

= Vitamin =

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 , but there is little evidence of nutritional benefit when used by otherwise healthy people .

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 . 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) . 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 .

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 .

= = List of vitamins = =

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

= = 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 .

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 .

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 .

== Supplements ==

In those who are otherwise healthy , there is little evidence that supplements have any benefits with respect to cancer or heart disease . 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 . While other findings suggest that vitamin E toxicity is limited to only a specific form when taken in excess .

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 (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 .

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 .

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 .

== Deficiencies ==

Humans must consume vitamins periodically but with differing schedules , to avoid deficiency . The body 's stores for different vitamins vary widely ; vitamins A , D , and B12 are stored in significant amounts , mainly in the liver , and an adult '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 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 (fortification) . In addition to these classical vitamin deficiency diseases , some evidence has also suggested links between vitamin deficiency and a number of different disorders .

= = = 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 . 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 .

= = 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 . Because they are not as readily stored , more consistent intake is important . Many types of water @-@ soluble vitamins are synthesized by bacteria . 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 .

= = 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 . 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 .

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 . 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 . 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 .

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. In 1881 , Russian surgeon Nikolai Lunin studied the effects of scurvy at the University of Tartu in present @-@ day Estonia . 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 . " However , his conclusions were rejected by his advisor , Gustav von Bunge , even after other students reproduced his results . A similar result by Cornelius Pekelharing appeared in a Dutch medical journal in 1905 , but it was not widely reported .

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 . 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 . 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 . Hopkins and Eijkman were awarded the Nobel Prize for Physiology or Medicine in 1929 for their discoveries .

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 Orizantin) . He published this discovery in a Japanese scientific journal . 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 " vitamins " (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 outlets . 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 vitaminism , in 1942 , to describe the appeal of relying on nutritional supplements rather than on obtaining vitamins from a varied diet of foods . The continuing preoccupation with a healthy lifestyle has led to an obsessive consumption of additives the beneficial effects of which are questionable .

== 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 . 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) , biologically inactive , toxic , or with unclassifiable effects in humans , or not generally recognised as vitamins by science , such as the highest @-@ numbered , which some naturopath practitioners call B21 and B22 . There are also nine lettered B complex vitamins (e.g. Bm) . There are other D vitamins now recognised as other substances , which some sources of the same type number up to D7 . The controversial cancer treatment laetrile was at one point lettered as vitamin B17 . 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 = =

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 . Pyrithiamine is similar to thiamine , vitamin B1 , and inhibits the enzymes that use thiamine .