What is Vitamin D?

Description

What is Vitamin D?

Vitamin D is a group of fat-soluble prohormones, the two major forms of which are vitamin D2 (or ergocalciferol) and vitamin D3 (or cholecalciferol). Vitamin D obtained from sun exposure, food, and supplements, is biologically inert and must undergo two hydroxylation reactions to be activated in the body. Calcitriol is the active form of vitamin D found in the body. The term vitamin D also refers to these metabolites and other analogues of these substances.

Calcitriol plays an important role in the maintenance of several organ systems. However, its major role is to increase the flow of calcium into the bloodstream, by promoting absorption of calcium and phosphorus from food in the intestines, and reabsorption of calcium in the kidneys; enabling normal mineralization of bone and preventing hypocalcemic tetany. It is also necessary for bone growth and bone remodeling by osteoblasts and osteoclasts.

Without sufficient vitamin D, bones can become thin, brittle, or misshapen. Deficiency can arise from inadequate intake coupled with inadequate sunlight exposure; disorders that limit its absorption; conditions that impair conversion of vitamin D into active metabolites, such as liver or kidney disorders; or, rarely, by a number of hereditary disorders. Vitamin D deficiency results in impaired bone mineralization and leads to bone softening diseases, rickets in children and osteomalacia in adults, and possibly contributes to osteoporosis. Vitamin D2 was chemically characterized in 1932. In 1936 the chemical structure of vitamin D3 was established and resulted from the ultraviolet irradiation of 7-dehydrocholesterol.

Chemically, the various forms of vitamin D are secosteroids; i.e., steroids in which one of the bonds in the steroid rings is broken. The structural difference between vitamin D2 and vitamin D3 is in their side chains. The side chain of D2 contains a double bond between carbons 22 and 23, and a methyl group on carbon 24.

Vitamin D2 (made from ergosterol) is produced by invertebrates, fungus and plants in response to UV irradiation; it is not produced by vertebrates. Little is known about the biologic function of vitamin D2 in nonvertebrate species. Because ergosterol can more efficiently absorb the ultraviolet radiation that can damage DNA, RNA and protein it has been suggested that ergosterol serves as a sunscreening system that protects organisms from damaging high energy ultraviolet radiation.

Vitamin D3 is made in the skin when 7-dehydrocholesterol reacts with UVB ultraviolet light at wavelengths between 270–300 nm, with peak synthesis occurring between 295-297 nm. These wavelengths are present in sunlight when the UV index is greater than 3. At this solar elevation, which occurs daily within the tropics, daily during the spring and summer seasons in temperate regions, and almost never within the arctic circles, adequate amounts of vitamin D3 can be made in the skin after only ten to fifteen minutes of sun exposure at least two times per week to the face, arms, hands, or back without sunscreen. However, season, geographic latitude, time of day, cloud cover, skin cover, skin color, smog, and sunscreen affect UV ray absorption and vitamin D synthesis. For example, sunlight exposure from November through February in Boston is insufficient to produce significant vitamin D synthesis in the skin. With longer exposure to UVB rays, an equilibrium is achieved in the skin, and excess vitamin D simply degrades as fast as

it is generated. In humans, D3 is as effective as D2 in vitamin D hormone activity in circulation, although others state that D3 is more effective than D2. However, in some species, such as rats, vitamin D2 is more effective than D 3.

Further Reading

- Vitamin D Biochemistry
- Vitamin D Supplementation
- Vitamin D Deficiency
- Vitamin D Overdose

Foundation, Inc.

Category

1. Scientific resources

Date Created
February 2013
Author
betsyjbell