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Vitamin K2 — A Crucial Ingredient for Heart and Bone Health

By Dr. Mercola | November 13th, 2017

Vitamin K is a fat-soluble vitamin that is well-known for its role in blood clotting. However, there are two different kinds of vitamin K, each providing its own set of health benefits. Vitamin K1 is primarily responsible for blood clotting whereas vitamin K2 works synergistically with calcium, magnesium and vitamin D to impart a number of important health benefits, including but not limited to:

Preventing osteoporosis	Preventing hardening of the arteries (atherosclerosis) and lowering your heart attack risk
Directing calcium to your bones, making them stronger, and your teeth to help prevent cavities.	Creating insulin to stabilize your blood sugar (keeping your system sensitive to maintaining correct amounts), thereby protecting against diabetes and helping to prevent metabolic problems associated with obesity
It also prevents calcium from going to the wrong areas, such as to your kidneys, where it could lead to kidney stones, or your blood vessels, where it could trigger heart disease	
Optimizing sexual function by increasing testosterone and fertility in men	Decreasing androgens, the male hormones, in women with polycystic ovarian syndrome
Suppressing genes that can promote cancer while strengthening genes that promote healthy cells.	Enhancing your ability to utilize energy as you exercise improving overall performance.
The 2010 European Prospective Investigation into Cancer and Nutrition (EPIC) study found that high intake of vitamin K2 — not K1 — leads to reduced cancer risk, as well as a 30 percent lower risk of dying from cancer	Serving as a mitochondrial electron carrier, vitamin K2 also helps maintain normal ATP production in mitochondrial dysfunction, such as that found in Parkinson's disease
Protecting against neurological deficiencies, including dementia	Prevent infectious diseases such as pneumonia
Improving disease activity in those with rheumatoid arthritis, and, in combination with vitamin D, improving osteoarthritis of the knee	Reducing the risk of osteoporosis and spontaneous fractures in adults with cerebral palsy
Supporting healthy immune function	Supporting growth and development of the fetus during pregnancy

Higher Vitamin K2 Intake Associated With Improved Heart Health

Vitamin K2 deficiency is actually what produces the symptoms of vitamin D toxicity, which includes inappropriate calcification of soft tissues that can lead to atherosclerosis.

A recent article in Life Extension Magazine also highlights the cardiovascular benefits of vitamin K2. Importantly, a double-blind, placebo-controlled study published in 2015 found that taking 180 micrograms (mcg) per day of vitamin K2 (MK-7 form) for three years improved arterial stiffness in postmenopausal women, especially those who had a high degree of arterial stiffness.

At the end of the study, the treatment group had a 5.8 percent lower stiffness index beta (a parameter of arterial stiffness) and a 3.6 percent lower carotid-femoral pulse wave velocity (a test that measures arterial stiffness). The placebo group, on the other hand, saw a 1.3 and 0.22 percent increase in these measurements respectively.

This study has been lauded as significant because while previous studies have only been able to show an association, this is the first to confirm that long-term use of vitamin K2 in the form of MK-7 does improve cardiovascular health. Prior to this study, it was unclear whether taking additional vitamin K2 could actually reverse calcification of the arteries that had already occurred. As noted in Life Extension:

“This is the first long-term human trial showing improvements in measures of arterial stiffness in response to long-acting vitamin K2.

While the 5.8 percent and 3.6 percent improvements might not appear substantial, when realizing that calcification often worsens with age, the fact that there was a reversal in arterial stiffness compared to placebo is quite remarkable ... This provides us all with an opportunity to restore more youthful flexibility to aging blood vessels and other soft tissues.”

Other Studies Also Confirm Vitamin K2 Helps Reduce Cardiovascular Events and Lowers Mortality

Other previous studies have also clearly demonstrated vitamin K2's importance for heart health and longevity. In the Rotterdam Study, which ran for 10 years, those who consumed the greatest amounts of K2 had the lowest risk of cardiovascular disease and cardiovascular calcification, and the lowest chance of dying from cardiovascular disease.

People who consumed 45 mcg of K2 daily lived seven years longer than people getting 12 mcg per day. This was a profound discovery because such a correlation did not exist for K1 intake. In a subsequent trial called the Prospect Study, 16,000 people were followed for 10 years. Here, they found that each additional 10 mcg of K2 in the diet resulted in 9 percent fewer cardiac events.

Vitamin K2 Is Crucial for Osteoporosis Prevention

As mentioned, vitamin K2 also plays a crucial role in bone health, and may be critical for the prevention of osteoporosis (brittle bones). Osteocalcin is a protein produced by your osteoblasts (cells responsible for bone formation), and is utilized within the bone as an integral part of the bone-forming process. However, osteocalcin must be “carboxylated” before it can be effective. Vitamin K functions as a cofactor for the enzyme that catalyzes the carboxylation of osteocalcin.

If you do not have sufficient amounts of vitamin K2, you run the risk of both brittle bones and calcification in your soft tissues. In other words, vitamin K2 is necessary to keep your bones strong and your soft tissues pliable. A number of Japanese trials have shown that vitamin K2 completely reverses bone loss and in some cases even increases bone mass in people with osteoporosis.

The pooled evidence of seven Japanese trials also show that vitamin K2 supplementation produces a 60 percent reduction in vertebral fractures and an 80 percent reduction in hip and other nonvertebral fractures. One Chinese meta-analysis of 19 randomized controlled trials found that vitamin K2 supplementation significantly improved vertebral

bone density in postmenopausal women and reduced the risk of bone fractures.

Another three-year-long placebo-controlled study done in the Netherlands found that postmenopausal women taking 180 mcg of MK-7 per day increased their bone strength and saw a decrease in the rate of age-related bone mineral decline and reduced loss of bone density, compared to those taking a placebo. The following graphic, from a 2014 research paper on vitamin K2, illustrates the dual effect of vitamin K on bone and vascular health.

The Differences Between Vitamins K1 and K2, and Why They Are Not Interchangeable

In the 1980s, it was discovered that vitamin K2 is needed to activate the protein osteocalcin, which is found in your bone. A decade or so later, another vitamin K-dependent protein was discovered: matrix Gla protein (MGP), found in your vascular system. Without vitamin K2, these and other vitamin K2-dependent proteins remain inactivated, and cannot perform their biological functions.

Another important finding was that MGP strongly inhibits calcification. When MGP remains inactivated, you end up with serious arterial calcifications, and this is why vitamin K2 is so crucial for cardiovascular health. The difference between vitamins K1 and K2 was clearly established in the Rotterdam Study, published in 2004. A variety of foods were measured for vitamin K content, and vitamin K1 was found to be present in high amounts in green leafy vegetables such as spinach, kale, broccoli and cabbage.

Vitamin K2, on the other hand, was only present in fermented foods. It's actually produced by specific bacteria during the fermentation process. Certain bacteria in your gut naturally produce vitamin K2 in your body as well.

Interestingly, while the K1 in vegetables is poorly absorbed, virtually all of the K2 in fermented foods is readily available to your body. More recent research has identified the foods highest in vitamin K2. I'll discuss that further below. Vitamin K2 can be further broken down into:

1. MK-4 (menaquinone-4), a short-chain form of vitamin K2 found in animal-based foods such as grass fed butter, butter oil and pastured egg yolks. Avoid supplements containing MK-4, however, as supplements only use a synthetic form of MK-4, typically obtained from tobacco plant extract.

MK-4 also has a very short biological half-life — about one hour — making it a poor candidate as a dietary supplement. That said, natural MK-4 from food is important for good health, as MK-4 plays a role in gene expression, turning some genes off and others on, and is therefore important for cancer prevention.

2. MK-7 (menaquinone-7), longer-chain forms found in fermented foods. There's a variety of these long-chain forms but the most common one is MK-7. This is the one you'll want to look for in supplements, as this form is extracted from real food, specifically natto, a fermented soy product.

The MK-7, which forms in the fermentation process, has two major advantages. It stays in your body longer and has a longer half-life, which means you can take it just once a day in very convenient dosing. Research has shown MK-7 helps prevent inflammation by inhibiting proinflammatory markers produced by white blood cells called monocytes.

Top Two MK-7 Vitamin K2 Sources

Again, vitamin K2 is found primarily in animal-based foods (MK-4) and fermented foods (MK-7). However, when it comes to MK-7, it's important to realize that not all bacteria make K2, so only certain fermented foods will contain it. Grain fed animals will also produce far lower amounts of K2, and are best avoided for other reasons. Only grass fed animals will develop naturally high K2 levels.

For these reasons, most commercial yogurts are virtually devoid of vitamin K2, and while certain types of cheeses, such as Gouda, brie and Edam are high in K2, others are not. One of the best ways to get plenty of vitamin K2 from your diet it is to regularly eat home-fermented vegetables made with a special starter culture designed with bacterial strains that produce vitamin K2.

You can get up to 500 mcg of vitamin K2 in a 2-ounce serving of fermented vegetables using such a starter culture, which is a clinically therapeutic dose. This is also one of your most economical alternatives.

Other Food Sources High in Vitamin K2

Testing by the Weston A. Price Foundation reveals there are virtually no other foods that can contend with natto in terms of providing MK-7 vitamin K2. Coming in at No. 1 for the richest source of MK-4 vitamin K2 is emu oil, which contains anywhere from 3.9 to 4.4 mcg of MK-4 per gram, but only a near-nonexistent 0.002 mcg/g of MK-7. While not very well-known, emu oil is a traditional fat and functional food from Australia, and is commercially available in supplement form.

To learn more about this oil, including what to look for in a high-quality supplement, see this blog post by registered nurse Kayla Grossmann. As mentioned, MK-4 does have important health benefits, but it does not appear to be as impressive as MK-7. Here's a sampling of other foods that contain higher amounts of vitamin K2 (MK-4 and MK-7). For complete results, download the test findings from WestonAPrice.com.

Food source	Mcg/g of MK-4	Mcg/g of MK-7
Natto	0	11
Emu oil	3.9 to 4.4	0.002
Oysters	0.001	0.002
Wild shrimp	0.0002	0.01
Chicken liver (farmed)	0.1	0.0008
Chicken liver (conventional)	0.04	0.01
Green Pastures butter oil	0.8	0
Cabot extra sharp aged cheddar	0.1	0.01
Nature's Promise organic sharp cheddar	0.09	0.007
PA Bowen Farmstead reserve cheddar	0.08	0.01
PA Bowen Farmstead raw blue cheese	0.04	0.01
Lard (pastured)	0.2	0

How Much Vitamin K2 Do You Need?

As for a clinically useful dosage of vitamin K2, some studies — including the Rotterdam study — have shown as little as 45 mcg per day is sufficient. As a general guideline, I recommend getting around 150 mcg of vitamin K2 per day. Others recommend slightly higher amounts; upward of 180 to 200 mcg.

You can obtain healthy amounts of K2 by eating 15 grams (half an ounce) of natto each day, or fermented vegetables. If you fermented them using a starter culture designed with vitamin K2-producing bacteria, 1 ounce will give you

about 200 to 250 mcgs.

If you are taking an oral vitamin D3 supplement, you may also need more vitamin K2, in order to maintain a healthy ratio. While the ideal or optimal ratios between vitamin D and vitamin K2 have yet to be elucidated, Rheaume-Bleue suggests taking 100 mcg of vitamin K2 for every 1,000 IUs of vitamin D you take.

If you opt for a vitamin K2 supplement, make sure it's MK-7. Also remember to take it with fat since it's fat-soluble and won't be absorbed otherwise. Fortunately, you don't need to worry about overdosing on K2, as it appears to be completely nontoxic. People have been given a thousandfold "overdose" over the course of three years, showing no adverse reactions (i.e., no increased clotting tendencies).

Keep in mind that vitamin K2 may not necessarily make you "feel better" per se. Its internal workings are such that you're not likely to feel the difference physically. Compliance can therefore be a problem, as people are more likely to take something that has a noticeable effect. So, remember, the fact you don't feel a difference does not mean it's not doing anything.

Contraindications

While nontoxic, people who are taking vitamin K antagonists, i.e., drugs that reduce blood clotting by reducing the action of vitamin K, are advised to avoid MK-7 supplements. Also, if you are pregnant or nursing, avoid vitamin K2 supplementation higher than the RDA (65 mcg) unless specifically recommended and monitored by your physician.

If you or your family has a history of osteoporosis or heart disease, I strongly advise adding vitamin K2 to your diet. Taking a little extra vitamin K2 every day is a simple way to ensure your blood vessels don't calcify. However, if you have experienced stroke, cardiac arrest, or are prone to blood clotting, you should not take vitamin K2 without first consulting your physician.

Signs and Symptoms of Vitamin K Deficiency

The following conditions may put you at an increased risk of vitamin K deficiency:

- Eating a poor or restricted diet
- Crohn's disease, ulcerative colitis, celiac disease and other conditions that interfere with nutrient absorption
- Liver disease that interferes with vitamin K storage
- Taking drugs such as broad-spectrum antibiotics, cholesterol drugs and aspirin

Some of the signs and symptoms of a vitamin K deficiency include:

- Blood thinning, poor clot formation, easy bruising and excessive bleeding from wounds, punctures or injections
- Heavy menstrual periods
- Anemia (looking tired and pale; feeling weak and listless)
- Bleeding from your gastrointestinal tract; blood in urine and/or stool
- Frequent nose bleeds

When Supplementing, Balance Vitamin K2 With Magnesium, Calcium and Vitamin D

One of the major benefits of getting your nutrients from a varied whole food diet is that you're less likely to end up with lopsided nutrient ratios. Foods in general contain all the cofactors and needed co-nutrients in the proper ratios for optimal health. Essentially, the wisdom of Mother Nature eliminates the guesswork. When you rely on supplements, you need to pay closer attention to how nutrients influence and interact with each other in order to avoid getting yourself into trouble.

As mentioned, we know that vitamin K2 acts synergistically with magnesium, calcium and vitamin D, so it's important to consider all of these ratios. Unfortunately, we don't yet know the precise ideal ratios between all of these nutrients. Some general guidelines and considerations include the following:

- Magnesium will help keep calcium in your cells so they can do their job better. The ideal ratio between magnesium and calcium is currently thought to be 1-to-1. Keep in mind that since you're likely getting far more calcium from your diet than you are magnesium, your need for supplemental magnesium may be two to three times greater than calcium.
- Magnesium and vitamin K2 also complement each other, as magnesium helps lower blood pressure, which is an important component of heart disease.
- Vitamin K2 has two crucial functions: cardiovascular health and bone restoration. By removing calcium from the lining of the blood vessels and shuttling it into your bone matrix, vitamin K2 helps prevent occlusions from atherosclerosis. Meanwhile, vitamin D helps optimize calcium absorption.

Vitamins D and K2 also work together to produce and activate Matrix GLA Protein (MGP), which congregates around the elastic fibers of your arterial lining, thereby guarding your arteries against calcium crystal formation.

As for how much vitamin D you need, I strongly recommend getting your vitamin D level tested twice a year (summer and winter) to help determine your personal dosage. Sensible sun exposure is the ideal way to optimize your levels, but if you opt for a supplement, your "ideal dosage" is one that will put you into the therapeutic range of 40 to 60 nanograms per milliliter.