

Water Soluble Vitamins

Water-soluble vitamins consist of the B-group vitamins and vitamin C. Their deficiency is treated by administration of the deficient vitamin.

B Group Vitamins Features

- A common feature of group B vitamins is their occurrence in yeast (except vitamin B₁₂). However, if the yeast is included in the diet only as a means of rising bread, then yeast is not considered the major source of group B vitamins in humans; a small quantity of yeast does not contain nutritionally significant amount of B vitamins.
- Their metabolic effects are inter-linked.
- Deficiency of only a single vitamin occurs rarely.
- They are produced by the intestinal micro flora but the amount produced is generally only a fraction of the daily recommended intake.
- Some are more frequently called by their name, others by number. Some vitamins may not have a number because it has been found that some substances, originally considered as vitamins, are NOT essential for humans, therefore they are not vitamins or are a mixture of substances.

Vitamin B₁ (thiamine)

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Checked version of the article can be found here (https://www.wikilectures.eu/index.php?title=Water_Soluble_Vitamins&oldid=10884).

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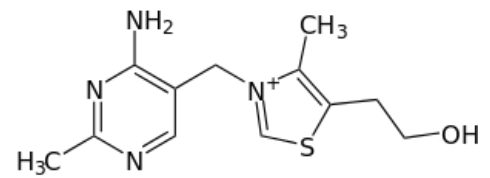
Thiamine (vitamin B₁) is a coenzyme decarboxylase important for the metabolism of glucose and energy supply to nerve and muscle cells.



Source

Meat, fish, cereals, yeast, legumes.

Daily recommended intake for adults: 1-1.4 mg ^[1]



Vitamin B1 - structure

Deficiency

The disease **beri-beri** ^[2]

from a lack of dietary vitamin B₁ is found today in very poor population groups (e.g. refugees) in countries where people live mostly on polished/white rice. It may also develop in people who live mostly on refined wheat flour products and among alcoholics and food faddists.

A typical image consists of nervous disorders, especially peripheral nerves (dry beri beri), edema and heart disease (beri beri wet). Impaired absorption of vitamin B₁ occurs in alcoholics and is manifested by **Wernicke encephalopathy**.

Suboptimal thiamine status based on biochemical criteria in Europe was detected only in 4-6% of the population. Risk group are alcoholics.

Laboratory evaluation: thiamine excretion in the urine. In the absence of erythrocytes is reduced transketolase concentration in the blood and the sera is high concentrations of glyoxalate.

Excess

Signs of excess are not encountered.

Vitamin B₂ (riboflavin)

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but later was changed.



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be found here (https://www.wikilectures.eu/index.php?title=Water_Soluble_Vitamins&oldid=11205).

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Riboflavin or vitamin B₂ is part of coenzymes flavinadenine mononucleotide (FAD) and flavin mononucleotide (FMN), plays a key role in oxidative metabolism.

Source

A small amount is found in many foods. Main sources are meat, milk and milk products; good sources are also fish, offal (inner organs), eggs, and whole grain cereals. Milling of cereals removes most of vitamin B₂ - some countries (e.g. USA) fortify cereal products with riboflavin.

Recommended daily intake for adults: 1.2 to 1.5 mg ^[1]

Deficiency

According to several population studies, the deficiency is widespread in developing countries, where diet is poor in animal foods, vegetables and fruits, and where cereals are milled (white flour)^[3]. Frequently the deficiency is secondary due to malabsorption, enterocolitis, coeliac disease, chronic hepatitis; in children often after the use of broad-spectrum antibiotics. It may develop in cancer, cardiac disease, diabetes^[3]

Clinical picture: The description of the signs of riboflavin deficiency is somewhat inconsistent in various scientific publications. Riboflavin deficiency occurs almost always together with deficiencies of other group B vitamins, which may cause some of the signs described in literature^[4]. The signs most frequently described are: angular stomatitis, peeling lips (cheilosis), glossitis, and normocytic normochromic anemia^[4].

Laboratory evaluation: decreases secretion of vitamin B₂ in urine (normal values are 106-638 nmol/l^[5]), decreased concentrations of glutathione and glutathione reductase in erythrocytes.

Excess

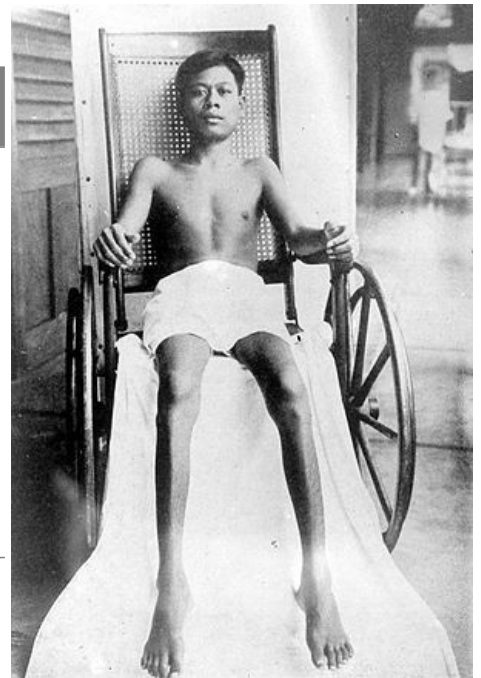
Signs of excess are not known.

Vitamin B₃ (niacin)

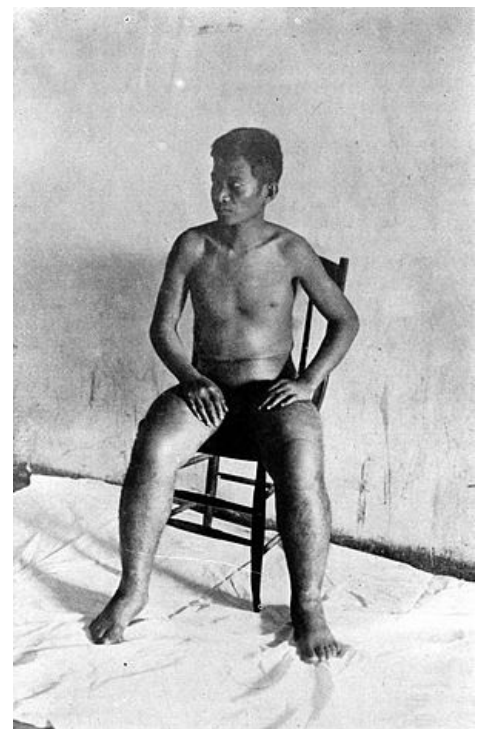
Niacin (vitamin B₃) is the name for nicotinamide and nicotinic acid. It is part of enzymes, oxido-reduction systems (nicotinamide adenine dinucleotide -NAD, nicotinamide adenine diphosphate -NADP). May form in the liver from tryptophan and its biosynthesis is very slow and it is needed vitamin B₆.

Source

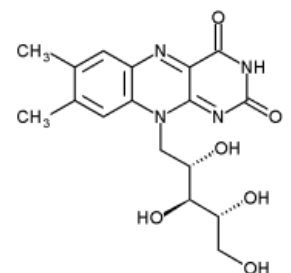
The source of most foods - meat, fish, cereals. The recommended daily dose for adults is by age and sex of 13-17 mg



Dry beri beri



Beri beri wet



Vitamin B2 structure

File:Nicotinic-acid.svg
Vitamin B3 structure

Deficit

Disease pellagra is caused by the current lack of niacin and its precursor tryptophan. Today it rarely occurs in a very poor population groups or for refugees in developing countries. Occurs in people who eat mostly corn/maize. The symptoms are as a mnemonic device used sometimes called "disease of three D" - dermatitis, diarrhea, dementia.

Surplus

Signs of excess food are not known. High doses of dietary supplements induce vasodilatation, warmth, gastritis, damage to liver cells. Intake should not exceed 35 mg / kg / day.

Pharmacological use

Nicotinic acid (niacin) and its derivatives are used to treat hyperlipidemia by inhibiting the secretion of VLDL from the liver and increasing the activity of peripheral lipoprotein lipase. This leads to a reduction in circulating VLDL (ie, TAG) and, consequently, LDL (cholesterol). In contrast adipose tissue blocking the intracellular lipase, thus releasing the MK inventory, further reducing supply to the liver TAG and reduces VLDL synthesis.

- Adverse effects: harmless vasodilation (mediated release of prostaglandins) in the skin associated with subjective stream feeling hot - it can handle submitting aspirin; at 1 / 5 of patients treated with hyperuricemia; skin rash.



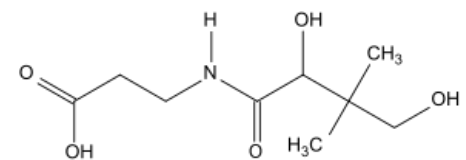
Pellagra

Vitamin B₅ (panthothenic acid)

Pantothenic acid (vitamin B₅) is part of coenzyme A.

Source

Small amounts are in almost all foods contain a large amount of yeast, liver, meat, milk, whole grains and legumes. The daily recommended dose for adults: 6 mg



Vitamin B5 structure

Deficit

Lack is not present - described only when administered pantothenic acid antagonists and extremely malnourished people with symptoms of deficiency of other nutrients, is manifested hair follicle atrophy, loss of pigmentation, dermatitis.

Surplus

Signs of excess are not known.

Vitamin B₆ (Pyridoxine)

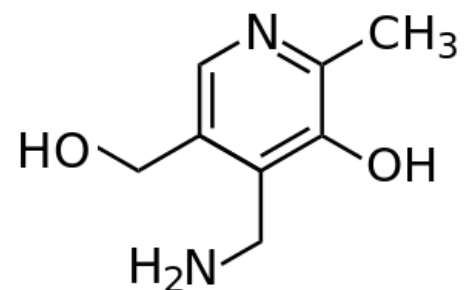
Pyridoxine the name vitamin B₆ comprises a group of compounds (pyridoxine, pyridoxamine, pyridoxal and phosphate). It is a coenzyme for more than 50 enzymatic reactions - decarboxylase and transaminases, synthesis of acid nicotine and arachidonic acid, affects the function of the nervous system, immune reactions and synthesis of haemoglobin.

Source

It is abundant in food. The daily recommended dose for adults: 13-17 mg

Deficit

Deficiency with normal eating habits does not occur; manifested skin and mucosal changes that occur rhagades corners, peripheral neuropathy.



Vitamin B6 structure

Surplus

Excess of food does not occur. After a prolonged intake of 50-500 mg have been reported sensory neuropathy.

Vitamin B₇ (Biotin)

Biotin Vitamin B₇ , vitamin H, factor R - Several scholars have described it, only later discovered that it is the same substance) is important for the metabolism of amino acids and fatty acids, is a cofactor for carboxylases.

File:Biotin.png
Vitamin B7 structure

Source

At low concentrations in many foods. Rich sources are yeast, liver, egg yolk, nuts, lentils. The daily requirement (RDA can not be estimated): 30-60 mg

Deficit

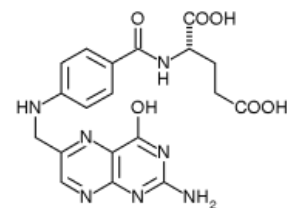
Deficiency of food does not occur. Scientists described the people who long consumed a large amount of raw eggs (irreversibly binds to biotin with avidin contained in raw egg white) and improper parenteral nutrition. Symptoms : seborrheic dermatitis , fatigue, anorexia , nausea ,hypercholesterolemia , vascular disorders.

Surplus

Signs of excess are not known.

Vitamin B₉ (Folic acid)

Folic acid also is known as vitamin B₉, folate or folacin . Includes a group of compounds: Folic Acid (contains pterin, p-aminobenzoic acid and glutamic) and folic acid. Along with vitamin B₁₂ is essential for the formation of nucleic acids and thus for synthesis of DNA , participate in the transfer radicals and in all processes of cell division , it is important for cell division and tissue with high mitotic activity.Absorbed in the proximal parts of the small intestine and when excess it is excreted in the urine.



Vitamin B9 structure

Source

Liver, yeast, green leafy vegetables, as well as whole grain cereals, meat, milk, eggs and legumes. The recommended daily adult dose: 400mg. In pregnancy, 600mg for prevention of congenital malformations (mainly cleft neural tube).

Deficit

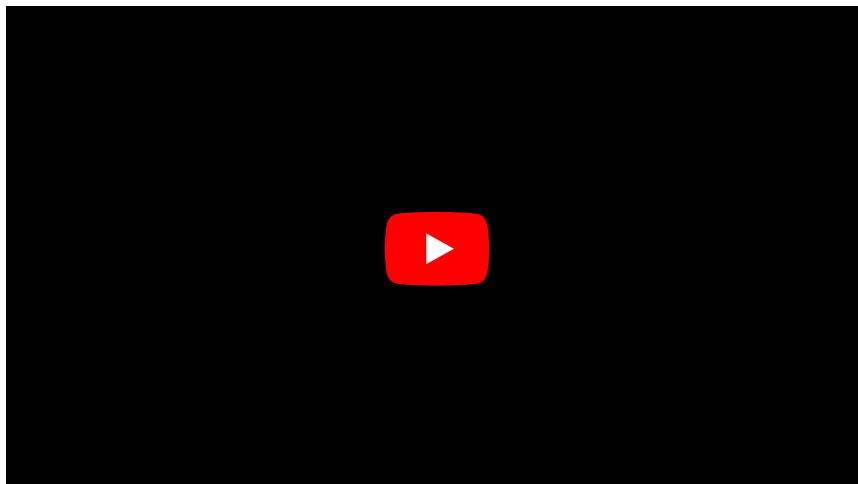
Deficiency of vitamin B₉ occurs in low supply, absorption or increased need during pregnancy. There is a megaloblastic anaemia , which is characterized by the presence of abnormal precursors of red blood cells in the bone marrow. Compared with normal cells are cells arising from these abnormal precursors of different shape, larger size, reduced viability and reduced ability to transport oxygen . Along with the lack of iron is its lack of a significant cause of anaemia in developing countries. Deficiency during pregnancy causes spina neural tube in the fetus.

- Laboratory evaluation: serum levels of folate, total homocysteine (increases in the absence, also in the absence of vitamin B₁₂)

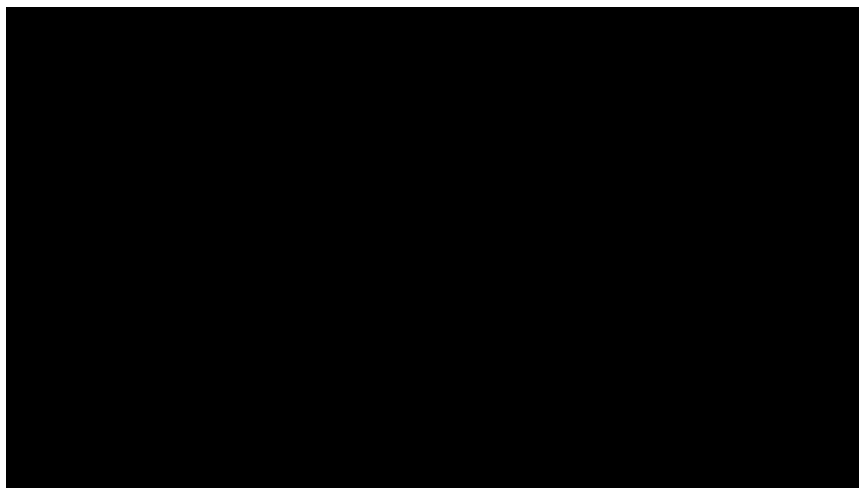
Surplus

High intake of folic acid can mask vitamin B₁₂ , so the upper limit of the daily recommended intake of up to 1000 mg / day.

Folate deficiency:



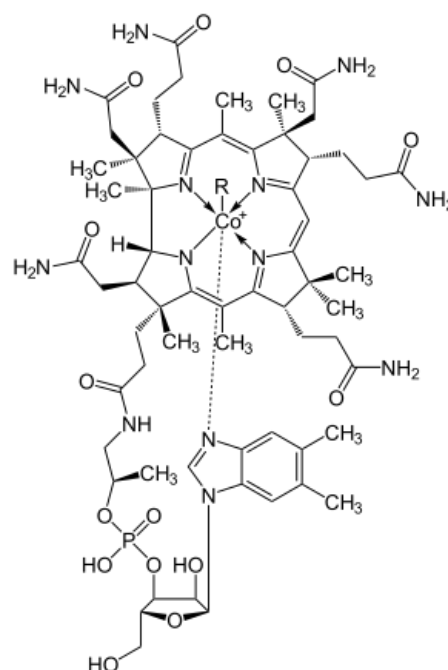
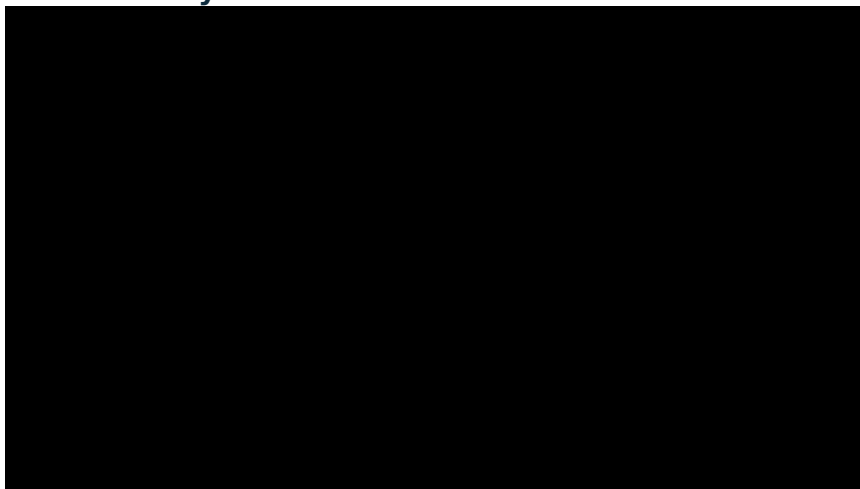
Folate deficiency 2:



Vitamin B₁₂ (cobalamin)

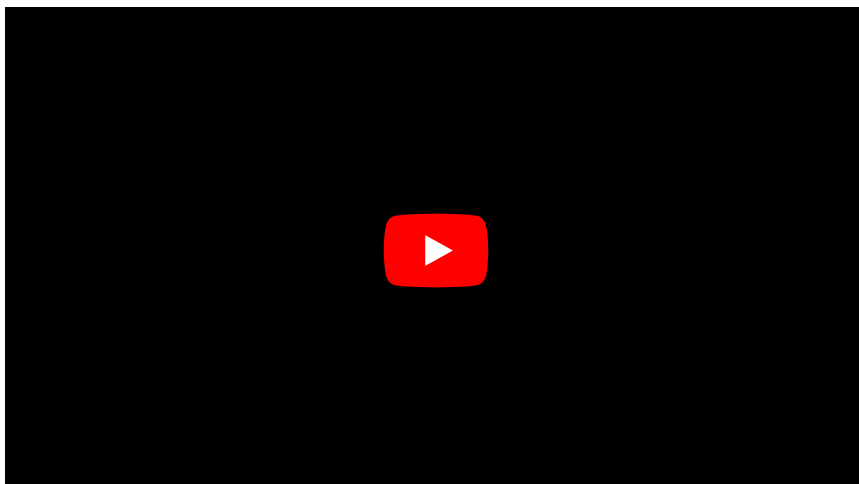
Vitamin B₁₂(cobalamin) is the collective name for several compounds that are in the center of porphyrin skeletal cobalt . Vitamin B₁₂ has a number of biological functions - plays an important role in hematopoiesis, is essential for the development of the central nervous system in children, contributes to the formation of nucleic acids , transmethylation marches and has anabolic effect. Deficiency of vitamin B₁₂ in adults causes macrocytic anemia , impaired rear and lateral spinal cords, peripheral nerves and dementia or depression . Lack of vitamin B₁₂ also affects secondary folate cycle resulting in impaired synthesis of purines and pyrimidines necessary for the formation of DNA and RNA.

B12 Deficiency:



Vitamin B12 structure

B12 Deficiency 2:



B12 Deficiency 3:



Source

In nutritionally significant quantities occurs only in animal foods. Rich sources are liver, kidney, meat warm-blooded animals (1-2 µg/100 g), fish, egg yolk and dairy products (milk µg/100, 0.3 ml cheese µg/100 0.2 to 0.6g). Plant foods contain trace amounts of vitamin B₁₂ only if it has been processed by bacterial fermentation (e.g beer). Absorbed in the small intestine only if the stomach creates a complex with an internal factor .Therefore it is necessary to properly functioning stomach and large amounts of vitamin B₁₂ are formed by the intestinal flora in humans unusable. Cobalamine with an internal factor in the distal ileum bind to specific receptor cubilin and this complex then enters by endocytosis into enterocytes. Inside the enterocyte cobalamin binds to other carriers and excreted into the plasma. 75-80% is bound to haptocorrin and goes to hepatocytes. The cells of other organs enter only vitamin B₁₂ bound to transcobalamin II (the holotranscobalamin) after binding to specific receptors through endocytosis. The cell cobalamin is converted to active metabolites and adenosylcobalamine methylcobalamin, which serve as cofactors of enzymes. The daily recommended dose for adults : 3 mg. Minimal in infants: approximately 0.1 to 0.3 mg.

Function

Haemopoiesis; development of the central nervous system in childhood; cofactor of two metabolic reactions: conversion of homocysteine to methionine by methionine synthase (failure of this reaction leads to the accumulation of homocysteine); conversion metylmalonyl-CoA to succinyl-CoA action metylmalonyl-CoA mutase (failure of this reaction leads to an accumulation of methylmalonic acid and its increased urinary excretion).

Deficit

Its deficiency is clinically manifested failure to thrive, macrocytic anemia and neurological symptoms. An adult is a stock (2-5 mg) of vitamin B₁₂ in the liver, which cover the need for a period of 5-10 years. Stocks, which creates the infant in utero (approximately 25 micrograms), will be exhausted as early as 3-5 months. Among laboratory manifestations include mostly macrocytic anemia, elevated aminotransferases, hyperhomocysteinemia and increased acid secretion metylmalonic acid plasma concentrations of homocysteine and methylmalonic acid excretion increased in the urine. Metabolic changes precede clinical manifestations. Pernicious anemia is an autoimmune disease that leads to atrophy of the gastric mucosa and by the lack of intrinsic factor.

Surplus

Signs of excess were reported even after a high intake (5 mg) of the supplement.

Vitamin C

L-ascorbic acid , also known as vitamin C is water soluble strongly reducing effects. Man (as well as other primates and guinea pigs) cannot synthesize it, since it lacks L-gulonolactonoxidase activity, therefore it must receive in food. L-ascorbate is involved in the hydroxylation of collagen , the synthesis of carnitine , the metabolism of tyrosine , acts as an antioxidant, supports immune system, iron absorption, has an effect on beta-oxidation of fatty acids , increases the activity of microsomal enzymes, accelerates the detoxification of xenobiotics. Reducing the effects of ascorbic acid are due to its easy oxidation to dehydroascorbate:

Source

Fruits, vegetables (including potatoes), liver. Average losses in cook foods are 30%. The daily recommended dose for adults : 100 mg . When the determination is considered, in addition to prevention of deficiency symptoms, as well as strengthening the immune system and prevention of degenerative diseases. Increased need for

considerable physical exertion, psychological stress, alcohol abuse and drugs, some diseases (eg diabetes, renal insufficiency, infection). Intake of 150 mg / day is recommended for smokers.

Deficit

Ascorbic acid deficiency - scurvy (scurvy) - now appears only in extreme conditions. With a slight lack of preclinical manifestations we see in our country (fatigue, prolonged convalescence, impaired wound healing and decreased resistance to infection).

- Laboratory evaluation of the situation: the level of vitamin C in plasma. Clinical symptoms appear with values $\leq 10 \mu\text{mol/L}$, an indicator of low intake of vitamin C are considered to values below $37 \mu\text{mol/L}$. In terms of prevention of atherosclerosis and the tumors are regarded as desirable values $\geq 50 \mu\text{mol/L}$.

Surplus

Signs of excess food are not. Approximately 1% of the unused vitamin C is converted to oxalate, the risk of urinary calculi, but low in healthy subjects. The care the daily intake should not exceed 1000 mg. Very high doses (5 g) can cause diarrhea. At high ascorbate intake (about grams per day), most of the substance excreted in the urine. It can then interfere with many clinical biochemistry determination by routine chemical urinalysis.

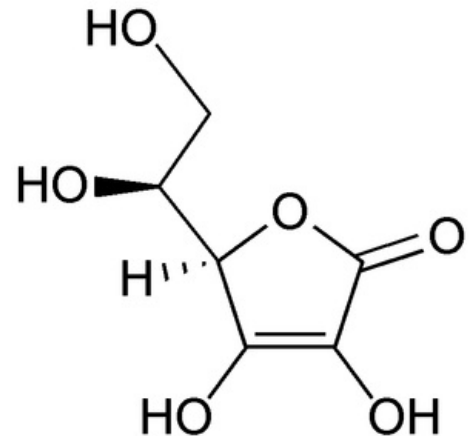
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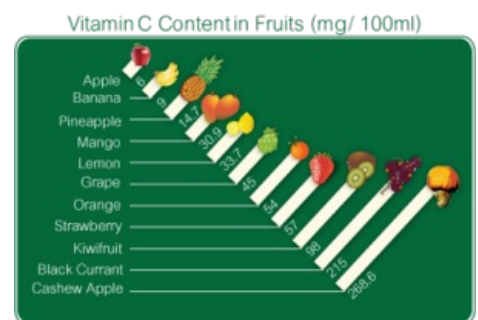
- Fat Soluble Vitamins
- Current Dietary Guidelines for Healthy Population
- Dietary Guidelines for Population

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2. WHO, UNHCR. . *Thiamine deficiency and its prevention and control in major emergencies* [online] . 1. edition. Geneva : World Health Organization, United Nations High Commissioner for Refugees, 1999. 52 pp. Available from



Vitamin C structure



Vitamin C in fruits



Scurvy

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