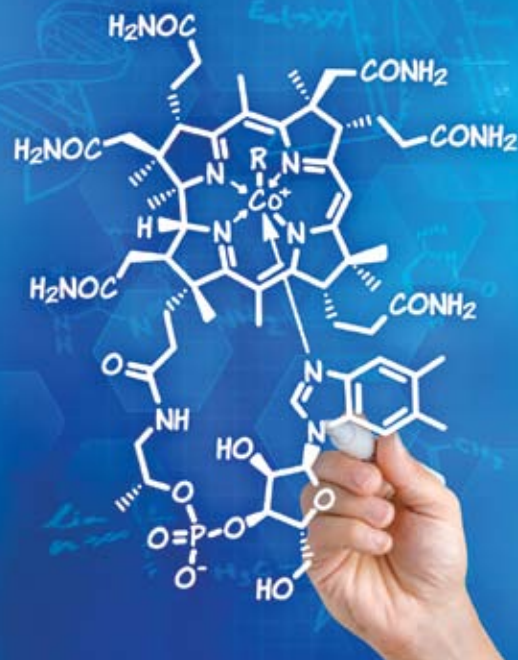


# VITAMIN B<sub>12</sub>



BY MILTON TESKE, MD

*What vegetarians need to know about this – the **largest** of all vitamins ...*

In humans (as well as all other animal life forms) Vitamin B-12 is essential for life. All of life is a complex system of biochemical reactions. And all of these reactions are mediated by specialized proteins called enzymes. These enzymes, often arranged like factory assembly lines, build the complex molecules needed to make us what we are

one step at a time. Other systems of enzymes disassemble certain molecules. And still others manipulate certain molecules to release and transfer the chemical energy stored in them making it available to power all the activities in the cell.

If you think of these enzymes as workmen, sometimes these workers need specialized tools to do a certain job. We call these tools **co-factors**. Think of a mechanic that needs a certain sized wrench to attach a certain part. B-12 is a co-factor (a tool used by an enzyme). Without the right sized tool, there is no way these mechanics can do their work — they just sit there idle, and the job is not done.

## Cobalt

At the center of every large B-12 molecule is an atom of cobalt. The electrons spinning around the nucleus of the cobalt atom are in such positions that they create six active sites where cobalt can form chemical bonds with the electrons of other atoms. B-12 has nitrogen

atoms positioned just perfectly to tightly bond with five of these positions, thus holding the cobalt tightly in its place at the center of the large B-12 molecule. This leaves the sixth position open and free to hold certain other molecules that we might want to attach or remove in

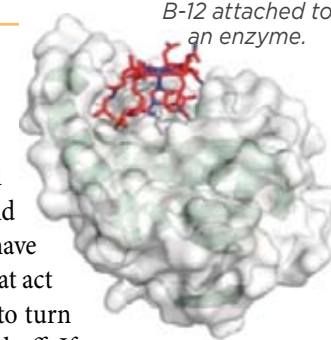
certain reactions.

The most common use of B-12 is to attach a methyl group to another molecule. To do this we must first have a methyl group attached in this sixth position on the cobalt. We now call this form of B-12 with a methyl attached: methylcobalamin. The methyl is attached tight enough to hold it in its place but loose enough that the enzyme can transfer it from the B-12 to another molecule it wants to methylate. Then having done its job, the B-12 (now without its methyl) is dropped by the enzyme and the enzyme picks up another B-12 that has a methyl so it can repeat its work again. The empty B-12 can be recharged by yet other enzymes that add a methyl back to it so it can be reused again.

## Cell Division

Vitamin B-12 is essential every time a cell divides. A cell is so small, it takes a powerful microscope to even see it. Yet in the nucleus of every cell is a thin thread of DNA about six feet long. The only way to fit it in without tangling it is to carefully wind it all up on special little spools made for this purpose. But for a cell to divide into two cells, it must first completely unwind all of the DNA and make a duplicate copy then carefully rewind both copies so they can each be separated into the two new cells all without getting tangled up. There must

be billions of these little spools in the cell nucleus and they each have little tails that act as switches to turn them on and off. If you attach a methyl in all the right spots on the tails, the spool turns on and winds up the DNA. And the enzymes that do that all need B-12 with methyl to do their job. It takes a huge amount of B-12 for even one cell to duplicate its DNA and get all the spools turned on and wound up and separated into the two new cells.



*B-12 attached to an enzyme.*



## Megaloblastic Anemia

Each hour, you are making millions of red blood cells. And if you don't have enough B-12, this cell dividing doesn't progress properly and you end up with some large irregular blood cells and not nearly enough. It is called megaloblastic anemia. This is one of the early signs of B-12 deficiency.

## Myelin Sheath

The axons of the neurons in your brain and spinal cord are covered with a special myelin sheath that is essential for high-speed nerve conduction. Without this myelin sheath, nerve conduction is just

too slow for normal thought processes. B-12 is essential to the cells that build this myelin sheath. Without enough B-12, there is a degeneration of the myelin in the brain and spinal cord leading to neuropathy and dementia. This progressive neurodegenerative damage **can be permanent**. This is why it is so important to prevent B-12 deficiency.

## Mitochondria

The mitochondria, the energy-producing powerhouses found in every cell, must have B-12 for some important steps in the reactions they use to produce the energy your cells need. This is one reason why weakness and fatigue are a part of B-12 deficiency syndrome.

## Homocysteine

Homocysteine is a harmful amino acid that can build up in the body. It is toxic to the endothelium of your arteries and can be very damaging to your neuronal synapses. The only way your body can get rid of homocysteine is with an enzyme that uses methylcobalamin to methylate the homocysteine into methionine that is safe and useful. Doctors now frequently test for homocysteine levels, as it is a known risk factor for heart attacks and strokes. If your level is greater than 10, you may be deficient in B-12.

## MMA (methylmalonyl-CoA)

MMA is a toxic, 4-carbon residue produced when you burn fat. An enzyme that uses B-12 is designed to convert this toxic substance into succinyl-CoA that can now easily be burned up for energy

in the mitochondria.

## Where can we get B-12?

Your body does not make vitamin B-12. No animal makes B-12. No plants make B-12. The only source for all of the B-12 on this earth is **bacteria**. Only these microbes have the enzymes necessary to build these large complex B-12 molecules that all animals are dependent upon for life.

The top six inches of natural soil in a meadow is full of microbial activity and high in B-12. As animals graze on this field they pick up lots of this B-12. The fecal material they leave behind is full of microbes and B-12. As the rainwater washes across the meadow, the streams become full of these microbes with their B-12. The natural world is full of B-12, and animals in the wild and living on farms have no shortage of B-12 on everything they eat.

Animal tissue is full of B-12. So if you are eating the flesh of other animals on a regular basis, there will be plenty of B-12 in your diet. Liver is especially high in B-12 because the body stores B-12 in the liver. Did you know that your liver can store enough B-12 to supply all you need for over 5 years?

The most concentrated source of B-12 is found in clams. They consume the fecal material that settles to the bottom of the bay and thus have extremely high levels of B-12. Eggs often thought of as a good source of B-12 are actually fairly low in B-12 and are a poor source for getting B-12.

But what if you are living on a plant-based diet? There is no B-12 made in plants. And what if you wash your food

carefully before eating it? And I do recommend washing your food. There are a lot of bad microbes in this world today that you want to avoid — cholera, typhoid, dysentery, amoebas, worm eggs, larvae, and other parasites. Plant-based diets today are very deficient in B-12. ***Vegetarians should take a Vitamin B-12 supplement daily.***

## How We Absorb B-12

Vitamin B-12 is a large, complex molecule, and God designed a special process for its protection and absorption and transportation through body to get it safely to every cell that needs it. It starts in the mouth where a special protector protein found in the saliva grabs it and wraps itself around the B-12, and then it can be safely swallowed. This protein protects it from destruction by the powerful, concentrated hydrochloric acid in the stomach. It passes safely through the stomach into the small intestine. Then here, the protector protein is removed by pancreatic enzymes setting the B-12 free to be picked up by intrinsic factor.

Intrinsic factor is produced in the stomach and is essential for B-12 absorption. Although produced in the stomach, it is in the small intestine that it actually picks up the B-12 that has now been released from its protector protein. Bound to the intrinsic factor, it is now ready to be absorbed by special receptors found only in the last part of the small intestine.

These intrinsic factor receptors in the last part of the small intestine absorb the intrinsic factor along with its attached B-12 into the intestinal cells. Then the B-12 is freed from the intrinsic factor.

But now it must be attached to a new special transporter protein that carries it safely through the blood to every cell in the body. Each cell has special receptors for this transporter protein that will pull it into the cell, and then the B-12 will be freed to be used by the cell for its various needs.

## Pernicious Anemia

Anything that damages the stomach or the distal intestine can prevent absorption. A big problem is the acid blocking drugs that are so commonly taken because of stomach pain today. They not only block the release of stomach acid, but they also block the release of intrinsic factor thus preventing the absorption of B-12. Gastric surgeries or Crohn's disease can also prevent B-12 absorption. And stomach abuse from years of coffee and spices and junk food can lead to atrophy of the stomach lining and loss of intrinsic factor with age. Drugs like metformin can block B-12 absorption. All of these persons will need monthly B-12 injections from their doctor to bypass these problems and get the B-12 directly into the body.

## Natural Alternative Myths

The bacteria in your mouth do not produce enough B-12 to supply your needs. The bacteria in your colon produce a lot of B-12 but it is too far down stream to be combined with intrinsic factor and it is far past the receptors in your small intestine so you cannot absorb it.

What about fermented foods like tempeh, miso, tamari, seaweed, sauerkraut,



## How much should I take?

**1,000 to 5,000 mcg of methylcobalamin** in a sublingual or chewable form that dissolves in your mouth daily with meals should give you a good level if you have no problems with absorption.

kimchi, etc.? Studies have shown they are not a reliable source and cannot prevent B-12 deficiency.

Spirulina and blue-green algae contain pseudo-vitamin B-12. This is similar enough to real B-12 that it is picked up and used by the enzymes as if it was B-12, but it is different enough that it does not work. It is like the mechanic is left holding the wrong size wrench. He can't do the job. I would avoid these supplements.

## Gradual Onset

Because the body can store large amounts of B-12 and possibly because of small amounts in the diet, the symptoms of B-12 deficiency are very gradual in onset over many years. They are also very vague and general in nature — brain fog (fuzzy thinking), fatigue, anxiety, difficulty concentrating, depression, irritability, dizziness, tingling in the hands and feet, difficulty balancing, muscle twitches, short-term memory loss, muscle weakness. All of these are so slow and gradual in onset that they are often just felt to be part of aging or blamed on some other cause. But the real danger lies in the fact that the neural damage associated with B-12 deficiency

is usually not reversible but will be permanent.

## Blood Tests

The following tests can be considered fairly reliable indicators of B-12 deficiency. If your:

- ✓ B-12 level is  $> 600$  pg/ml
- ✓ Homocysteine is  $< 10$  umol/L
- ✓ MMA  $< 4$  mcg/mg creatine
- ✓ MCV is  $< 98$  (on your CBC)

...then you can be comfortable that you **do not** have a B-12 deficiency. These levels are all off in a B-12 deficiency.

## Take Your Vitamin B-12

The damaging effects of B-12 deficiency can be especially severe and of long-term consequences in the developing brain. Vegan mothers who are pregnant or breast-feeding are at very high risk of damaging their baby if they do not supplement with B-12. Vegan children should be given B-12 supplements.

**All vegetarians who do not supplement will eventually become B-12 deficient.**



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