

## VITAMIN B12

**Vitamin B12 commonly used specifications are Cyanocobalamin, Methylcobalamin, Cobamamide((Adenosylcobalamin) and Hydroxocobalamin (Hydroxocobalamin HCL and Hydroxocobalamin Acetate) in foods, nutrients, and feed.**

**Cyanocobalamin** is usually prescribed after surgical removal of part or all of the stomach or intestine to ensure adequate serum levels of vitamin B12. It is also used to treat pernicious anemia, vitamin B12 deficiency (due to low intake from food or inability to absorb due to genetic or other factors), thyrotoxicosis, hemorrhage, malignancy, liver disease and kidney disease. Cyanocobalamin injections are often prescribed to gastric bypass patients who have had part of their small intestine bypassed, making it difficult for B12 to be acquired via food or vitamins.

Cyanocobalamin is also used to perform the Schilling test to check ability to absorb vitamin B 12.

Cyanocobalamin is also produced in the body (and then excreted via urine) after intravenous hydroxycobalamin is used to treat cyanide poisoning.

Cyanocobalamin is commercially prepared by bacterial fermentation. Fermentation by a variety of microorganisms yields a mixture of methylcobalamin, hydroxocobalamin and adenosylcobalamin. These compounds are converted to cyanocobalamin by addition of potassium cyanide in the presence of sodium nitrite and heat. Since multiple species of *Propionibacterium* produce no exotoxins or endotoxins and have been granted GRAS status (generally regarded as safe) by the United States Food and Drug Administration, they are the preferred bacterial fermentation organisms for vitamin B12 production.

Historically, the physiological form was initially thought to be cyanocobalamin. This was because hydroxocobalamin produced by bacteria was changed to cyanocobalamin during purification in activated charcoal columns after separation from the bacterial cultures (because cyanide is naturally present in activated charcoal). Cyanocobalamin is the form in most pharmaceutical preparations because adding cyanide stabilizes the molecule.

**Methylcobalamin** (mecobalamin, MeCbl, or MeB12) is a cobalamin, a form of vitamin B12. It differs from cyanocobalamin in that the cyano group at the cobalt is replaced with a methyl group. This vitamin is one of two active coenzymes used by vitamin B12-dependent enzymes and is the specific vitamin B12 form used by 5-methyltetrahydrofolate-homocysteine methyltransferase (MTR), also known as methionine synthase.

Methylcobalamin participates in the Wood-Ljungdahl pathway, which is a pathway by which some organisms utilize carbon dioxide as their source of organic compounds. In this pathway, methylcobalamin provides the methyl group that couples to carbon monoxide (derived from CO<sub>2</sub>) to afford acetyl-CoA. Acetyl-CoA is a derivative of acetic acid that is converted to more complex molecules as required by the organism.

Methylcobalamin is produced by some bacteria. It plays an important role in the environment. In the environment, it is responsible for the biomethylation of certain heavy metals. For example, the highly toxic methylmercury is produced by the action of methylcobalamin. In this role, methylcobalamin serves as a source of "CH<sub>3</sub><sup>+</sup>".



A lack of cobalamin can lead to megaloblastic anemia and subacute combined degeneration of the spinal cord.

Methylcobalamin can be produced in the laboratory by reducing cyanocobalamin with sodium borohydride in alkaline solution, followed by the addition of methyl iodide.

**Adenosylcobalamin**, also known as coenzyme B12, cobamamide, and dibenzocide, is, along with methylcobalamin, one of the biologically active forms of vitamin B12.

Adenosylcobalamin participates as a cofactor in radical-mediated 1,2-carbon skeleton rearrangements. These processes require the formation of the deoxyadenosyl radical through homolytic dissociation of the carbon-cobalt bond. This bond is exceptionally weak, with a bond dissociation energy of 31 kcal/mol, which is further lowered in the chemical environment of an enzyme active site. An enzyme that uses adenosylcobalamin as a cofactor is methylmalonyl-CoA mutase (MCM).

**Hydroxocobalamin** is a vitamin found in food and used as a dietary supplement. As a supplement it is used to treat vitamin B12 deficiency including pernicious anemia. Other uses include treatment for cyanide poisoning, Leber's optic atrophy, and toxic amblyopia. It is given by injection into a muscle or vein.