Assessment of Dietary Intake of Vitamin K and Maximum Limits for Vitamin K in Food Supplements

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Authors’ contributions

This work was carried out in collaboration between all authors. The opinion has been assessed and approved by the Panel on Nutrition, Dietetic Products, Novel Food and Allergy of VKM. All authors read and approved the final manuscript.

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ABSTRACT

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) has, at the request of the Norwegian Food Safety Authority (Mattilsynet; NFSA), evaluated the intake of vitamin K in the diet. VKM has also assessed the consequences of establishing maximum limits for vitamin K in food supplements at 100, 200, 300, 600 or 800 µg/day. The former maximum limit for vitamin K of 200 µg/day in food supplements was repealed 30 May 2017.

Vitamin K is a fat-soluble vitamin required for the carboxylation of glutamic acid residues in proteins that regulate blood coagulation and bone metabolism. The naturally occurring forms of vitamin K present in food and supplements are phylloquinone (vitamin K1) mainly produced by plants, and a range of menaquinones (vitamin K2) mainly produced by bacteria. The chemical structure of vitamin K is characterised by a methylated naphtoquinone ring structure assumed to be responsible for its function, in addition to a side chain which differs in length and degree of...
saturation. Due to the varying side chains, the different forms of vitamin K are thought to behave differently with regard to absorption, metabolism, bioavailability and thereby also toxic potential. Dark green leafy vegetables are rich sources of phylloquinone. Meat and liver products provide menaquinone-4, the most common menaquinone in Western diets, while other menaquinones are found in fermented foods and cheese.

An Adequate Intake (AI) of phylloquinone of 1 µg/kg body weight per day was set by the Scientific Committee on Food (SCF) in 1993 and maintained by the European Food Safety Authority (EFSA) in 2017. No dietary reference values (DRVs) have been established for menaquinones due to insufficient evidence. Furthermore, no tolerable upper intake levels (ULs) have been established for any form of vitamin K due to insufficient evidence, but previous reports stated that no adverse effects associated with vitamin K consumption from food or supplements had been reported in humans or animals. In 2003, the UK Expert Group on Vitamins and Minerals (EVM) proposed a guidance level (GL) for safe upper intake of supplemental phylloquinone of 1 mg/day in adults. The GL was set by applying an uncertainty factor of 10 for inter-individual variation to the supplemental dose of 10 mg/day that had been consumed by eight female athletes (age 20-44) for 30 days with no reported adverse effects. The UK expert group emphasised that GLs had been derived from limited data and were less secure than safe upper levels. This GL was supported by a double-blind randomised study cited in the Nordic Nutrition Recommendations (2012), in which 440 postmenopausal women with osteopenia received a daily supplement of 5 mg phylloquinone or placebo for up to four years with no difference in adverse events between the randomised groups.

Corresponding GLs for children and adolescents have been derived by adjusting for reference body weights0.75 by Rasmussen et al. (2006).

The distribution of intakes of vitamin K across age groups in Norway is not known, since food composition data is not available. However, habitual intakes in a representative sample of middle-aged and older adults in Western Norway were assessed in the population-based Hordaland Health Study 1997-2000, and revealed higher intakes than those estimated from dietary surveys in the other Nordic countries. Due to lack of representative estimates of vitamin K intakes in the Norwegian population, information on vitamin K intakes from other Nordic countries is included in the current opinion. This includes the distribution of vitamin K intakes in Sweden and Finland reported by EFSA, and the distribution of vitamin K intakes in Denmark, assessed by the Technical University of Denmark (DTU). In middle-aged and older Western Norwegians participating in the Hordaland Health Study 1997-2000, estimated mean intakes of total vitamin K (denoting the sum of K1+K2) ranged from 109 to 148 µg/day in four groups based on age and gender, while the 95-percentiles ranged from 261 to 329 µg/day. Average intakes of total vitamin K in the other Nordic countries are in the magnitude of 100 µg/day in adults, while 95-percentiles in adults are in the magnitude of 200 µg/day.

To illustrate the consequences of establishing maximum limits for vitamin K at 100, 200, 300, 600 or 800 µg/day in food supplements, VKM has compared these levels to the age-specific GLs for supplemental phylloquinone proposed by EVM (2003). The GLs are: 1000 µg/day for adults, 870 µg/day at age 15-17 years, 670 µg/day at age 11-14 years, 500 µg/day at age 710 years, 370 µg/day at age 4-6 years and 270 µg/day at age 1-3 years.

VKM concludes that:

• In adults and adolescents 15-17 years old, maximum limits of 100, 200, 300, 600 and 800 µg/day are below GL.
• In adolescents 11-14 years old, maximum limits of 100, 200, 300 and 600 µg/day are below GL while the maximum limit of 800 µg exceeds GL.
• In children 4-10 years old, maximum limits of 100, 200 and 300 µg/day are below GL while maximum limits of 600 µg/day and 800 µg/day exceeds GL.
• In children 1-3 years old, maximum limits of 100 µg/day and 200 µg/day are below GL while maximum limits of 300, 600 and 800 µg/day exceeds GL.
VKM notes that the current conclusions apply to phylloquinone (vitamin K1) only, while there is insufficient evidence to appraise potential health consequences of maximum limits of menaquinones (vitamin K2).

VKM emphasises that the current assessment of maximum limits for vitamin K in food supplements is merely based on published reports concerning upper levels from the IOM (2001, USA), SCF (2003, EU), EVM (2003, UK) and NNR (2012, Nordic countries). VKM has not conducted any systematic review of the literature for the current opinion, as this was outside the scope of the terms of reference from NFSA.

Keywords: VKM; risk assessment; Norwegian Scientific Committee for Food and Environment; vitamin K; phylloquinone; menaquinones; food supplements; safe upper level; guidance level; exposure.

Available: https://vkm.no/download/18.18fcdf1161d31d8fb92434f/1521019683082/Assessment%20of%20dietary%20intake%20of%20vitamin%20K%20and%20maximum%20limits%20for%20vitamin%20K%20in%20food%20supplements.pdf


NOTE:

This work was carried out in collaboration between all authors. The opinion has been assessed and approved by the Panel on Nutrition, Dietetic Products, Novel Food and Allergy of VKM. All authors read and approved the final manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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