Vitamin

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A bottle of high potency B-complex vitamin supplement pills.

A **vitamin** is an **organic compound** and a vital **nutrient** that an **organism** requires in limited amounts. An organic chemical compound (or related set of compounds) is called a vitamin when the organism cannot **synthesize** the compound in sufficient quantities, and it must be obtained through the diet; thus, the term "vitamin" is conditional upon the circumstances and the particular organism. For example, **ascorbic acid** (one form of vitamin **C**) is a vitamin for humans, but not for most other animal organisms. Supplementation is important for the treatment of certain health problems,[1] but there is little evidence of nutritional benefit when used by otherwise healthy people.[2]

By convention the term **vitamin** includes neither other **essential nutrients**, such as **dietary minerals**, **essential fatty acids**, or **essential amino acids** (which are needed in greater amounts than vitamins) nor the great number of other nutrients that promote health, and are required less often to maintain the health of the organism.[3] Thirteen vitamins are universally recognized at present. Vitamins are classified by their biological and chemical activity, not their structure. Thus, each "vitamin" refers to a number of **vitamer** compounds that all show the biological activity associated with a particular vitamin. Such a set of chemicals is grouped under an alphabetized vitamin "generic descriptor" title, such as "vitamin **A**", which includes the compounds **retinal**, **retinol**, and four known **carotenoids**. Vitamers by definition are convertible to the active form of the vitamin in the body, and are sometimes inter-convertible to one another, as well.

Vitamins have diverse biochemical functions. Some, such as vitamin **D**, have hormone-like functions as regulators of mineral metabolism, or regulators of cell and tissue growth and differentiation (such as some forms of vitamin **A**). Others function as **antioxidants** (e.g., vitamin **E** and sometimes vitamin **C**).[4] The largest number of vitamins, the **B complex** vitamins, function as enzyme **cofactors** (coenzymes) or the **precursors** for them; coenzymes help **enzymes** in their work as **catalysts** in **metabolism**. In this role, vitamins may be tightly bound to enzymes as part of **prosthetic groups**: For example, **biotin** is part of enzymes involved in making **fatty acids**. They may also be less tightly bound to enzyme catalysts as coenzymes, detachable molecules that function to carry **chemical groups** or electrons between molecules.
For example, folic acid may carry methyl, formyl, and methylene groups in the cell. Although these roles in assisting enzyme-substrate reactions are vitamins’ best-known function, the other vitamin functions are equally important.[5]

Until the mid-1930s, when the first commercial yeast-extract vitamin B complex and semi-synthetic vitamin C supplement tablets were sold, vitamins were obtained solely through food intake, and changes in diet (which, for example, could occur during a particular growing season) usually greatly altered the types and amounts of vitamins ingested. However, vitamins have been produced as commodity chemicals and made widely available as inexpensive semisynthetic and synthetic-source multivitamin dietary and food supplements and additives, since the middle of the 20th century. Study of structural activity, function and their role in maintaining health is called vitaminology.[6]

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List of vitamins

Each vitamin is typically used in multiple reactions, and, therefore, most have multiple functions.[7]

<table>
<thead>
<tr>
<th>Vitamin generic descriptor name</th>
<th>Vitamer chemical name(s) (list not complete)</th>
<th>Solubility</th>
<th>Recommended dietary allowances (male, age 19–70)[8]</th>
<th>Deficiency disease</th>
<th>Upper Intake Level (UL/day)[8]</th>
<th>Overdose disease</th>
<th>Food sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Retinol, retinal, and four carotenoids</td>
<td>Fat</td>
<td>Night blindness, hyperkeratosis</td>
<td>3,000 µg</td>
<td>Hypervitaminosis A</td>
<td>Liver, orange, ripe yellow fruit</td>
<td></td>
</tr>
<tr>
<td>Vitamin generic descriptor name</td>
<td>Vitamer chemical name(s) (list not complete)</td>
<td>Solubility</td>
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<tr>
<td>Vitamin B1</td>
<td>Thiamine</td>
<td>Water</td>
<td>1.2 mg</td>
<td>Beriberi, Wernicke-Korsakoff syndrome</td>
<td>N/D</td>
<td>Drowsiness or muscle relaxation with large doses</td>
<td>leafy vegetables, carrots, pumpkin, squash, spinach, fish, soya milk, milk, including beta carotene and keratomalacia[9]</td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>Riboflavin</td>
<td>Water</td>
<td>1.3 mg</td>
<td>Ariboflavinosis, glossitis, angular stomatitis</td>
<td>N/D</td>
<td>[10]</td>
<td></td>
</tr>
<tr>
<td>Vitamin B3</td>
<td>Niacin, niacinamide</td>
<td>Water</td>
<td>16.0 mg</td>
<td>Pellagra</td>
<td>35.0 mg</td>
<td>Liver damage (doses &gt; 2g/day) and other problems</td>
<td>Pork, oatmeal, brown rice, vegetable potatoes, liver, eggs</td>
</tr>
<tr>
<td>Vitamin B5</td>
<td>Pantothenic acid</td>
<td>Water</td>
<td>5.0 mg [13]</td>
<td>Paresthesia</td>
<td>N/D</td>
<td>Diarrhea; possibly nausea and heartburn.</td>
<td>Meat, broccoli, avocados</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Pyridoxine, pyridoxamine, pyridoxal</td>
<td>Water</td>
<td>1.3–1.7 mg</td>
<td>Anemia [15] peripheral neuropathy</td>
<td>100 mg</td>
<td>Impairment of propioception, nerve damage (doses &gt; 100 mg/day)</td>
<td>Meat, vegetable, tree nuts, bananas</td>
</tr>
<tr>
<td>Vitamin B7</td>
<td>Biotin</td>
<td>Water</td>
<td>30.0 µg</td>
<td>Dermatitis, enteritis</td>
<td>N/D</td>
<td>[14]</td>
<td>Raw egg yolk, liver, peanuts,</td>
</tr>
<tr>
<td>Vitamin generic descriptor name</td>
<td>Vitamer chemical name(s) (list not complete)</td>
<td>Solubility</td>
<td>Recommended dietary allowances (male, age 19–70)</td>
<td>Deficiency disease</td>
<td>Upper Intake Level (UL/day)</td>
<td>Overdose disease</td>
<td>Food sources</td>
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<td>-------------</td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;9&lt;/sub&gt;</td>
<td>Folic acid, folinic acid</td>
<td>Water</td>
<td>400 µg</td>
<td>Megaloblastic anemia and deficiency during pregnancy is associated with birth defects, such as neural tube defects</td>
<td>1,000 µg</td>
<td>May mask symptoms of vitamin B&lt;sub&gt;12&lt;/sub&gt; deficiency; other effects</td>
<td>Leafy green vegetables, pasta, bread, cereal, liver</td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;12&lt;/sub&gt;</td>
<td>Cyanocobalamin, hydroxocobalamin, methylcobalamin</td>
<td>Water</td>
<td>2.4 µg</td>
<td>Megaloblastic anemia&lt;sup&gt;[16]&lt;/sup&gt;</td>
<td>N/D</td>
<td>Acne-like rash [causality is not conclusively established]</td>
<td>Meat and other animal products</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Ascorbic acid</td>
<td>Water</td>
<td>90.0 mg</td>
<td>Scurvy</td>
<td>2,000 mg</td>
<td>Vitamin C megadosage</td>
<td>Many fruits and vegetables, liver</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Cholecalciferol (D3), Ergocalciferol (D2)</td>
<td>Fat</td>
<td>10 µg&lt;sup&gt;[17]&lt;/sup&gt;</td>
<td>Rickets and osteomalacia</td>
<td>50 µg</td>
<td>Hypervitaminosis D</td>
<td>Fish, eggs, liver, mushroom</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Tocopherols, tocotrienols</td>
<td>Fat</td>
<td>15.0 mg</td>
<td>Deficiency is very rare; sterility in males and abortions in females, mild hemolytic anemia in newborn infants&lt;sup&gt;[18]&lt;/sup&gt;</td>
<td>1,000 mg</td>
<td>Increased congestive heart failure seen in one large randomized study.&lt;sup&gt;[19]&lt;/sup&gt;</td>
<td>Leafy green vegetables such as spinach, egg yolks, liver</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>phyloquinone, menaquinones</td>
<td>Fat</td>
<td>120 µg</td>
<td>Bleeding diathesis</td>
<td>N/D</td>
<td>Increases coagulation in patients taking warfarin.&lt;sup&gt;[20]&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>[8]</sup>  
<sup>[16]</sup>  
<sup>[17]</sup>  
<sup>[18]</sup>  
<sup>[19]</sup>  
<sup>[20]</sup>
**Health effects**

Vitamins are essential for the normal growth and development of a multicellular organism. Using the genetic blueprint inherited from its parents, a fetus begins to develop, at the moment of conception, from the nutrients it absorbs. It requires certain vitamins and minerals to be present at certain times. These nutrients facilitate the chemical reactions that produce among other things, skin, bone, and muscle. If there is serious deficiency in one or more of these nutrients, a child may develop a deficiency disease. Even minor deficiencies may cause permanent damage.\(^{[21]}\)

For the most part, vitamins are obtained with food, but a few are obtained by other means. For example, microorganisms in the intestine — commonly known as "gut flora" — produce vitamin K and biotin, while one form of vitamin D is synthesized in the skin with the help of the natural ultraviolet wavelength of sunlight. Humans can produce some vitamins from precursors they consume. Examples include vitamin A, produced from beta carotene, and niacin, from the amino acid tryptophan.\(^{[8]}\)

Once growth and development are completed, vitamins remain essential nutrients for the healthy maintenance of the cells, tissues, and organs that make up a multicellular organism; they also enable a multicellular life form to efficiently use chemical energy provided by food it eats, and to help process the proteins, carbohydrates, and fats required for respiration.\(^{[4]}\)

**Supplements**

In those who are otherwise healthy, there is little evidence that supplements have any benefits with respect to cancer or heart disease.\(^{[2][22]}\) Vitamin A and E supplements not only provide no health benefits for generally healthy individuals, but they may increase mortality, though the two large studies that support this conclusion included smokers for whom it was already known that beta-carotene supplements can be harmful.\(^{[22][23]}\) While other findings suggest that vitamin E toxicity is limited to only a specific form when taken in excess.\(^{[24]}\)

The European Union and other countries of Europe have regulations that define limits of vitamin (and mineral) dosages for their safe use as food supplements. Most vitamins that are sold as food supplements cannot exceed a maximum daily dosage. Vitamin products above these legal limits are not considered food supplements and must be registered as prescription or non-prescription \((\text{over-the-counter drugs})\) due to their potential side effects. As a result, most of the fat-soluble vitamins (such as the vitamins A, D, E, and K) that contain amounts above the daily allowance are drug products. The daily dosage of a vitamin supplement for example cannot exceed 300% of the recommended daily allowance, and for vitamin A, this limit is even lower (200%). Such regulations are applicable in most European countries.\(^{[25][26]}\)
500 mg calcium supplement tablets, with vitamin D, made from calcium carbonate, maltodextrin, mineral oil, hypromellose, glycerin, cholecalciferol, polyethylene glycol, and carnauba wax.

Dietary supplements often contain vitamins, but may also include other ingredients, such as minerals, herbs, and botanicals. Scientific evidence supports the benefits of dietary supplements for persons with certain health conditions. In some cases, vitamin supplements may have unwanted effects, especially if taken before surgery, with other dietary supplements or medicines, or if the person taking them has certain health conditions. They may also contain levels of vitamins many times higher, and in different forms, than one may ingest through food.

Effect of cooking

Shown below is percentage loss of vitamins after cooking averaged for common foods such as vegetables, meat or fish.

Typical Maximum Nutrient Losses due to cooking

<table>
<thead>
<tr>
<th>Vitamin &amp; Minerals</th>
<th>Freeze</th>
<th>Dry</th>
<th>Cook</th>
<th>Cook+Drain</th>
<th>Reheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>no</td>
<td>partially [clarification needed]</td>
<td>partially [clarification needed]</td>
<td>relatively stable</td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td>very unstable</td>
<td>yes [clarification needed]</td>
<td>yes [clarification needed]</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>no</td>
<td>no [clarification needed]</td>
<td>no [clarification needed]</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

It should be noted however that some vitamins may become more "bio-available" – that is, usable by the body – when steamed or cooked.

The table below shows whether various vitamins are susceptible to loss from heat—such as heat from boiling, steaming, cooking etc.—and other agents. The effect of cutting vegetables can be seen from exposure to air and light. Water-soluble vitamins such as B and C seep into the water when a vegetable is boiled.

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Soluble in Water</th>
<th>Exposure to Air</th>
<th>Exposure to Light</th>
<th>Exposure to Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>no</td>
<td>partially [clarification needed]</td>
<td>partially [clarification needed]</td>
<td>relatively stable</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>very unstable</td>
<td>yes [clarification needed]</td>
<td>yes [clarification needed]</td>
<td>yes</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>no</td>
<td>no [clarification needed]</td>
<td>no [clarification needed]</td>
<td>no</td>
</tr>
<tr>
<td>Vitamin</td>
<td>Soluble in Water</td>
<td>Exposure to Air</td>
<td>Exposure to Light</td>
<td>Exposure to Heat</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Thiamine (B₁)</td>
<td>highly</td>
<td>no</td>
<td>?</td>
<td>&gt; 100 °C</td>
</tr>
<tr>
<td>Riboflavin (B₂)</td>
<td>slightly</td>
<td>no</td>
<td>in solution</td>
<td>no</td>
</tr>
<tr>
<td>Niacin (B₃)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Pantothenic Acid (B₅)</td>
<td>quite stable</td>
<td>?</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Vitamin B₆</td>
<td>yes</td>
<td>?</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Biotin (B₇)</td>
<td>somewhat</td>
<td>?</td>
<td>?</td>
<td>no</td>
</tr>
<tr>
<td>Folic Acid (B₉)</td>
<td>yes</td>
<td>?</td>
<td>when dry</td>
<td>at high temp</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>yes</td>
<td>?</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

**Deficiencies**

Humans must consume vitamins periodically but with differing schedules, to avoid deficiency. The human body's stores for different vitamins vary widely; vitamins A, D, and B₁₂ are stored in significant amounts in the human body, mainly in the liver, and an adult human's diet may be deficient in vitamins A and D for many months and B₁₂ in some cases for years, before developing a deficiency condition. However, vitamin B₃ (niacin and niacinamide) is not stored in the human body in significant amounts, so stores may last only a couple of weeks. For vitamin C, the first symptoms of scurvy in experimental studies of complete vitamin C deprivation in humans have varied widely, from a month to more than six months, depending on previous dietary history that determined body stores.

Deficiencies of vitamins are classified as either primary or secondary. A primary deficiency occurs when an organism does not get enough of the vitamin in its food. A secondary deficiency may be due to an underlying disorder that prevents or limits the absorption or use of the vitamin, due to a "lifestyle factor", such as smoking, excessive alcohol consumption, or the use of medications that interfere with the absorption or use of the vitamin. People who eat a varied diet are unlikely to develop a severe primary vitamin deficiency. In contrast, restrictive diets have the potential to cause prolonged vitamin deficits, which may result in often painful and potentially deadly diseases.

Well-known human vitamin deficiencies involve thiamine (beriberi), niacin (pellagra), vitamin C (scurvy), and vitamin D (rickets). In much of the developed world, such deficiencies are rare; this is due to (1) an adequate supply of food...
and (2) the addition of vitamins and minerals to common foods, often called fortification.[8][18] In addition to these classical vitamin deficiency diseases, some evidence has also suggested links between vitamin deficiency and a number of different disorders.[34][35]

**Side-effects**

In large doses, some vitamins have documented side-effects that tend to be more severe with a larger dosage. The likelihood of consuming too much of any vitamin from food is remote, but overdosing (vitamin poisoning) from vitamin supplementation does occur. At high enough dosages, some vitamins cause side-effects such as nausea, diarrhea, and vomiting.[9][36] When side-effects emerge, recovery is often accomplished by reducing the dosage. The doses of vitamins differ because individual tolerances can vary widely and appear to be related to age and state of health.

In 2008, overdose exposure to all formulations of vitamins and multivitamin-mineral formulations was reported by 68,911 individuals to the American Association of Poison Control Centers (nearly 80% of these exposures were in children under the age of 6), leading to 8 "major" life-threatening outcomes, but no deaths.[37]

**Pharmacology**

Vitamins are classified as either water-soluble or fat-soluble. In humans there are 13 vitamins: 4 fat-soluble (A, D, E, and K) and 9 water-soluble (8 B vitamins and vitamin C). Water-soluble vitamins dissolve easily in water and, in general, are readily excreted from the body, to the degree that urinary output is a strong predictor of vitamin consumption.[38] Because they are not as readily stored, more consistent intake is important.[39] Many types of water-soluble vitamins are synthesized by bacteria.[40] Fat-soluble vitamins are absorbed through the intestinal tract with the help of lipids (fats). Because they are more likely to accumulate in the body, they are more likely to lead to hypervitaminosis than are water-soluble vitamins. Fat-soluble vitamin regulation is of particular significance in cystic fibrosis.[41]
### History

The value of eating a certain food to maintain health was recognized long before vitamins were identified. The ancient Egyptians knew that feeding liver to a person would help cure night blindness, an illness now known to be caused by a vitamin A deficiency.[42] The advancement of ocean voyages during the Renaissance resulted in prolonged periods without access to fresh fruits and vegetables, and made illnesses from vitamin deficiency common among ships' crews.[43]

In 1747, the Scottish surgeon James Lind discovered that citrus foods helped prevent scurvy, a particularly deadly disease in which collagen is not properly formed, causing poor wound healing, bleeding of the gums, severe pain, and death.[42] In 1753, Lind published his Treatise on the Scurvy, which recommended using lemons and limes to avoid scurvy, which was adopted by the British Royal Navy. This led to the nickname limey for British sailors. Lind's discovery, however, was not widely accepted by individuals in the Royal Navy's Arctic expeditions in the 19th century, where it was widely believed that scurvy could be prevented by practicing good hygiene, regular exercise, and maintaining the morale of the crew while on board, rather than by a diet of fresh food.[42] As a result, Arctic expeditions continued to be plagued by scurvy and other deficiency diseases. In the early 20th century, when Robert Falcon Scott made his two expeditions to the Antarctic, the prevailing medical theory at the time was that scurvy was caused by "tainted" canned food.[42]

During the late 18th and early 19th centuries, the use of deprivation studies allowed scientists to isolate and identify a number of vitamins. Lipid from fish oil was used to cure rickets in rats, and the fat-soluble nutrient was called "antirachitic A". Thus, the first "vitamin" bioactivity ever isolated, which cured rickets, was initially called "vitamin A"; however, the bioactivity of this compound is now called vitamin D.[44] In 1881, Russian surgeon Nikolai Lunin studied the effects of scurvy while at the University of Tartu in present-day Estonia.[45] He fed mice an artificial mixture of all the separate constituents of milk known at that time, namely the proteins, fats, carbohydrates, and salts. The mice that received only the individual constituents died, while the mice fed by milk itself developed normally. He made a conclusion that "a
natural food such as milk must therefore contain, besides these known principal ingredients, small quantities of unknown substances essential to life."[45] However, his conclusions were rejected by his advisor, Gustav von Bunge, even after other students reproduced his results.[46] A similar result by Cornelius Pekelharing appeared in a Dutch medical journal in 1905, but it was not widely reported.[46]

The Ancient Egyptians knew that feeding a person liver would help cure night blindness.

In East Asia, where polished white rice was the common staple food of the middle class, beriberi resulting from lack of vitamin B₁ was endemic. In 1884, Takaki Kanehiro, a British trained medical doctor of the Imperial Japanese Navy, observed that beriberi was endemic among low-ranking crew who often ate nothing but rice, but not among officers who consumed a Western-style diet. With the support of the Japanese navy, he experimented using crews of two battleships; one crew was fed only white rice, while the other was fed a diet of meat, fish, barley, rice, and beans. The group that ate only white rice documented 161 crew members with beriberi and 25 deaths, while the latter group had only 14 cases of beriberi and no deaths. This convinced Takaki and the Japanese Navy that diet was the cause of beriberi, but they mistakenly believed that sufficient amounts of protein prevented it.[47] That diseases could result from some dietary deficiencies was further investigated by Christiaan Eijkman, who in 1897 discovered that feeding unpolished rice instead of the polished variety to chickens helped to prevent beriberi in the chickens.[32] The following year, Frederick Hopkins postulated that some foods contained "accessory factors" — in addition to proteins, carbohydrates, fats etc. — that are necessary for the functions of the human body.[42] Hopkins and Eijkman were awarded the Nobel Prize for Physiology or Medicine in 1929 for their discoveries.[48]

In 1910, the first vitamin complex was isolated by Japanese scientist Umetaro Suzuki, who succeeded in extracting a water-soluble complex of micronutrients from rice bran and named it aberic acid (later Orizanin). He published this discovery in a Japanese scientific journal.[49] When the article was translated into German, the translation failed to state that it was a newly discovered nutrient, a claim made in the original Japanese article, and hence his discovery failed to gain publicity. In 1912 Polish-born biochemist Casimir Funk, working in London, isolated the same complex of
micronutrients and proposed the complex be named "vitamine". It was later to be known as vitamin B3 (niacin), though he described it as "anti-beri-beri-factor" (which would today be called thiamine or vitamin B1). Funk proposed the hypothesis that other diseases, such as rickets, pellagra, coeliac disease, and scurvy could also be cured by vitamins. Max Nierenstein, a friend and reader of Biochemistry at Bristol University reportedly suggested the "vitamine" name (from "vital amine"). The name soon became synonymous with Hopkins' "accessory factors", and, by the time it was shown that not all vitamins are amines, the word was already ubiquitous. In 1920, Jack Cecil Drummond proposed that the final "e" be dropped to deemphasize the "amine" reference, after researchers began to suspect that not all "vitamines" (in particular, vitamin A) have an amine component.

In 1930, Paul Karrer elucidated the correct structure for beta-carotene, the main precursor of vitamin A, and identified other carotenoids. Karrer and Norman Haworth confirmed Albert Szent-Györgyi's discovery of ascorbic acid and made significant contributions to the chemistry of flavins, which led to the identification of lactoflavin. For their investigations on carotenoids, flavins and vitamins A and B2, they both received the Nobel Prize in Chemistry in 1937.

In 1931, Albert Szent-Györgyi and a fellow researcher Joseph Svirbely suspected that "hexuronic acid" was actually vitamin C, and gave a sample to Charles Glen King, who proved its anti-scorbutic activity in his long-established guinea pig scorbutic assay. In 1937, Szent-Györgyi was awarded the Nobel Prize in Physiology or Medicine for his discovery. In 1943, Edward Adelbert Doisy and Henrik Dam were awarded the Nobel Prize in Physiology or Medicine for their discovery of vitamin K and its chemical structure. In 1967, George Wald was awarded the Nobel Prize (along with Ragnar Granit and Haldan Keffer Hartline) for his discovery that vitamin A could participate directly in a physiological process.

Etymology

The term vitamin was derived from "vitamine", a compound word coined in 1912 by the Polish biochemist Kazimierz Funk when working at the Lister Institute of Preventive Medicine. The name is from vital and amine, meaning amine of life, because it was suggested in 1912 that the organic micronutrient food factors that prevent beriberi and perhaps other similar dietary-deficiency diseases might be chemical amines. This was true of thiamine, but after it was found that other such micronutrients were not amines the word was shortened to vitamin in English.

Society and culture

Once discovered, vitamins were actively promoted in articles and advertisements in McCall's, Good Housekeeping, and other media. Marketers enthusiastically promoted cod-liver oil, a source of Vitamin D, as "bottled sunshine", and bananas as a "natural vitality food". They promoted foods such as yeast cakes, a source of B vitamins, on the basis of scientifically-determined nutritional value, rather than taste or appearance. World War II researchers focused on the need to ensure adequate nutrition, especially in processed foods. Robert W. Yoder is credited with first using the term vitamania, in 1942, to describe the appeal of relying on nutritional supplements rather than on obtaining vitamins from a varied diet of foods.
Governmental regulation

Most countries place dietary supplements in a special category under the general umbrella of foods, not drugs. As a result, the manufacturer, and not the government, has the responsibility of ensuring that its dietary supplement products are safe before they are marketed. Regulation of supplements varies widely by country. In the United States, a dietary supplement is defined under the Dietary Supplement Health and Education Act of 1994. There is no FDA approval process for dietary supplements, and no requirement that manufacturers prove the safety or efficacy of supplements introduced before 1994. The Food and Drug Administration must rely on its Adverse Event Reporting System to monitor adverse events that occur with supplements. In 2007, the US Code of Federal Regulations (CFR) Title 21, part III took effect, regulating GMP practices in the manufacturing, packaging, labeling, or holding operations for dietary supplements. Even though product registration is not required, these regulations mandate production and quality control standards (including testing for identity, purity and adulterations) for dietary supplements. In the European Union, the Food Supplements Directive requires that only those supplements that have been proven safe can be sold without a prescription. For most vitamins, pharmacopoeial standards have been established. In the United States, the United States Pharmacopeia (USP) sets standards for the most commonly used vitamins and preparations thereof. Likewise, monographs of the European Pharmacopoeia (Ph.Eur.) regulate aspects of identity and purity for vitamins on the European market.
Naming

The reason that the set of vitamins skips directly from E to K is that the vitamins corresponding to letters F–J were either reclassified over time, discarded as false leads, or renamed because of their relationship to vitamin B, which became a complex of vitamins.

The German-speaking scientists who isolated and described vitamin K (in addition to naming it as such) did so because the vitamin is intimately involved in the coagulation of blood following wounding (from the German word Koagulation). At the time, most (but not all) of the letters from F through to J were already designated, so the use of the letter K was considered quite reasonable.[59][62] The table nomenclature of reclassified vitamins lists chemicals that had previously been classified as vitamins, as well as the earlier names of vitamins that later became part of the B-complex.

There are other missing B vitamins which were reclassified or determined not to be vitamins. For example, B9 is folic acid and five of the folates are in the range B11 through B16, forms of other vitamins already discovered, not required as a nutrient by the entire population (like B10, PABA for internal use[63]), biologically inactive, toxic, or with unclassifiable effects in humans, or not generally recognised as vitamins by science,[64] such as the highest-numbered, which some

<table>
<thead>
<tr>
<th>Previous name</th>
<th>Chemical name</th>
<th>Reason for name change[59]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B₄</td>
<td>Adenine</td>
<td>DNA metabolite; synthesized in body</td>
</tr>
<tr>
<td>Vitamin B₈</td>
<td>Adenylic acid</td>
<td>DNA metabolite; synthesized in body</td>
</tr>
<tr>
<td>Vitamin F</td>
<td>Essential fatty acids</td>
<td>Needed in large quantities (does not fit the definition of a vitamin).</td>
</tr>
<tr>
<td>Vitamin G</td>
<td>Riboflavin</td>
<td>Reclassified as Vitamin B₂</td>
</tr>
<tr>
<td>Vitamin H</td>
<td>Biotin</td>
<td>Reclassified as Vitamin B₇</td>
</tr>
<tr>
<td>Vitamin J</td>
<td>Catechol, Flavin</td>
<td>Catechol nonessential; flavin reclassified as Vitamin B₂</td>
</tr>
<tr>
<td>Vitamin L₁[60]</td>
<td>Anthranilic acid</td>
<td>Non essential</td>
</tr>
<tr>
<td>Vitamin L₂[60]</td>
<td>Adenylthiomethylpentose</td>
<td>RNA metabolite; synthesized in body</td>
</tr>
<tr>
<td>Vitamin M</td>
<td>Folic acid</td>
<td>Reclassified as Vitamin B₉</td>
</tr>
<tr>
<td>Vitamin O</td>
<td>Carnitine</td>
<td>Synthesized in body</td>
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<tr>
<td>Vitamin P</td>
<td>Flavonoids</td>
<td>No longer classified as a vitamin</td>
</tr>
<tr>
<td>Vitamin PP</td>
<td>Niacin</td>
<td>Reclassified as Vitamin B₃</td>
</tr>
<tr>
<td>Vitamin S</td>
<td>Salicylic acid</td>
<td>Proposed inclusion[61] of salicylate as an essential micronutrient</td>
</tr>
<tr>
<td>Vitamin U</td>
<td>S-Methylmethionine</td>
<td>Protein metabolite; synthesized in body</td>
</tr>
</tbody>
</table>
naturopath practitioners call B\textsubscript{21} and B\textsubscript{22}. There are also nine lettered B complex vitamins (e.g. B\textsubscript{m}). There are other D vitamins now recognised as other substances,\textsuperscript{[63]} which some sources of the same type number up to D\textsubscript{7}. The controversial cancer treatment laetrile was at one point lettered as vitamin B\textsubscript{17}. There appears to be no consensus on any vitamins Q, R, T, V, W, X, Y or Z, nor are there substances officially designated as Vitamins N or I, although the latter may have been another form of one of the other vitamins or a known and named nutrient of another type.

### Anti-vitamins

Main article: Antinutrient

Anti-vitamins are chemical compounds that inhibit the absorption or actions of vitamins. For example, avidin is a protein in egg whites that inhibits the absorption of biotin.\textsuperscript{[65]} Pyrithiamine is similar to thiamine, vitamin B\textsubscript{1}, and inhibits the enzymes that use thiamine.\textsuperscript{[66]}

See also

- Food portal

### References

1. Use and Safety of Dietary Supplements NIH office of Dietary Supplements.
   


Plain type indicates Adequate Intakes (A/I). "The AI is believed to cover the needs of all individuals, but a lack of data prevent being able to specify with confidence the percentage of individuals covered by this intake" (see Dietary Reference Intakes: Vitamins. The National Academies, 2001).


• Bennett, David. Every Vitamin Page. All Vitamins and Pseudo-Vitamins.


• Vitamins and minerals – names and facts. pubquizhelp.34sp.com


External links

- Wikisource has the text of the 1922 Encyclopædia Britannica article Vitamine.
- USDA RDA chart in PDF format
- Health Canada Dietary Reference Intakes Reference Chart for Vitamins
- NIH Office of Dietary Supplements: Fact Sheets

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Vitamins (A11)

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Food chemistry

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Malnutrition or nutrition disorders (E40–E68, 260–269)

Dietary supplements

Authority control

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- **NDL**: 00560693

Categories:
- Essential nutrients
- Nutrition
- Vitamins