

# Vitamin K

## Its Functions & Benefits

By Gene Bruno, MS, MHS

**V**itamin K, a fat-soluble vitamin, was first known for its essential role in the functioning of several proteins involved in blood clotting or coagulation (which is important to prevent excessive bleeding after an injury).<sup>1</sup> In fact, the “K” in vitamin K is derived from the German word “koagulation.” Now, vitamin K is understood to offer additional benefits, including its role delivering vitamin-K dependent proteins, which are necessary for bone mineralization (e.g., helping to keep calcium in the bone).<sup>2</sup>

### Two Forms

The two naturally occurring forms of vitamin K are K1 and K2. Plants synthesize phyloquinone, which is also known as vitamin K1. Friendly intestinal bacteria synthesize a range of vitamin K2 forms collectively referred to as menaquinones.<sup>3</sup> The menaquinone form of vitamin K2 will be designated according to the number of repeating five-carbon units in the side chain of the molecule. For example, if there are seven repeating five-carbon units, the designation will be menaquinone-7, or MK-7. These two forms of vitamin K have different benefits to offer for human

health, apparently with K2 offering the greater range of benefits.

### Vitamin K Deficiency

Adults at risk of vitamin K deficiency include those taking vitamin K antagonist anticoagulant drugs and individuals with significant liver damage or disease.<sup>4</sup> Additionally, individuals with disorders of fat malabsorption may be at increased risk of vitamin K deficiency.<sup>5</sup> Symptoms of deficiency include easy bruising and bleeding. This may occur as nosebleeds, bleeding gums, blood in the urine, blood in the stool, tarry black stools or extremely heavy menstrual

bleeding. Vitamin K deficiency in infants may result in life-threatening bleeding within the skull.<sup>4</sup>

## Dosing

The daily value for vitamin K is 80 mcg. Of course, daily value is a one-size-fits-all measurement or “adults and children 4 or more years of age,” so it lacks accuracy. This is different from the adequate intake (AI) level for vitamin K established by the Food and Nutrition Board of the Institute of Medicine established. The AI for men 19 or more years of age is 120 mcg/day, and 90 mcg/day for women. However, in some of the studies about to be presented, significantly higher doses of 45 mg have been used, which is about 500 times higher than the AI for vitamin K.

Nevertheless, there is no known toxicity associated with high doses of the vitamin K1 or K2 (although the same is not true for synthetic vitamin K3, menadione). Consequently, no tolerable upper level (UL) of intake has been established for vitamin K1 or K2.<sup>6</sup>

Regardless of dose, vitamin K antagonizes the effects of oral anticoagulants such as warfarin (Coumadin), and should not be used concurrently with this medication.

## Bone Health

Osteocalcin and matrix Gla protein (MGP) are vitamin-K dependent proteins that have been isolated in bone. Osteocalcin is a protein synthesized by osteoblasts, and is thought to be related to bone mineralization. MGP has been found in bone, cartilage and soft tissue, including blood vessels. Research suggests MGP prevents the calcification of soft tissue and cartilage, while facilitating normal bone growth and development.<sup>7-9</sup>

Various clinical trials in women have reported that 45 mg of vitamin K2 daily improved bone mineral density (BMD), significantly reduced bone loss, reduced the risk of fracture and improved measures of bone strength.<sup>10-13</sup> Likewise, in a meta-analysis of seven Japanese randomized controlled trials, vitamin K2 supplementation was associated increased BMD and a statistically significant reduction in fracture incidence. Specifically, supplementation lowered risk for vertebral fractures by 60 percent,

hip fractures by 77 percent and non-vertebral fractures by 81 percent; all associations were statistically significant.<sup>14</sup> The daily dose used in six of the trials was 45 mg, while one of the trials used 15 mg. While these are very high doses of vitamin K2, a more recent study has demonstrated efficacy for bone health at a significantly lower dose.

In a three-year study<sup>15</sup>, 244 healthy postmenopausal women received a daily dose of 180 mcg of vitamin K2 as MK-7, or a placebo. Compared to placebo, vitamin K2 significantly decreased the age-related decline in bone mineral content and BMD at the lumbar spine and femoral neck. Bone strength was also favorably affected by K2. In addition, K2 significantly decreased the loss in vertebral height.

## Cardiovascular Health

Calcification of atherosclerotic plaques occurs as the condition progresses (i.e., like cementing in the plaque). This results in decreased elasticity of the blood vessels and increases the risk of clot formation, which is the usual cause of a heart attack or stroke. Vitamin K-dependent proteins have been shown to inhibit vascular calcification, and so are thought to promote cardiovascular health. In a population-based study<sup>16</sup>, 4,807 subjects were analyzed for their vitamin K intake as well as other risk factors for poor cardiovascular health. The results showed that the relative risk for poor cardiovascular health was significantly reduced, as was severe aortic calcification with vitamin K2 intake (but not with vitamin K1).

In a cross-sectional study<sup>17</sup> among 564 post-menopausal women, 62 percent with coronary calcification, higher dietary intake of vitamin K2 (but not vitamin K1) was associated with a reduced risk of coronary calcification. In addition, preliminary clinical evidence<sup>18</sup> indicates that 45 mg/day vitamin K2 helped significantly lower cholesterol levels in patients on continuous ambulatory peritoneal dialysis after three months, lending further credence to this nutrient's role in cardiovascular health.

## Cell Growth

Another vitamin K-dependent protein, Gas6, was identified in 1993. Gas6 appears to be a cellular growth regula-

tion factor with cell-signaling activities, although its mechanism of action is not known. Nevertheless, it is important for various cellular functions including cell adhesion, cell proliferation and protection against apoptosis (i.e. programmed cell death).<sup>19</sup> Gas6 also seems to play important roles in both the developing and aging nervous system.<sup>20,21</sup> In addition, Gas6 is involved in regulating platelet signaling and vascular homeostasis.<sup>22</sup> It has been found throughout the nervous system, as well in the heart, lungs, stomach, kidneys and cartilage. A potential clinical application for this cell-growth regulating effect was suggested in *in-vitro* research where vitamin K2 was shown to suppress the recurrence of abnormal liver cell growth.<sup>23,24</sup> Furthermore, in a cohort study, dietary vitamin K2 intake was found to reduce the incident of abnormal prostate cell growth in men by 63 percent.<sup>25</sup>

## Vitamin K & D Synergism

Data show that vitamin K2 enhances vitamin D3 gene induction of osteocalcin (OC), a pro-osteoblastic, noncollagenous protein found in bone matrix.<sup>26</sup> Human clinical research has demonstrated that the combination of vitamin D and K2 is more effective in supporting BMD than either nutrient alone. Likewise, research has shown that vitamin D and K both down-regulate pro-inflammatory cytokines, thereby promoting a healthy inflammatory balance.

Furthermore, vitamins K and D also overlap metabolically at the cellular level in cyclic oxidation and reduction, protecting living cells against oxidative attack.<sup>27</sup> Consequently, there is value in jointly supplementing with these two vitamins. **VR**

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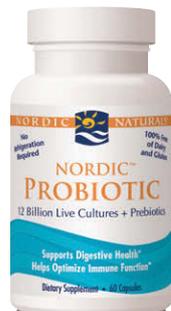
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of sales and marketing with New York-based American Health/Ester-C/Home. "With more than 50 percent of women saying they have sensitive skin, this launch represented a tremendous opportunity to grow the personal care business," she said, adding that the line is clinically tested, features clean ingredients, free of known irritants, hypoallergenic, non-comedogenic, non-GMO and vegan friendly.

- In addition to spotlighting its new probiotic product, Nordic Probiotic, California-based Nordic Naturals launched a new training module in its online training platform. "The 'Triglyceride Advantage' module will educate retailers on the fact that not all fish oils are created equal, and on why our bodies absorb a triglyceride form of omega-3 best," said Marci van der Meulen, national sales manager, retail division.

- Utah-based RidgeCrest Herbals was excited to showcase its newest prod-



ucts, SinusClear, a nutritional and herbal blend to help clear nasal and sinus passages while keeping mucous levels in check, and Thyroid Thrive, a mineral and herbal formula that supports the critical relationship between the thyroid, hypothalamus, pituitary and adrenal glands. "The overall response to these products were incredible and we couldn't be more excited to bring them to market," said Chris Herbert, retail sales manager, noting that Thyroid Thrive has experienced the fastest growth the company has ever seen in a newly released product. "We look forward to seeing them in more health food stores."

In addition to finding new products and meeting new people, attendees had the chance to see the launch of NEXT™, a unique portfolio of data and analytics tools from Natural Products Expo East show producers, New Hope Natural Media. Products include the NEXT Accelerator ([www.nextaccelerator.com](http://www.nextaccelerator.com)), a unique online tool for entrepreneurial manufac-

turers in the natural products industry, and NEXT Trend ([www.nexttrend.com](http://www.nexttrend.com)), a transformational new data and insights solution for industry innovators.

## Awards

During the event some of the most innovative brands were recognized and awarded with Natural Products Expo East Show Awards. Winners include:

- Most Innovative: Kombucha Wonder Drink by Tea Tibet
- Best New Green Product: Red Palm Oil by Nutiva
- Best New Health & Beauty: Peppermint Crème Nourishing Facial Refresher by Dairyface
- Best New Supplements/Herbs: QuinoaSure by Factoria Quinoa

## Next Year

Next year's Natural Products Expo East will return to Baltimore Convention Center September 17-20, 2014. Before that, plan on attending Natural Products Expo West March 6-9, 2014, at the Anaheim Convention Center in Anaheim, CA. **VR**

# SupplementScience (Continued from page 39)

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Gene Bruno, MS, MHS, the dean of academics for Huntington College of Health Sciences, is a nutritionist, herbalist, writer and educator. For more than 30 years he has educated and trained natural product retailers and health care professionals, has researched and formulated natural products for dozens of dietary supplement companies, and has written articles on nutrition, herbal medicine, nutraceuticals and integrative health issues for trade, consumer magazines and peer-reviewed publications.