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Vitamin K1 and K2— Two Underappreciated Nutrients That Are Crucial for Health

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By Dr. Mercola

Most readers here appreciate the importance of vitamin D, as do many physicians. However, there's another vitamin that is virtually equivalent in terms of benefit that is still sorely underappreciated, and that is vitamin K2.

Very little is known about it, and it doesn't get much media attention. Dr. Leon Schurgers is a senior scientist who did his PhD work on [vitamin K](#), and I recently had the pleasure of interviewing him on this important topic.

He began his research on vitamin K some 20 years ago at Maastricht University in the Netherlands, and he's currently one of the leading researchers in the world on this vitamin.

Vitamin K—both K1 and K2—are well known for their function in thrombosis. According to Dr. Schurgers, all K vitamins actually have more or less the same function, which is related to the first part of the vitamin, called the naphthoquinone ring structure.

This ring structure is identical for both K1 and K2. The two vitamins are only different in their side chains.

The Blood Clotting Functions of Vitamins K

[Vitamin K1](#) is well known for being crucial for proper blood clotting. But Dr. Schurgers clarifies this by saying that both vitamins K1 and K2 activate certain coagulation factors. Specifically, there are four coagulation factors (Factor 2, 7, 9, and 10) in the coagulation cascade that are activated by vitamins K1 and K2.

According to Dr. Schurgers, there's no risk of over coagulating if you take a lot of vitamin K. In other words, your coagulation factors will not become overactive if you take high amounts of vitamin K1 or K2. So it is quite safe to consume vitamin K when you are not taking an oral anticoagulant drug.

Elderly people with atrial fibrillation (AF) or venous or deep-vein thrombosis are often put on oral anticoagulants, which are vitamin K antagonists, meaning they block the recycling of vitamin K—not only K1, but also K2. In this case, you do need to be cautious.

Story at-a-glance

Vitamin K2 is necessary to prevent arterial calcification, which it does by activating Matrix Gla protein (MGP)

If you fail to consume adequate amounts of vitamin K1 and K2, you will radically increase your risk of heart disease and stroke

People who consume the greatest amounts of K2 have the lowest risk of cardiovascular disease, cardiovascular calcification, and the lowest chance of dying from cardiovascular disease

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According to Dr. Schurgers:

*“If you take oral anticoagulants – Coumadins and Warfarins, you have to be careful with K1 AND K2. However, the advice in the United States is to skip **everything** that contains vitamin K, and that is something I argue against.*

Because if you take away all the K1 and K2 from the diet, every little interference—if you take a little bit of vitamin K—will have a dramatic effect on the anticoagulant level. However, if you have a steady intake level of vitamin K1 or K2, or both, a little bit of interference is not that bad anymore.

So I advocate, please take vitamin K from the diet every day, and put the anticoagulant level on top of that”... [But] there is no real benefit to take extra vitamin K on top of Coumadin, and I would not advocate that.”

In other words, get your baseline PT (prothrombin) measurements while you are taking vitamin K 1 and K2 from the diet and your oral anticoagulant. Then have your doctor adjust your dose based upon that. However, it is important you take the same dose of K1 and K2 all the time or else the drug may over-anticoagulate you.

Vitamin K Benefits Go Far Beyond Blood Clotting

Vitamin K also has important benefits beyond healthy blood clotting. In the 1980s, it was discovered that vitamin K 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 K, these and other vitamin K-dependent proteins remain inactivated, and cannot perform their biological functions.

Another important finding was that MGP is a *very* strong inhibitor of calcification. If you inactivate MGP, you end up with serious arterial calcifications, and this is why vitamin K is so crucial for cardiovascular health. Evidence suggests vitamin K can even regress arterial calcification induced by vitamin K deficiency. According to Dr. Schurgers:

“There is a very strong correlation between inactive MGP and microcalcifications. It’s very interesting to speculate that vitamin K deficiency is causative of microcalcification, which then sets on a whole cascade of processes leading to atherosclerosis.”

On a side note, when I was in medical school in the late ‘70s, MGP was completely unknown, which underscores the importance of doctors to stay on top of the research, which is moving quite quickly these days.

Key Differences Between K1 and K2

The difference between vitamins K1 and K2 was first established in the Rotterdam Study,¹ which Dr. Schurgers was part of. He explains:

“We published this in 2004... I measured a variety of food items for vitamin K content... Vitamin K1 is highly available in green, leafy vegetables – spinach, kale, broccoli, and cabbage.

However, the absorption of vitamin K1 from food is extremely low. Only 10 percent of the vitamin K, which is found in green leafy vegetables, is absorbed in your body... And there’s no variable or modification of the consumption that will significantly increase the absorption...

That was when we started to measure vitamin K2 in food items. We discovered that it was only present in fermented foods. Vitamin K2 is produced by bacteria in the fermentation product...

The total amount of vitamin K2 in cheese is lower than K1 in green leafy vegetables. However, all the vitamin K2 is absorbed by the body... Vitamin K2 in the food item is nearly completely absorbed...

Vitamin K2 Is Important for Cardiovascular Health

The Rotterdam Study found that those who consumed the greatest amounts of K2 had the lowest risk of cardiovascular disease, cardiovascular calcification, and the lowest chance of dying from cardiovascular disease. This was a profound discovery, because such a correlation did not exist for K1 intake. Later on, other studies also showed that while K2 has health benefits, K1 has none. That's when the investigation into the differences between K1 and K2 began in earnest.

"If you absorb vitamin K1 and K2, we showed that K1 is mainly going to your liver and stays there," Dr. Schurgers says. "It has a relatively short half-life. After three to four hours after ingesting a dose of vitamin K1 from food, it is gone. It is taken up by the liver. K2 also goes to the liver, but the liver redistributes it via the low density lipoprotein (LDL) cholesterol fraction... [which] is going to peripheral tissues such as bone and vasculature."

Both K1 and K2 are fat-soluble, but K2 is more fat-soluble, at least in long-chain menaquinones such as MK7. MK7 is transported more to the vasculature as compared to the vitamin K1. We hypothesized that that is one of the main functions – that K2 has additional benefit in the cardiovascular system, and K1 is more present in the liver."

So, in addition to activating MGP, which is a potent inhibitor of calcification, K2 also helps prevent arterial calcification by transporting calcium away from areas where it shouldn't be (in the lining of your blood vessels) to where it's really needed (such as in your bone).

K2 also appears to be important for vascular flow to your brain. Upon autopsy, many with Alzheimer's are found to have vascular degeneration, which is thought to produce symptoms of Alzheimer's. And although there's limited research in this area, evidence suggests vitamin K2 might help prevent Alzheimer's by preventing plaque deposition. According to Dr. Schurgers, at least one study has also shown that vitamin K2 has a major function in delivering cellular energy for Parkinson's disease patients, and may be beneficial in the treatment of this disease.

How to Measure Vitamin K Deficiency

Just as you can measure your serum vitamin D level to ascertain whether you might be sufficient or deficient, you can measure your vitamin K1 and K2 levels as well. The problem, however, is that it really only reveals what you ate the day before, which makes it very difficult to judge sufficiency or deficiency.

"For example, if I measure vitamin K in your blood and yesterday you consumed a lot of spinach, your vitamin K1 will be high. If you consumed a hamburger, for example, with low amount of vitamin K, your vitamin K will probably be very low. So it's not a very good marker for vitamin K status," Dr. Schurgers says.

To get around this problem, researchers have developed enzyme-linked immunosorbent assays (ELISA). These blood tests measure the active and inactive forms of MGP. By that, you can more accurately determine whether you're sufficient in vitamin K or not. These tests are currently being commercialized, and should be available in both Europe and the US in 2015. Interestingly enough, Dr. Schurgers has found that virtually everyone is clinically vitamin K-deficient based on these tests. And, it's particularly noteworthy that, in studies, patients with the highest levels of inactive MGP had the highest chance of dying from cardiovascular disease.

"There is always a certain amount of matrix Gla protein, which is circulating in the inactive form, meaning in biochemistry, you need extra vitamin K to activate this form," he explains.

Recommended Dosages

To avoid vitamin K1 deficiency, Dr. Schurgers recommends eating a minimum of 200 grams of vegetables each day. He also suggests consuming K2 on a daily basis, which means you need to eat some form of fermented food.

"Some people ask: 'Why is vitamin K2 more important [than K1], whereas there's K1 in the diet? Where does this benefit come from?' The only explanation I can come up with, which is just purely hypothetical, is that 100 years ago, we didn't have refrigerators. Most of the food were in our house for more days and were most likely fermented," Dr. Schurgers notes.

While the ideal dosage has yet to be determined, studies suggest you need about 360-500 micrograms (mcg) of

vitamin K2 per day. There are no known side effects of higher dosages, however, so it's likely better to err on the higher side. At bare minimum, you need 45 mcgs per day to help ward off cardiovascular disease, as evidenced in the Rotterdam Study,² which was the first study demonstrating the beneficial effect of vitamin K2. In this study, people who consumed 45 mcg of K2 daily lived seven years longer than people getting 12 mcg per day.

Foods high in K2 include raw dairy products such as hard and soft cheeses, raw butter, and kefir, as well as fermented vegetables like sauerkraut. Keep in mind that the K2 content of pasteurized dairy and products from confined animal feeding operations (CAFOs), which comprise most commercial sources, are NOT high in K2 and should be avoided. Only grass-fed animals (not grain fed) will develop naturally high K2 levels. The following table contains estimates of the K2 content of various foods.

Food	Vitamin K2
Natto (3.5 ounces)	1,000 mcg
Fermented vegetables made with Kinetic Culture (2 ounces)	400-500 mcg
Whole egg mayonnaise	197 mcg
Gouda or Brie cheese (1 ounce)	75 mcg
Miso	10-30 mcg
Lamb or duck (1 cup)	6 mcg
Beef liver (1 cup)	5 mcg
Dark meat turkey (1 cup)	5 mcg
Chicken liver (1 cup)	3 mcg

Also keep in mind that fermented foods contain a wide variety of different bacteria, and only certain ones—such as *Bacillus subtilis*—actually make vitamin K2. You can boost the K2 content of fermented foods by making them yourself, using a starter culture specifically designed to optimize K2. My research team found that we could get 400 to 500 mcgs of vitamin K2 in a two-ounce serving of fermented vegetables using a starter culture, which is a clinically therapeutic dose.

Take-Home Message...

Optimizing your vitamin K level has tremendous potential for improving your health, and it's such a simple intervention—especially if you opt for fresh vegetables and fermented foods. For me, that's the real take-home message here. Sure, you can swallow vitamin K supplements, but it's far easier to get vitamin K2 from fermented vegetables. I believe taking this simple step is a really crucial nutritional strategy that can go a long way toward optimizing your health.

While most if not all people are deficient in vitamin K to some degree, if you've already been diagnosed with cardiovascular disease, you can be absolutely certain that you are deficient, and it would behoove you to take steps to ensure you're getting plenty of vitamin K1 and K2, which may help regress some of the damage. Eating lots of green vegetables, especially kale, spinach, collard greens, broccoli, and Brussels sprouts, will increase your vitamin K1 levels naturally.

For vitamin K2, cheese curd is an excellent source. You can also obtain about 200 mcgs of K2 by eating 15 grams of natto each day, which is half an ounce. It's a small amount and very inexpensive, but many Westerners do not enjoy the taste and texture. If you don't care for the taste of natto, do try some fermented veggies made with Kinetic Culture, which will produce high levels of K2. This is what I do nearly every day. As a last resort, take a high-quality K2 supplement. Remember you must always take your vitamin K supplement with fat since it is fat-soluble and won't be absorbed without it. Again, 45 mcg/day is the bare minimum, but you could go as high as 500 mcgs per day or even much higher, as this is one of the few supplements where toxicity has never been demonstrated.

[+] Sources and References

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