USANA Technical Bulletin

Vitamin K

Technical Background

- Vitamin K (*koagulation* vitamin) is an essential fat-soluble vitamin required for the normal biosynthesis and activation of several key proteins.
- There are three forms of Vitamin K. Vitamin K_1 (also known as phylloquinone or phytonadione) is found in green plants and is the form included in dietary supplements. Vitamin K_2 (also called menaquinone) is produced by bacteria, including some found in the human intestinal tract. Vitamin K_3 (or menadione) is a synthetic derivative used as a source of vitamin K in animal feeds.[1]
- One of the main activities of vitamin K is the synthesis of several proteins involved in blood coagulation.[1]
- Vitamin K's other main role is synthesizing proteins involved in bone metabolism, and it may also participate in establishing calcium binding sites. As a result, the potential role of vitamin K in osteoporosis has received increasing attention.[2,3,4]
- Vitamin K is also important to kidney and vascular tissues. The presence of vitamin K in vascular tissues suggests a role in regulating vascular calcification.[5,6]
- Most people consume enough vitamin K in their diets to satisfy requirements for normal blood clotting and to prevent hemorrhagic deficiency symptoms.[1] However, recent preliminary evidence focusing on low bone density suggests that the current RDA may be too low and that osteoporosis may be, in part, a symptom of vitamin K deficiency.[7]
- Vitamin K deficiencies occur with some frequency in newborns.[8] As a result, commercial baby formulas are routinely supplemented with vitamin K, and the American Academy of Pediatrics has recommended administration of phylloquinone at birth as routine prophylaxis.[9]
- Persons taking anticoagulants like Coumadin (and its analogs) as prescribed treatments for heart disease, phlebitis, and other diseases in which blood clotting poses a threat, should consult with their physician before taking nutritional supplements containing vitamin K.[10]

Sources and Recommended Intake

- Major dietary sources of phylloquinone include green vegetables like spinach, broccoli, Brussels sprouts, and kale. Additional sources include soybean oil, canola oil, and olive oil. Vitamin K is heat-stable, so it is not rapidly destroyed during food preparation.[1]
- In recognition of the importance of vitamin K, the American Medical Association has recently increased the Recommended Dietary Allowance (RDA) to 90 mg/day for women and 120 mg/day for men.[2] The RDA for infants is 5-10 mcg/day during the first year, while children should consume 15-45 mcg/day. As noted earlier, evidence is accumulating to

suggest that the adult RDA for vitamin K may be too low to prevent osteoporosis in some women. Trauma, physical debilitation, compromised ability to absorb lipids, and prolonged use of broad-spectrum antibiotics may increase vitamin K requirements.**Error! Bookmark not defined.**

- There is no known toxicity associated with taking large doses of phylloquinone.[1]

Abstracts

Schurgers LJ, Dissel PE, Spronk HM, Soute BA, Dhore CR, Cleutjens JP, Vermeer C. Role of vitamin K and vitamin K-dependent proteins in vascular calcification. Z Kardiol. 2001;90 Suppl 3:57-63. OBJECTIVES: To provide a rational basis for recommended daily allowances (RDA) of dietary phylloquinone (vitamin K1) and menaquinone (vitamin K2) intake that adequately supply extrahepatic (notably vascular) tissue requirements. BACKGROUND: Vitamin K has a key function in the synthesis of at least two proteins involved in calcium and bone metabolism, namely osteocalcin and matrix Gla-protein (MGP). MGP was shown to be a strong inhibitor of vascular calcification. Present RDA values for vitamin K are based on the hepatic phylloquinone requirement for coagulation factor synthesis. Accumulating data suggest that extrahepatic tissues such as bone and vessel wall require higher dietary intakes and have a preference for menaquinone rather than for phylloquinone. METHODS: Tissue-specific vitamin K consumption under controlled intake was determined in warfarin-treated rats using the vitamin K-quinone/epoxide ratio as a measure for vitamin K consumption. Immunohistochemical analysis of human vascular material was performed using a monoclonal antibody against MGP. The same antibody was used for quantification of MGP levels in serum. RESULTS: At least some extrahepatic tissues including the arterial vessel wall have a high preference for accumulating and using menaquinone rather than phylloquinone. Both intima and media sclerosis are associated with high tissue concentrations of MGP, with the most prominent accumulation at the interface between vascular tissue and calcified material. This was consistent with increased concentrations of circulating MGP in subjects with atherosclerosis and diabetes mellitus. CONCLUSIONS: This is the first report demonstrating the association between MGP and vascular calcification. The hypothesis is put forward that undercarboxylation of MGP is a risk factor for vascular calcification and that the present RDA values are too low to ensure full carboxylation of MGP.

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