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As a part of the vitamin B complex, vitamin B12 is a water-soluble vitamin. However, vitamin B12 is unique among all the water-soluble vitamins in that it is not excreted quickly in the urine. Rather, vitamin B12 is accumulated and stored in the liver, kidney, and other body tissues. As a result of this storage factor of vitamin B12, a deficiency in this vitamin may not manifest itself or show its symptoms until after five or six years of diet with inadequate supply of vitamin B12.

Another reason for the uniqueness of vitamin B12 lies in the fact that only smaller amounts of this vitamin is required and the body already makes full use of it. For instance, ten micrograms of B12 spread over a day seems to be able to provide adequate supply for the body to use.

Vitamin B12 is also called cobalamin owing to the fact that it contains the metal, cobalt.

## ***What are the Health Benefits of Vitamin B12?***

The main benefit of vitamin B12 in food is to function as a methyl donor. By working with folic acid, it plays an important role in the synthesis of DNA (the genetic material of all cells). It also appears to promote and maintain the normal function of healthy nerve cells and red blood cells.

Vitamin B12 in food is also vitally important in maintaining the health of the insulation sheath or the myelin sheath that surround all nerve cells. Thus, lack of vitamin B12 in the body may sometimes result in neurologically related conditions.

## ***What is Vitamin B12 Deficiency?***

A common problem, vitamin B12 deficiency affects the general population, especially the elderly. There are two types of sufferers from vitamin B12 deficiency. The first group is comprised of asymptomatic vitamin B12 deficiency and the other one is composed of hematologic vitamin B12 deficiency.

The type of deficiency you have may depend on how your body absorbs the nutrients from foods. The body's method of absorbing vitamin B12 from foods is complex. And that is why a defect in the absorption process can become a cause of vitamin B12 deficiency. Often, the absorption of vitamin B12 occurs in the stomach where the release of gastric acid and pepsin help release cobalamin from animal proteins. Vitamin B12 absorption may also occur in the mouth where it binds preferentially to salivary R protein.

Pancreatic enzymes and an alkaline pH may also react with vitamin B12 and contribute to its rate of absorption. These two compounds digest the R protein-cobalamin complex but before it is absorbed, vitamin B12 first binds to intrinsic factor (IF) secreted by the intestines to form an IF-cobalamin complex.

One cause of vitamin B12 deficiency is certain medical conditions that affect vitamin B12 absorption. These conditions include low consumption of vitamin B12 because of eating foods that lack vitamin B12. The cause of this vitamin B12 deficiency is veganism, or those strict vegetarians that eat only plants and vegetables that do not contain any cobalamin.

The failure to digest food protein is also a leading cause of vitamin B12 deficiency. This may be caused by the decreased release of gastric acid, which is in turn caused by an underlying health condition.

As briefly mentioned earlier, absorption of vitamin B12 by the body is accomplished when all the factors – that is, the compounds necessary are present. Vitamin B12 combined with salivary R protein need to bind with

intrinsic factors in the small intestine in order for the vitamin to be properly absorbed. If there are no intrinsic factors, then absorption fails and thus, this shortage of a vital compound can be a cause of vitamin B12 deficiency. Conditions that lead to absence of intrinsic factor include pernicious anemia and gastrectomy.

The most obvious solution to preventing vitamin B12 deficiency is to eat food high in vitamin B12. Countless reports from around the world show that many long-term vegetarians (vegetarians who do not use any eggs, meat, fish, poultry, or dairy products) are especially susceptible to vitamin B12 deficiency. Since they cannot eat the regular food high in vitamin B12 that other people eat, they often resort to supplements.

Besides lack of adequate consumption of food high in vitamin B12, another factor that may lead to a deficiency in this vitamin is lack of adequate absorption. Despite the fact that the body does not need to consume a lot of food high in vitamin B12, the vitamin is actually difficult to absorb. For this reason, even with a diet of food high in vitamin B12, people may still suffer from vitamin B12 deficiency.

Poor absorption of the vitamins found in food high in vitamin B12 can be due to an underlying condition, including a lack of B12 in diet because of poor food selections, a lack of intrinsic factor secretion due to aging, gastritis, or the partial removal of the stomach by surgery (gastrectomy), lack of hydrochloric acid in the stomach, especially in the elderly, or ileal resection or ileitis.

Although vitamin B12 is made by bacteria and fungi, they are not normally found in yeasts or higher plants. Most of the friendly bacteria reside in large quantities in the gastrointestinal tracts of animals and humans and because of this, food high in vitamin B12 are mostly meat products.

Food rich in vitamin B12 are very important because vitamin B12, along with B6, is a major contributing factor to the promotion of the body's metabolism of folic acid. In addition, foods rich in vitamin B12 also contain vital nutrients that play a range of important roles in countless activities, including cellular repair, digestion, the immune system and the production of energy.

Correction of deficiency simply means increasing the amount of vitamin B12 that you take. Treating underlying disorders that cause vitamin B12 deficiency in conjunction with the intake of vitamin B12 supplements is also another approach to correcting the deficiency. Moreover, vitamin B12 supplementation seems to alleviate the symptoms of folic acid deficiency. This is, of course, granted that folate supplements are also provided to the patient. The reason for this is that there may be unsuspected B12 deficiency along with the lack of folate and the sudden availability of folate may use up the remaining B12, which is known to potentially be harmful to the nerves of the spinal cord.

### ***What is the Normal Dosage of Vitamin B12?***

The recommended intake of vitamin B12 is actually very low. The body only needs about 2 micrograms of this vitamin in order to make full use of all its benefits. However, despite this, many still suffer from deficiency due mostly to poor absorption of the vitamin.

### ***What Foods are Rich in Vitamin B12?***

Food containing vitamin B12 are mostly animal-derived foods. A diet of food containing vitamin B12, such as dairy products or eggs provides adequate vitamin B12. For vegetarians, fortified food containing vitamin B12 are also available. These include Nutri-Grain, some brands of nutritional yeast, or some soy analogs.

The best way to discover other food containing vitamin B12 is to read labels of products in the supermarket. Due to an alarming number of vitamin B12 deficient cases, many foods are now fortified with vitamin B12 to counteract the deficiency.

Besides animal products and yeast extracts, there are other sources as well that can be considered as food rich in vitamin B12. These are: asparagus, bananas, broccoli, brown rice, cheese, dried apricots, dried dates and figs, eggs, fish, milk, nuts, potatoes, poultry, pulses, red meat, spinach, wheat germ, wholegrain cereals, yeast extract (e.g. marmite), and yogurt.

Vegetables and plants are not one of the food rich in vitamin B12, with very little exception. As a result, many vegetarians and especially vegans stand the risk of deficiency in this vitamin. Vegetarians who consume eggs and dairy produce will obtain sufficient B12 since these foods contain enough vitamin B12 to prevent deficiency. However, if neither is consumed, especially with regards to strict vegetarians or vegans, B12 supplements need to be considered.

Tempeh and sea vegetables, such as spirulina and nori, may also be food containing vitamin B12. However, their B12 content often varies so do not rely on them as good sources of vitamin B12. After analysis, it has been found that the B12 content in sea vegetables appear to be caused by the presence of compounds that are structurally similar to B12, known as B12 analogues.

Supplementation is also recommended for those who do not consume dairy products, eggs, or fortified foods regularly. However, some researchers have found that B12 supplements such as spirulina may in fact increase the risk of B12 deficiency disease than alleviate it. This is because the B12 analogues in spirulina often compete with B12 and inhibit metabolism.

Specific examples of vitamin B12 food sources include animal foods such as fish, meat, poultry, eggs, milk, and milk products. Another good vitamin B12 food

source is fortified breakfast cereals, which is a particularly valuable source of vitamin B12 for vegetarians. Because plants and vegetables can never be considered as vitamin B12 food sources, vegetarians stand more chance of suffering from deficiency of this vitamin. To compensate for the loss, vitamin B12 food sources fortified with the vitamin are made available for them.

Other vitamin B12 food sources are mollusks and clams (mixed species, cooked). Three ounces of these contain as much as 84.1 micrograms of vitamin B12, equivalent to 1400 Daily Value (DV).

One slice of braised liver or beef is also a good vitamin B12 food source, containing as much as 47.9 micrograms of vitamin B12, equivalent to 780 DV. Trout, rainbow, salmon, sockeye, and fortified breakfast cereals have vitamin B12 ranging from 6.0 to 2.4 micrograms.

Even fast food, such as cheeseburger and taco, contains a good amount of vitamin B12. And yogurt, haddock, tuna, milk, pork, egg, American pasteurized cheese food, and chicken contain vitamin B12 as well.

### ***What about Vitamin B1 and B6 in relation to Vitamin B12?***

Originally thought to be one single vitamin, Vitamin B is actually a complex of several chemically distinct vitamins. The name arises from the fact that these vitamins happen to often coexist in the same foods. Later research, however, found otherwise.

The B Vitamins often include B1 B12 B6 Vitamins, B2 B3 B4 B5 B7 B8 and B9. B1 B12 B6 vitamins are sometimes called thiamine, pyridoxine and pyridocamine, and cyanocobalamin, respectively. Each of these vitamins has distinctive effects on the body, especially on the process called metabolism. B1 B12 B6 vitamins specifically bolster the metabolic rate of the body, maintain healthy skin and muscle tone, and enhance the immune and nervous system. B vitamins also help

promote cell growth and division, including that of red blood cells that help prevent anemia.

B1 B12 B6 vitamins are water soluble, just as all B vitamins are. They are dispersed throughout the body and an essential nutritional requirement to help the body perform its normal functions. B1 B12 B6 vitamins must be replenished daily and any excess is excreted in the urine. So far, no study has yet to show of any adverse side effect due to over-consumption of B1 B12 B6 vitamins.

The combinations of B1 B12 B6 vitamins often help combat the symptoms of behavioral diseases. That is why the B1 B12 B6 vitamin combination is often used to treat stress, depression, and even cardiovascular diseases.

Otherwise known as Vitamin B1, thiamine is a colorless compound that is soluble in water and insoluble in alcohol. It is the essential component of the coenzyme Thiamine pyrophosphate (TPP) for pyruvate dehydrogenase,  $\alpha$ -ketoglutarate dehydrogenase and transketolase. These enzymes help in the metabolism of compounds, such as carbohydrates, synthesis of NADPH and the pentose sugars, deoxyribose and ribose.

Vitamin B6 is made up of two major forms – pyridoxine and pyridoxamine. When these two compounds are found in the liver, they take on the form of pyridoxal 5'-phosphate or PLP which is a cofactor in many reactions of amino acid metabolism. The release of glucose from glycogen is also made possible with the presence of PLP. In addition to that, Vitamin B6 is needed for more than 100 enzymes involved in protein metabolism, as well as red blood cell metabolism.

Cyanocobalamin is the principal Vitamin B12 form found in foods and nutritional supplements. Out of all the B Vitamins, B12 is the most chemically complex. Its structure is based on a corrin ring, which, although similar to the porphyrin ring found in haem, chlorophyll, and cytochromes, has two of the pyrrole rings directly bonded to it.



## ***Conclusion***

A shortage in the supply of vitamin B12 in food that you eat will lead to deficiency. And a deficiency in this vitamin often leads to countless diseases, such as asthma, anemia, and various neurological disturbances, including senile dementia and Alzheimer's disease.

Often, the best way to stop the onset of a disease is to prevent it from happening in the first place. The same applies to vitamin B12 deficiency. Because symptoms of vitamin B12 deficiency rarely show themselves during the early stages, it is difficult for doctors to diagnose the deficiency. That is why it is all the more important for you to pay attention to your own consumption of the vitamin. Foods rich in vitamin B12 should always be a part of your diet, no matter if you are a meat-eater or a vegetarian.