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Fact Sheet: Vitamin B12 for the Vegetarian

By [Team](#), General Conference Nutrition Council

Why is vitamin B12 important?

Vitamin B12 is an essential nutrient, required for DNA synthesis (and ultimately cell division), maturation of red blood cells, and the synthesis of myelin sheaths around nerves in the body.

Sources of vitamin B12:

Vitamin B12 is of special interest to vegetarians, particularly total vegetarians, since it is found only in animal-based products including red meats, poultry, seafood, dairy products and eggs. While plant-based foods are typically not a source of vitamin B12, significant levels can be found in some foods fortified with the vitamin such as fortified ready-to-eat breakfast cereals, fortified plant beverages (made from soy, rice, almond, coconut, oats, hazelnut, or cashew), fortified vegetarian meat analogs (canned and frozen), or fortified nutritional yeast (such as Red Star®). It is also available as a B12 supplement and as part of many multivitamin supplements. It is important to note that inactive analogs of vitamin B12 may be present in some foods such as spirulina, seaweed, and fermented foods such as tempeh. While food labels may claim the presence of vitamin B12 in these foods, they do not provide any significant level of active vitamin B12 (cobalamin) useful for the body.

Digestion and absorption of vitamin B12:

The digestion of vitamin B12 begins in the stomach, where gastric secretions split vitamin B12 from proteins. Vitamin B12 is then free to bind to R-factor found in saliva. Pancreatic secretions partially degrade the R factor, and vitamin B12 is then tightly bound to intrinsic factor, a glycoprotein secreted by the stomach. Intrinsic factor (with the B12 attached to it) binds to special receptors at the lower end of the small intestine (ileum)¹. This binding facilitates the absorption of vitamin B12 into the bloodstream, a process that is about

50% efficient. From here vitamin B12 is carried by a transport protein (holotranscobalamin II or TC2) to the liver, where it is stored.

The good rate of absorption, combined with low daily requirements and the body's efficient reabsorption of B12 secreted into the intestinal tract, enables the body to survive a long time, often years, on a low intake of the vitamin before a deficiency is clinically shown or manifested. It is estimated that intestinal absorption is saturated at about 1.5–2.0 µg per meal, so that vitamin B12 sources should be taken at each meal². Vitamin B12 absorption from food decreases drastically when the capacity of intrinsic factor is exceeded (at 1–2 µg of vitamin B12). Vitamin B12 appears to be more bioavailable from dairy than from eggs or other animal products⁽³⁾.

Since vitamin B12 in meat, fish, dairy products, and eggs comes attached to the protein in food, its digestion can be inefficient in the elderly due to diminished gastric secretions. The vitamin B12 in supplements and that added to fortified foods is more efficiently absorbed since it occurs in an unbound form not requiring digestion⁴. Hence, it is recommended that anyone over 50 should obtain a significant amount of their dietary B12 from foods fortified with B12, or else they will need to take a regular supplement. For efficient absorption, a B12 tablet must be chewed rather than swallowed. Only about 1-2% of a large supplement is absorbed by passive diffusion, a mechanism different from that described above⁵. In dietary supplements, vitamin B12 is usually present as cyanocobalamin, a form that the body readily converts to the active forms. It is not necessary to consume a more expensive form of the supplement, methyl cobalamin. Furthermore, there is no difference in absorption between oral tablets and the sub-lingual preparations.

What are the Signs of Vitamin B12 deficiency?

Vitamin B12 is a nutrient of concern for all vegetarians as its deficiency is not uncommon. In one British study involving 689 men, it was found that vegans (total vegetarians) had mean serum B12 levels that were 33% lower than the lacto-ovo-vegetarians. 52% of vegans and 7% of vegetarians were vitamin B12 deficient⁶. The statistics would have shown higher percentages of deficiency if a higher, more traditional cut-off value was used to define deficiency (200 pg/ml rather than 160 pg/ml, i.e. 148 pmol/L rather than 118 pmol/L). Elimination of animal products from the diet typically produces a lower B12 status of the individual. An assessment of the B12 status of 340 SDA ministers in Australia in 1997 revealed that the 53% of the lacto-ovo-vegetarians and vegans had vitamin B12 deficiency largely due to a low dietary intake of the vitamin⁽⁷⁾.

Since both folate deficiency and B12 deficiency are associated with macrocytic anemia, it is possible that B12 deficiency can be masked by a high intake of folic acid. The folate may correct the macrocytic anemia, but if B12 deficiency exists, it could go undetected until neurological symptoms appear. There are multiple manifestations of B12 deficiency. Hematological complications of B12 deficiency include macrocytic anemia (in which there are large immature red blood cells), neutropenia (an abnormally low level of white blood cells), and thrombocytopenia (low platelet count). All these signs are reversible with B12 supplements.

Vitamin B12 deficiency can also lead to the demyelination of peripheral nerves, the spinal cord, cranial nerves and the brain, resulting in nerve damage and neuropsychiatric abnormalities. Neurological symptoms of vitamin B12 deficiency include numbness and tingling of the hands and feet, difficulty in walking with a loss of balance, memory loss, dementia, depression, general weakness and psychosis. Unless detected and treated early, these symptoms may be irreversible⁽¹⁾.

An infant born to a vegan mother, who has followed her dietary practices for some time without B12 supplementation or fortified foods, can be at considerable risk of becoming vitamin B12 deficient. If the mother's B12 stores are low and her B12 intake is very low, the fetus will not obtain sufficient vitamin during fetal development and the infant will not get sufficient vitamin from mother's milk. Within months the child can show signs of B12 deficiency such as developmental delay or regression, failure to thrive, seizures, loss

of reflexes, lethargy, and anemia(8).

Vitamin B12 is important for aiding osteoblasts, the bone-forming cells. In the Framingham Offspring Osteoporosis study, those with lower vitamin B12 levels (less than 200 pg/mL or 148 pmol/L) had lower-than-average bone mineral density compared with participants who had vitamin B12 levels above 200 pg/mL(9).

Causes of vitamin B12 deficiency

- Inadequate dietary intake:
 - Following a restrictive diet. Some vegetarian diets (especially a vegan diet) without supplementation or use of B12 -fortified foods
- Inadequate absorption or impaired utilization
 - Loss of gastric acid and/or pepsin (major contributor to B12 deficiency) in the elderly. This is independent of the diet pattern followed by the elderly person.
 - Lack of intrinsic factor
 - Gastritis and the partial or total surgical removal of the stomach
 - Ileal disease or ileal resection (secondary to Crohn's disease)
 - Use of medications commonly used to treat elevated blood pressure (ACE inhibitors), diabetes (metformin), Parkinson's disease (levodopa), and for suppression of gastric acid secretion such as proton-pump inhibitors (Prilosec)
 - Gastric infection with *Helicobacter pylori*
- Increased requirements
 - During pregnancy and lactation

How can you avoid vitamin B12 deficiency?

Careful food selection is necessary to ensure adequate vitamin B12 intake. The recommended daily intake of vitamin B12 for adolescents and adults is 2.4 µg¹⁰. This amount can be achieved by lacto-ovo- vegetarians by selecting from a variety of low-fat dairy products and eggs as well as using B12-fortified foods. Vegans must consume B12-fortified foods or B12 supplements on a daily basis, This is particularly important for women during pregnancy and lactation, especially for total vegans^{2,11}. A supplement of 500 µg B12 three to four times a week is recommended for those with a low dietary intake. The B12 supplement should be thoroughly chewed for good absorption. Alternatively a sub-lingual form is very effective¹². Vitamin B12 has a low potential for toxicity. No adverse effects have been observed in people taking 1000 µg daily for 5 years.

Seaweed (such as nori and the blue-green algae, Spirulina), fermented soy (such as tempeh and miso) should not be relied upon as valid sources of active B12. The amount of vitamin B12 produced in the mouth is also an insignificant amount, insufficient to begin to meet your daily needs. B12 is produced in the large bowel of humans by certain bacteria residing in the large intestine. However, this production occurs beyond the ileum (the lower end of the small intestine), where active B12 absorption takes place. Small amounts of vitamin B12 are found in white button mushrooms, but they cannot be relied upon as a significant dietary source(13).

Years ago, Adventists were given the counsel that the time would come to discard milk and eggs¹⁴ (which are good sources of B12). In most Western countries, fortified soy and similar beverages and other B12-fortified foods (mentioned earlier) are now readily available, thus removing the necessity of using dairy and egg. However, in many other countries, these B12 fortified foods and beverages are not available, necessitating a daily food source of B12 (or a regular B12 supplement) for good health. Removing dairy from the diet without an appropriate substitute to provide a regular supply of B12 could lead to a serious unwanted B12 deficiency (described earlier). Ellen White warned that some people in abstaining from milk and eggs

fail “to supply the body with proper nourishment and as a consequence become weak and unable to work”(14). Such a result only brings the health reform into disrepute¹⁴. She warns that “we are not to advocate extremes in health reform”¹⁴. While a balanced vegan diet has been shown to be safe and healthy in North America and other Western countries having B12 fortification readily available¹², it may not support optimal health in other countries without diligent efforts to obtain a regular B12 intake.

Why is B12 fortification of a plant diet necessary today if the original diet was ideal and ensured optimal health? We don't know. In past centuries, B12-synthesizing intestinal flora may have inhabited the small intestine of humans making B12 absorption in the ileac region a distinct possibility. Changes in the gut flora of humans over time could have occurred making B12 production to occur lower down in the colon, and hence unavailable for absorption. Also, ideally, natural contamination of foods and water with vitamin B12 could have occurred in the conditions of creation. These conditions have changed with the human actions towards foods (i.e. thermal treatments during food processing among others). Furthermore, we are unaware of the nutritional content of the fruit from the tree of life in the Garden of Eden. The tree was removed from access to men and women after the Fall. We are sure of one thing. Long periods of no B12 intake produce serious clinical signs of B12 deficiency that impair our health.

Assessment of one's vitamin B12 status

A vitamin B12 deficiency can manifest itself with serious clinical symptoms (as described above). Hence, it is especially important that vegans have their B12 status assessed annually to facilitate early intervention when necessary. Monitoring the vitamin B12 status of pregnant vegans and young vegan children should be considered especially important ¹¹. Measuring blood levels of methylmalonic acid (MMA) provides the easiest and most accurate form of assessment. An elevated level is an indication of vitamin B12 deficiency. Typically, healthcare professionals measure only serum levels of vitamin B12. For the most reliable approach to diagnose vitamin B12 deficiency it is recommended to measure at least two biomarkers, such as cobalamin and MMA (15)

The range of values for serum vitamin B12 that are accepted as normal varies between different countries and between different labs. Typically in the USA, the accepted normal levels of vitamin B12 range between 200 to 900 pg/mL (148 pmol/L to 664 pmol/L). Values less than 200 pg/mL (148 pmol/L) are generally considered to indicate a vitamin B12 deficiency. However, many believe that B12 adequacy can only be achieved with a serum level of no less than 350 pg/mL (258 pmol/L). This is based upon the fact that neurological changes have been observed in individuals with serum B12 levels between 200 and 350 pg/ml (16), even though blood cell abnormalities were absent.

The General Conference Nutrition Council recommends that the total vegetarian should regularly consume foods fortified with vitamin B12 or else use a 500 µg supplement of vitamin B12 3-4 times a week. This would be especially important for a pregnant or breast-feeding woman. Elderly, total vegetarians, and lacto-ovo-vegetarians with decreasing consumption of dairy and eggs should have their vitamin B12 status checked regularly, at least on an annual basis.

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