

# USANA Technical Bulletin

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## Vitamin B<sub>12</sub> (cyanocobalamin)

### Technical Background

- Vitamin B<sub>12</sub> is one of the water-soluble B vitamins essential for human health and well-being. Its chemistry is unique in two respects; (1) it is the only human vitamin that contains a mineral component, and (2) it is one of the few essential substances in the body that contains the mineral cobalt.
- Vitamin B<sub>12</sub> is frequently referred to as cyanocobalamin, though technically cyanocobalamin is the pharmaceutical or supplement form of vitamin B<sub>12</sub> (used because it is chemically stable). In the human body, however, cyanocobalamin must be converted into one of two related cobalamin molecules before becoming metabolically active.<sup>1</sup>
- Vitamin B<sub>12</sub> is a coenzyme, meaning that its function is closely associated with – and essential for – the activity of one or more enzymes.<sup>2</sup> In the human body, vitamin B<sub>12</sub> binds to an enzyme responsible for part of the cyclic metabolism of folic acid, another B vitamin that in turn is required for amino acid metabolism, the synthesis of nucleic acids, red blood cell formation, and myelin synthesis and maintenance.
- Absorption of vitamin B<sub>12</sub> is a multi-stage process, and defects in any one of the enzyme systems required for release, transport, and absorption of B<sub>12</sub> in the gut can result in a deficiency of the vitamin.<sup>1</sup> Deficiencies also result from inadequate B<sub>12</sub> in the diet.
- Clinical symptoms of vitamin B<sub>12</sub> deficiency include pernicious anemia, numbness and tingling in the hands and feet, poor balance, poor coordination, and a loss of mental acuity.<sup>3,4</sup> Low levels of B<sub>12</sub> have also been associated with brittle bones, a higher incidence of fractures in the elderly,<sup>5</sup> and an increased risk of having a pregnancy affected by Spina Bifida.<sup>6</sup> A shortage of vitamin B<sub>12</sub> results in an interruption of folic acid regeneration and consequent folic acid deficiency. As such, vitamin B<sub>12</sub> deficiencies are often mistaken for folic acid deficiencies both in laboratory tests and in analysis of clinical symptoms,<sup>1</sup> making Vitamin B<sub>12</sub> deficiencies difficult to diagnose.

### Sources and Recommended Intake

- All vitamin B<sub>12</sub> found in nature is made by microorganisms.<sup>1</sup> The best food sources are those in which this microbial product has moved up the food chain and become relatively concentrated. Such sources include meat (particularly liver), fish, clams, oysters, milk, fermented cheeses, and eggs.<sup>1,3</sup> Fortified breakfast cereals are also a good source.
- Vitamin B<sub>12</sub> is virtually absent from fruits, grains, legumes, and vegetables. As such, strict vegetarians are at risk for B<sub>12</sub> deficiencies. Note that some vegan foods (such as tempeh, miso

and legumes) have been labeled as B<sub>12</sub> sources, but the cobalamin-like compounds they contain are inactive in humans.<sup>7</sup>

- Human requirements for vitamin B<sub>12</sub> are relatively small. The RDA for this nutrient is 2.4 mcg/day for adults.<sup>8</sup> Higher levels are suggested for pregnant and lactating women (2.6-2.8 mcg/day) and for senior citizens.<sup>9</sup> The average American diet contains 3-7 mcg/day,<sup>10</sup> although this value reflects a high intake of meat.
- Despite these figures, it is estimated that a significant percentage of Americans, particularly among vegetarians and the elderly, are B<sub>12</sub> deficient.<sup>9,11</sup>

## Abstracts

*Takasaki Y, Moriuchi Y, Tsushima H, Ikeda E, Koura S, Taguchi J, Fukushima T, Tomonaga M, Ikeda S. [Effectiveness of oral vitamin B12 therapy for pernicious anemia and vitamin B12 deficiency anemia.] Rinsho Ketsueki. 2002 Mar;43(3):165-9.* We investigated the efficacy of oral vitamin B12 (B12) therapy in patients with B12-deficiency anemia. Between June 1994 and June 2000, 17 patients, who were diagnosed as having B12-deficiency anemia and gave their informed consent, were enrolled in this study. Of these patients, 7 were further treated with a maintenance dose of methylcobalamin (1,500 micrograms daily for 7 days every 1-3 months). Correction of hematological and neurological abnormalities was prompt. The hemoglobin level and serum concentration of B12 were normalized within two months after starting the treatment. Recovery from neurological disturbance was observed within one month. To maintain a normal serum concentration of B12, a 7-day regime of administration was needed every month in 3 patients, every 2 months in 3 patients, and every 3 months in 1 patient. These results demonstrate the effectiveness of oral cobalamin therapy, and also that oral intermittent therapy is useful for maintaining a normal serum B12 concentration. Oral cobalamin therapy might be as effective as conventional injection therapy, and useful for long-term treatment.

## References

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