

Vitamin D₃

'Chole' - "calci" - fer-ol

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). [1] 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 (1,25-Dihydroxycholecalciferol) 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; condition that impair conversion of vitamin D into active metabolites, (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 D plays a number of other roles in human health including inhibition of calcitonin release from the thyroid gland. Calcitonin acts directly on osteoclasts, resulting in inhibition of bone resorption and cartilage degradation. Vitamin D can also inhibit parathyroid hormone secretion from the parathyroid gland, modulate neuromuscular and immune function and reduce inflammation

Vitamin D₃ is synthesized from **7-De-Hydrocholesterol**, a derivative of cholesterol, which is then photolyzed by ultraviolet light in 6-electron conrotatory electrocyclic reaction being **Pre-Vitamin D₃**.

Mechanism of action

After vitamin D is produced in the middle layers of skin or consumed in food, it is converted in the liver and kidney to form 1,25 dihydroxyvitamin D, (1,25(OH)₂D), the physiologically active form of vitamin D (when "D" is used without a subscript it refers to either D2 or D3). This physiologically active form of vitamin D is known as calcitriol. Following this conversion, calcitriol is released into the circulation, and by binding to a carrier protein in the plasma, vitamin D binding protein (VDBP), it is transported to various target organs.

The physiologically active form of vitamin D mediates its biological effects by binding to the vitamin D receptor (VDR), which is principally located in the nuclei of target cells. The binding of calcitriol to the VDR allows the VDR to act as a transcription factor that modulates the gene expression of transport proteins (such as TRPV6 and calbindin), which are involved in calcium absorption in the intestine.

The vitamin D receptor belongs to the nuclear receptor superfamily of steroid/thyroid hormone receptors, and VDRs are expressed by cells in most organs, including the brain, heart, skin, gonads, prostate, and breast. VDR activation in the intestine, bone, kidney, and parathyroid gland cells leads to the maintenance of calcium and phosphorus levels in the blood (with the assistance of parathyroid hormone and calcitonin) and to the maintenance of bone content.

The VDR is known to be involved in cell proliferation and differentiation. Vitamin D also affects the immune system, and VDRs are expressed in several white blood cells, including monocytes and activated T and B cells