style="list-style-type: none">• Necessary for the formation of visual purple, a substance in the eyes necessary for proper night vision• Valuable in fighting infections—protects mucous membranes against invading bacteria• Along with zinc, vitamin A plays an important role in epithelial cell health.
Food Sources	<ul style="list-style-type: none">• Cod liver oil• Liver (sheep and beef)• Dandelion greens, collard greens, kale• Carrots• Yams• Egg yolk• Whitefish• Note: Vegetables and fruits provide carotene—the vitamin A precursor. Animal products provide vitamin A.
Clinical Uses	<ul style="list-style-type: none">• Acne• Clients who experience itchy eyes because of hay fever or other allergies often get relief from vitamin A supplementation.• To boost the immune system• To increase wound healing• Antioxidant—fat soluble and as beta carotene• Eczema• Dry eyes
Deficiency	<ul style="list-style-type: none">• Early signs of deficiency include night blindness, xerosis (thickening and pigmentation of conjunctiva of the eye) and hyperkeratosis folliculi (small bumps on back of the arms)• Other signs of deficiency include:<ul style="list-style-type: none">• Rough, dry or prematurely aged skin• Loss of sense of smell and appetite• Frequent fatigue and/or insomnia• Skin blemishes• Dry hair and brittle fingernails
Toxicity	<ul style="list-style-type: none">• Vitamin A toxicity is associated with ingestion of > 50,000 IUS/day for sustained periods of time.

	<ul style="list-style-type: none"> • Excessive ingestion of beta carotene does not cause vitamin A toxicity, but produces caretonosis, an asymptomatic pigmentation of the skin. • Early signs of toxicity are: <ul style="list-style-type: none"> • Sparse, coarse hair • Alopecia of the eyebrows • Dry rough and itching skin and cracked lips • Later signs are: <ul style="list-style-type: none"> • Severe headaches • General weakness • Bone pain and fragility
CAUTION	<ul style="list-style-type: none"> • Vitamin A has been reported to be teratogenic, due to its ability to cause birth defects. • It is suggested that no more than 10,000 IU of vitamin A be used by pregnant women.

VITAMIN D

Definition	<ul style="list-style-type: none"> • Vitamin D is known as the “sunshine” vitamin or “rickets preventing factor” • Can be synthesized in the skin by action of UV light. 7-dehydrocholesterol in the skin is converted into vitamin D (cholecalciferol) • Absorbed from the small intestine and stored in liver, bones, brain and skin • Exists in various different chemical forms • Cholecalciferol is converted into 25-hydroxycholecalciferol in the liver • 25-hydroxycholecalciferol is converted in the kidneys into 1,25 dihydroxycholecalciferol, the most active form of vitamin D
Functions	<ul style="list-style-type: none"> • 1,25 dihydroxycholecalciferol , the most active form of vitamin D, has the following functions: <ul style="list-style-type: none"> • Increases absorption of calcium from intestines • Increases resorption of calcium from the bone • Increases serum calcium levels
Food Sources	<ul style="list-style-type: none"> • Sunshine • Cod liver oil • Fish: Mackerel, herring, salmon, sardines, tuna • Milk (fortified) • Eggs • Liver
Clinical Uses	<ul style="list-style-type: none"> • Treating rickets • Fractures • Osteoporosis • Mobilizing excess calcium

Deficiency	<ul style="list-style-type: none"> • Vitamin D deficiency in children causes rickets • Deficiency in adults causes osteomalacia, which leads to increased bone fractures and muscle spasms • Other symptoms of deficiency include: <ul style="list-style-type: none"> • Burning in mouth and throat • Diarrhea • Insomnia • Nervousness • Lack of sunlight is a common cause of deficiency
Toxicity	<ul style="list-style-type: none"> • Excess vitamin D can lead to calcification of heart, kidneys or lungs. • Excess consumption can cause elevated serum calcium levels. • Vitamin D intake of 2,000 to 3,000 IUS/day may cause toxicity symptoms in children.

VITAMIN E

Definition	<ul style="list-style-type: none"> • Composed of a mixture of tocopherols. • There are 8 tocopherols. D- alpha-tocopherol has the most biological activity. • Look for D-alpha-tocopherol as the DL-alpha form is the synthetic form of vitamin E and has low biological activity. • Requirements of vitamin E increase as polyunsaturated fat intake increases. • Requires bile for absorption. • Stored in pituitary and adrenal glands.
Functions	<ul style="list-style-type: none"> • Potent fat soluble antioxidant • Protects all cell membranes from damage • Protects liver from fat soluble oxidative damage • Protects nerve and muscle cell function • Prevents the peroxidation of cholesterol and other lipids • Prevents platelets from clumping together
Food Sources	<ul style="list-style-type: none"> • Wheat germ oil • Sunflower seeds • Corn oil • Cod liver oil • Olive oil • Whole wheat • Nuts: pecans, walnuts, hazelnuts
Clinical Uses	<ul style="list-style-type: none"> • Restless leg syndrome • Prevention of lipid peroxidation • Muscle cramps with exercise

	<ul style="list-style-type: none"> • Painful menstrual cramps • PMS • Menopause • Acne • Cardiovascular disease • Topically can help with burns and scars
Deficiency	<ul style="list-style-type: none"> • Can decrease levels of zinc and may worsen a zinc deficiency • Deficiency may decrease absorption of vitamin A. • Signs of deficiency include: <ul style="list-style-type: none"> ○ Dry skin ○ Easy bruising ○ Decreased clotting time ○ Fibrocystic diseases ○ Benign prostatic hypertrophy ○ Poor wound healing
Toxicity	<ul style="list-style-type: none"> • The most common symptom of large amounts of vitamin E are GI disturbances: nausea, gas or diarrhea. • Doses of 1,800 IUS/day have been shown to increase clotting time.

VITAMIN K

Definition	<ul style="list-style-type: none"> • Exists in three forms: • K1, the natural form from plants, stored in the liver • K2, formed by intestinal bacteria • K3, a water soluble synthetic form • Fat soluble forms require bile for absorption. • Vitamin K requirements are met 50:50 by diet and intestinal bacteria.
Functions	<ul style="list-style-type: none"> • Used by body in the calcification process • Protects the kidneys from formation of calcium stones • Used in the anti-coagulation pathways in the blood clotting function • Controls formation of various factors in the coagulation reactions of blood clotting
Food Sources	<ul style="list-style-type: none"> • Turnip greens • Broccoli • Cabbage • Beef liver

	<ul style="list-style-type: none"> • Lettuce • Cheddar cheese • Asparagus
Clinical Uses	<ul style="list-style-type: none"> • Blood clotting disorders • Osteoporosis • Nausea and vomiting during pregnancy • Floaters in the eye • Fractures • Prevention of calcium oxalate kidney stones • Bruising
Deficiency	<ul style="list-style-type: none"> • Lack of intestinal bacteria can cause vitamin K deficiency and hemorrhagic disease in newborns. • Easy bleeding in young children • Common signs of deficiency include: <ul style="list-style-type: none"> • Easy bleeding • Hemorrhage • Inappropriate bruising • Vitamin K deficiency can lead to osteoporosis, due to vitamin K's role in calcification of bone.
Toxicity	<ul style="list-style-type: none"> • Large doses of the synthetic form of vitamin K (K3- menadione) can cause hemolytic anemia.

WATER SOLUBLE VITAMINS

VITAMIN B1 (THIAMIN)

Definition	<ul style="list-style-type: none">• Vitamin B1 is called thiamin.• Thiamin is a water-soluble vitamin found in high concentrations in the heart, kidney, liver and brain.• It is found in the germ and bran of grains.• It is absorbed rapidly in the upper and lower small intestine.• It is not stored in the body in any great quantity and must be consumed daily.
Functions	<ul style="list-style-type: none">• The main function of thiamin is to help convert carbohydrates into energy.• It is essential for nerve conduction in the body.• Magnesium is necessary for the conversion of thiamin into thiamin pyrophosphate, the biologically active form.• Thiamin is essential for proper energy production in the brain.
Food Sources	<ul style="list-style-type: none">• Brewer's yeast• Wheat germ• Sunflower seeds• Soybeans• Nuts: Brazil nuts, pecans• Grains: Oats, millet, wheat, corn• Brown rice• Lentils
Clinical Uses	<ul style="list-style-type: none">• Prevention of and conditions associated with thiamin deficiency• Alcoholism• Improve mental function• Anemia that does not respond to vitamin B12 or folate supplementation• Blood sugar dysregulation
Deficiency	<ul style="list-style-type: none">• Common causes of thiamin deficiency include:• Alcohol consumption• High refined carbohydrate diets and excess blood sugar• Smoking• Malabsorption problems (chronic diarrhea)• Stress• Deficiency of thiamin makes it difficult for a person to digest carbohydrates.• Common signs of deficiency include: fatigue, memory loss, anorexia, constipation, depression, poor coordination, confusion, shortness of breath, anxiety.

Toxicity	There is little sign of thiamin toxicity.
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VITAMIN B2 (RIBOFLAVIN)

Definition	<ul style="list-style-type: none"> • Riboflavin is part of the vitamin B complex that is known as the “G” factor. • Soluble in alcohol, relaxes smooth muscle and acts as a vasodilator • Riboflavin is soluble in water and is a yellow, green fluorescent compound that is the bright orange color that is seen in the urine after taking a multiple or vitamin B complex vitamin supplement.
Functions	<ul style="list-style-type: none"> • Acts as a cofactor in oxidation-reduction reactions involved in carbohydrate metabolism • Essential for cellular respiration and utilization of cellular oxygen • Necessary for converting Vitamin B6 into its active form • Important in conversion of niacin into tryptophan • Involved in the breakdown, utilization and metabolism of carbohydrates, fats and proteins
Food Sources	<ul style="list-style-type: none"> • Organ meats • Almonds • Yeast • Alfalfa • Wheat germ • Green leafy vegetables • Soybeans • Whole grains
Clinical Uses	<ul style="list-style-type: none"> • Alcoholism • Prevention of migraine headaches • Cataracts • A person needing riboflavin will often have to urinate shortly after going to bed. This is not the same thing as getting up to urinate in the night, which is a sign of prostate problems in men. • High blood pressure
Deficiency	<p>Early signs of deficiency:</p> <ul style="list-style-type: none"> • Cracks and sores in corner of mouth and lips • Red sore tongue • Feeling of sand or grit under eyelids • Burning and itching of eyes • Increased light sensitivity • Loss of visual acuity • Sluggishness <p>Common causes:</p> <ul style="list-style-type: none"> • Alcoholism

	<ul style="list-style-type: none"> • Diabetes • Congestive Heart failure • Chronic stress
Toxicity	<ul style="list-style-type: none"> • There are no signs of riboflavin toxicity.

VITAMIN B3 (NIACIN)

Definition	<ul style="list-style-type: none"> • Found in foods that contain thiamin • Can be created in the body from the amino acid tryptophan • Exists in three forms: <ul style="list-style-type: none"> • Niacinamide • Nicotinic acid • Nicotinamide • Exists in supplemental form as niacin, niacinamide or inositol hexaniacinate. Each form has different uses
Functions	<ul style="list-style-type: none"> • Plays an essential role as a co-enzyme in the breakdown of fats, proteins and carbohydrates into energy. • Required for fatty acid and steroid hormone production.
Food Sources	<ul style="list-style-type: none"> • Nutritional and brewer's yeast • Rice bran • Wheat bran • Peanuts • Sesame seeds • Liver • Salmon • Chicken • Turkey
Clinical Uses	<ul style="list-style-type: none"> • The different supplemental forms of niacin have different clinical uses. • Inositol hexaniacinate and nicotinic acid: <ul style="list-style-type: none"> • Lowering blood fats (cholesterol, etc.) • Raynaud's phenomenon • Intermittent claudication • Niacinamide <ul style="list-style-type: none"> • Lowering blood sugar • Arthritis • Acne
Deficiency	<ul style="list-style-type: none"> • Pellagra is the conditions associated with niacin deficiency.

	<ul style="list-style-type: none"> • Pellagra presents symptoms that are often called the 3 D's: dermatitis, dementia and diarrhea. • Signs of niacin deficiency include: <ul style="list-style-type: none"> • Cracked, scaly dermatitis • Muscular weakness • Confusion, memory loss or depression • Loss of appetite • GI symptoms: indigestion, diarrhea and vomiting • Excess consumption of sugar can deplete niacin.
Toxicity	<ul style="list-style-type: none"> • The most common side effect of niacin is the skin flushing that occurs 20-30 minutes after taking supplemental niacin. • Other side effects include: <ul style="list-style-type: none"> • Gastric irritation • Nausea • Liver damage • Altered glucose tolerance in diabetics
Special Notes	<ul style="list-style-type: none"> • Timed-release forms of niacin, which prevent skin flushing, increase the risk of liver toxicity and should not be used. • Inositol hexaniacinate is the safest form of niacin and can be used safely at high doses. • Regardless of the form of niacin, regular checking of liver function tests and cholesterol levels should be performed when high dose of niacin, inositol hexaniacinate or niacinamide are used.

VITAMIN B5 (PANTOTHENIC ACID)

Definition	<ul style="list-style-type: none"> • A water soluble vitamin • Often found supplementally in its calcium form or as pantethine
Functions	<ul style="list-style-type: none"> • Plays an important role in heart, muscle, adrenal and liver cells • Stimulates the adrenal glands and can increase levels of cortisol and other adrenal hormones • Essential constituent of CoEnzyme A • Essential for hemoglobin synthesis • Involved in the energy producing cycles of the body • Essential for the production of cholesterol, steroid hormones and fatty acids
Food Sources	<ul style="list-style-type: none"> • Nutritional and Brewer's yeast • Liver • Peanuts • Mushrooms

	<ul style="list-style-type: none"> • Peas • Pecans • Soybean flour • Brown rice • Oatmeal
Clinical Uses	<ul style="list-style-type: none"> • Pantothenic acid exists in two supplemental forms: calcium pantothenate and pantethine. Each has a different application • Calcium pantothenate: <ul style="list-style-type: none"> • Adrenal function • Rheumatoid arthritis • Pantethine <ul style="list-style-type: none"> • Lowering blood cholesterol and triglycerides
Deficiency	<ul style="list-style-type: none"> • Deficiency of pantothenic acid is rare • Signs of deficiency include: <ul style="list-style-type: none"> • Burning feet • Numbness and shooting pains in the feet • Vomiting • Restlessness • Fatigue • Abdominal pain, gas and bloating
Toxicity	<ul style="list-style-type: none"> • There are no reported side effects or toxicity associated with pantothenic acid

VITAMIN B6 (PYRIDOXINE)

Definition	<ul style="list-style-type: none"> • Pyridoxine has many roles in the body • It is involved in over 60 different chemical reactions • Absorption occurs in the upper small intestine • Vitamin B6 exists in two forms: <ul style="list-style-type: none"> • Pyridoxal-5-phosphate is the physiologically active form (more expensive) • Pyridoxine Hydrochloride is the synthetic form (less expensive)
Functions	<ul style="list-style-type: none"> • Required for production of stomach acid • Required for absorption of vitamin B12 • Acts as a coenzyme in the breakdown of fats, proteins, and carbohydrates into energy • Involved in the production of neurotransmitters in the brain (e.g. serotonin, dopamine) • Involved in the production of structural proteins, red blood cells and prostaglandins

	<ul style="list-style-type: none"> • Critical for the maintenance of hormonal balance and proper immune function
Food Sources	<ul style="list-style-type: none"> • Brewer's yeast • Brown rice • Sunflower seeds • Wheat germ • Soybeans • Walnuts • Lentils • Buckwheat • Fish: salmon, tuna
Clinical Uses	<ul style="list-style-type: none"> • Carpal tunnel syndrome • Asthma • Kidney stones • Acne • Depression • Epilepsy • Immune support • Nausea and vomiting of pregnancy • MSG sensitivity • Blood sugar disregulation • Atherosclerosis
Deficiency	<ul style="list-style-type: none"> • Characterized by mental symptoms such as confusion, depression and convulsions • Other signs include: • Water retention in pregnancy • Cracks around mouth, lips, tongue and eyes • Poor glucose tolerance • Impaired nerve function • Numbness and cramps in the arms and legs • Visual disturbances • Pyridoxine deficiency can be exacerbated and caused by vitamin B6 antagonists in the environment. Food supply which decrease vitamin B6 absorption these include: • Hydrazine dyes (yellow food coloring #5) • Oral contraceptives and other exogenous estrogens • Alcohol • Pollutants • Certain drugs • Pyridoxine deficiency can lead to increased homocysteine levels.

<p>Toxicity</p>	<ul style="list-style-type: none"> • Associated with toxicity in large doses (>2,000 mg/day) or moderate doses (500 mg/day) for a long period of time • Symptoms of nerve toxicity (tingling in feet and loss of muscle control) have been noticed in people taking the above doses. • It is recommended that pyridoxine doses are limited to 50 mg/day.
<p>Special Notes</p>	<ul style="list-style-type: none"> • People who are sensitive to MSG (known as Chinese restaurant syndrome) may be deficient in vitamin B6. • People who do not remember their dreams may be deficient in vitamin B6. • People needing vitamin B6 may remark that coffee makes them feel “jittery”. • Women on birth control pills are at an increased risk of vitamin B6 deficiency.

VITAMIN B12 (COBALAMIN)

<p>Definition</p>	<ul style="list-style-type: none"> • Vitamin B12 contains the trace element cobalt in its structure. • The majority of dietary vitamin B12 comes from animal sources and is bound to carrier proteins. • Optimal stomach acid is needed to break the vitamin B12 from its protein carrier. • A substance called intrinsic factor binds the vitamin B12 and transports it to the terminal ileum for absorption. • Vitamin B12 is stored in the liver and functional stores can be stored for up to 3 years. • The 2 main forms of vitamin B12 are cyanocobalamin or hydroxycobalamin.
<p>Functions</p>	<ul style="list-style-type: none"> • Involved as a co-factor in the transfer of methyl groups, an essential process in the synthesis of DNA • Necessary for the conversion of homocysteine to methionine • Involved in carbohydrate metabolism
<p>Food Sources</p>	<ul style="list-style-type: none"> • The majority of B12 is found in animal products. Vegans are at a risk for being B12 deficient • Liver • Fish: Sardines, herring, salmon, tuna, halibut • Beef • Cheese • Eggs • Milk
<p>Clinical Uses</p>	<ul style="list-style-type: none"> • Prevention of pernicious anemia • Reduction of wheezing in asthmatic children

	<ul style="list-style-type: none"> • Reduction of sulfite sensitivity asthma • Anemia • Viral hepatitis • Neuropathies and neuralgias • Allergies • Acne • Depression
Deficiency	<ul style="list-style-type: none"> • Irreversible neurological complications can occur with deficiency. • Can lead to vitamin B12 deficiency anemia, which presents with decreased red blood cells and hematocrit, and large red blood cells. • A lack of intrinsic factor can cause a vitamin B12 deficiency and a disease called pernicious anemia. • Some of the signs of vitamin B12 deficiency include: <ul style="list-style-type: none"> • Progressive peripheral neuropathy • Pronounced anemia • Swollen, red tongue
Toxicity	<ul style="list-style-type: none"> • No toxicity has been reported.

FOLIC ACID

Definition	<ul style="list-style-type: none"> • Folic acid appears as folate and folacin. • Folic acid in food is usually in the tetrahydrofolate form. • Liver stores up to 4 months worth of folic acid. • Found in high levels in vegetables, which will lose large amounts of folic acid if stored at room temperature. • Alcohol interferes with folic acid absorption and metabolism.
Functions	<ul style="list-style-type: none"> • Essential for the synthesis of the purines of DNA synthesis: adenine, guanine and thymine. • Essential for the formation and maturation of red and white blood cells. • Plays an important role in the transformation of the amino acid glutamate from histadine. • Required for the conversion of homocysteine into methionine.
Food Sources	<ul style="list-style-type: none"> • Liver • Brewer's yeast • Orange juice • Black-eyed peas • Soybeans • Egg yolk • Beets • Wheat bran

	<ul style="list-style-type: none"> • Rice
Clinical Uses	<ul style="list-style-type: none"> • Megaloblastic Anemia • Pregnancy to prevent neural tube defects (the primary cause of spina bifida) • Restless leg syndrome • Glossitis • Cervical dysplasia • Depression • Malabsorption and GI inflammation • Reduction of homocysteine
Deficiency	<ul style="list-style-type: none"> • Can cause a megaloblastic anemia (anemia with large red blood cells) • Rapidly dividing cells will be affected by a folic acid deficiency especially the epithelial cells of stomach, intestines, vagina and cervix. • Very common in pregnancy and can cause neural tube defects in developing fetus • Some other signs of folic acid deficiency include digestive disturbances, restless legs, depressed reflexes, insomnia and weakness.
Toxicity	<ul style="list-style-type: none"> • Folic acid may interfere with anticonvulsant drugs • High levels of folic acid for a long period of time may cause vitamin B12 levels to drop • Folic Acid is contraindicated with some chemo-therapeutic drugs
Special Notes	<ul style="list-style-type: none"> • Folic acid supplementation may correct a megaloblastic anemia but leave an underlying and undetected B12 deficiency uncorrected. This can lead to irreversible neurological complications.

BIOTIN

Definition	<ul style="list-style-type: none"> • A co-enzyme essential for carbohydrate and fat metabolism • An extremely biologically active substance
Functions	<ul style="list-style-type: none"> • A cofactor in the synthesis and oxidation of fatty acids • Involved in amino acid metabolism • Required for the synthesis of pancreatic amylase and niacin • Involved in the synthesis of insulin
Food Sources	<ul style="list-style-type: none"> • Liver • Kidney • Milk • Butter

	<ul style="list-style-type: none"> • Egg yolk • Rye • Haddock • Rice bran • Oats
Clinical Uses	<ul style="list-style-type: none"> • Blood sugar dysregulation • Seborrheic dermatitis • Lowering blood cholesterol
Deficiency	<ul style="list-style-type: none"> • Biotin deficiency is first noted in the skin. • Symptoms are not unlike those of thiamin deficiency: dermatitis, scaling or hardness of the skin, which often appears around the eyes. • Other signs and symptoms include anorexia, lassitude, nausea, loss of hair and muscular atrophy. • Deficiency may elevate blood glucose and cholesterol.
Toxicity	<ul style="list-style-type: none"> • No toxicity has been reported.
Special Notes	<ul style="list-style-type: none"> • The great nutritional pioneers of the 20th century, including Dr. Royal Lee, believed that what we now call vitamin B complex was really two distinct vitamin complexes. • They were called “B” and “G”. • Although related, they also had some very different properties. • By combining them into one complex practitioners lost some valuable clinical tools. <p>“B” Fraction</p> <ul style="list-style-type: none"> • Thiamin or B1 based • Contained other vitamins that were soluble in alcohol: • B1- Thiamin • B12 • B5- Pantothenic acid • B4 (anti-paralysis factor) <p>“G” Fraction</p> <ul style="list-style-type: none"> • Riboflavin or B2 based • Contained other vitamins that were not soluble in alcohol: • B2- Riboflavin • B3- Niacin • Folic acid • Inositol • Choline

CHOLINE

Definition	<ul style="list-style-type: none">• Choline is considered to be one of the B-complex vitamins.• Along with inositol, choline is a constituent of lecithin (phosphatidylcholine).• Can be manufactured from the body from the amino acids methionine and serine
Functions	<ul style="list-style-type: none">• A lipotropic substance that prevents fat accumulation in the liver. Without choline fats become trapped in the liver• Required for the proper metabolism of fat• Essential for synthesis of the neurotransmitter acetylcholine• A main component of cell membranes in the form of phosphatidylcholine and sphingomyelin• Acts as a methyl donor and is essential for proper liver function and the export of fat from the liver
Food Sources	<ul style="list-style-type: none">• Whole grains• Legumes• Liver• Soy• Egg yolk• Cauliflower• Lettuce
Clinical Uses	<ul style="list-style-type: none">• Lowering of serum cholesterol and triglyceride levels, raising HDL levels• Liver disorders• Increasing bile solubility in biliary insufficiency• Protection of liver damage in alcoholism• Alzheimer's disease
Deficiency	<ul style="list-style-type: none">• People who are choline deficient may develop fatty deposits in the liver and have other signs of liver dysfunction.• Actual signs and symptoms of choline deficiency have yet to be established but may be related to cirrhosis of liver, atherosclerosis and high blood pressure.
Toxicity	<ul style="list-style-type: none">• Generally well tolerated• At high doses the supplement phosphatidylcholine may cause a reduced appetite and GI complaints such as nausea, abdominal bloating, pain and diarrhea.

INOSITOL

Definition	<ul style="list-style-type: none">• Inositol, like choline, is an unofficial B vitamin.• Closely associated with biotin and choline• Found as part of the phospholipid complex that forms cell membranes• In plants, it is found in the fiber component of phytic acid (inositol phosphate).• In the intestines, bacteria will liberate the inositol from the phytic acid.• Large amounts are found in the spinal cord, nerves, brain and spinal fluid
Functions	<ul style="list-style-type: none">• Acts as a lipotropic agent, i.e. promotes export of fat from the liver• Essential for thinning of the bile and preventing bile stagnation• As a constituent of the cell membrane, it is essential for the growth and survival of all cells• Required for the proper action of brain neurotransmitters, e.g. serotonin and acetylcholine
Food Sources	<ul style="list-style-type: none">• Citrus fruits• Nuts• Seeds• Legumes
Clinical Uses	<ul style="list-style-type: none">• Liver disorders• Depression• Diabetes• Panic attacks• Neuritis and neuralgia at high doses
Deficiency and Toxicity	<ul style="list-style-type: none">• No deficiency or toxicity has been associated with inositol.• At very high doses it can decrease bile function.

VITAMIN C

Definition	<ul style="list-style-type: none">• Discovered as a result of its ability to treat scurvy• Humans, along with guinea pigs, primates and bats, are unable to synthesize their own vitamin C due to an absence of a key enzyme. All other species can produce their own vitamin C.• Highest amounts of vitamin C are found in the adrenal glands, the majority of which is in the adrenal cortex.• Tissue concentrations are about 10 times higher than plasma levels.
Functions	<ul style="list-style-type: none">• Essential for connective tissue synthesis• Essential for conversion of tyrosine into the neurotransmitters

	<p>norepinephrine and epinephrine</p> <ul style="list-style-type: none"> • Aids in the absorption of dietary iron • Necessary for steroid hormone synthesis in the adrenal glands • A powerful antioxidant • Used in liver to aid in drug detoxification and metabolism • Antihistamine-like activities • Regulates the immune system
Food Sources	<ul style="list-style-type: none"> • Orange juice • Rose hips • Peppers • Acerola cherries • Black currants • Strawberries • Grapefruit juice • Melon • Papaya
Clinical Uses	<ul style="list-style-type: none"> • Stress • Bacterial and viral infections • Lowers triglyceride levels • Decrease platelet stickiness • Allergies • Wound healing • Diabetes • Heavy metal detoxification
Deficiency	<ul style="list-style-type: none"> • Vitamin C deficiency causes scurvy, a disease responsible for the deaths of thousands of people. • Symptoms of scurvy include: <ul style="list-style-type: none"> • Hemorrhage and easy bruising • Swollen and bleeding gums • Breakdown of scar tissue • Listlessness and weakness • Irritability • Muscle pain and cramps, aches in joints and bones • Dry skin • In adults scurvy can remain latent for up to 3-12 months post severe vitamin C deficiency. • The lingual ascorbic acid test is an easy to use and clinically effective method of assessing tissue levels of vitamin C.

Toxicity	<ul style="list-style-type: none">• Doses greater than 6-10 grams/day may cause osmotic diarrhea, a phenomenon called bowel tolerance to vitamin C.• Can raise uric acid levels and precipitate a gout attack• High levels may decrease copper absorption.• Vitamin C may increase aluminum absorption• In cases of high levels of iron in the body, vitamin C should not be taken because it enhances iron absorption.• Vitamin C raises oxalic acid levels in the urine, which may contribute to kidney stones.• Large doses of vitamin C may interfere with certain laboratory tests including: occult blood in stool and urine glucose testing.
Special Notes	<ul style="list-style-type: none">• Vitamin C does not appear in nature in an isolated form. It occurs as a complex of nutrients, which help with its absorption and utilization in the body. <p>These include:</p> <ul style="list-style-type: none">• Bioflavanoids• Chelated ascorbate minerals• Copper• Rutin• Large amounts of synthetic vitamin C can lead to long term vitamin C deficiency because of a depletion of cofactors.• Long-term vitamin C supplementation should be in the vitamin C complex form.