Assessment of Dietary Intake of Chromium (III) in Relation to Tolerable Upper Intake Level

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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 chromium. VKM has also conducted scenario calculations to illustrate the consequences of establishing maximum limit for chromium at 50, 125, 200 or 300 μg/day in food supplements. The former maximum limit for chromium of 125 μg/day in food supplements was revoked 30 May 2017.

Chromium is present in food and supplements mainly as trivalent chromium, Cr(III), whereas in drinking water, chromium is present mainly as Cr(VI). Trivalent chromium has been reported to be an essential trace element in that it has been postulated to be necessary for the efficacy of insulin in regulation of the metabolism of carbohydrates, lipids and proteins. However, no mechanisms for these roles have been identified. Absorption of Cr(III) from food has been estimated to range from 0.4 to 2.5%, depending among other factors on the chemical properties of the ingested source and the presence of other dietary components. Absorption efficiency of supplemental Cr(III) has been reported to be between 0.1 and 5.2%, and to vary between the chromium complex ingested.
In general, Cr(III) has very low toxicity by the oral route (ATSDR, 2012), and there are hardly any well-documented observations of toxicity after peroral intake in humans. In a series of animal repeat dose toxicity studies, the no observed adverse effect level (NOAEL) for general toxicity was consistently the highest dose tested (EFSA, 2014b).

Chromium is ubiquitous in foods, and rich sources include meat and meat products, oils and fats, breads and cereals, fish, pulses and spices.

There are no Norwegian recommendations for intake of chromium. The Nordic Nutrition Recommendations and the European Food Safety Authority (EFSA) concluded that no recommendations could be given for chromium due to lack of sufficient evidence (EFSA, 2014a; NNR Project Group, 2012). Furthermore, no tolerable upper intake levels (UL) have been established for chromium. However, the EFSA Panel on Contaminants in the Food Chain (CONTAM Panel) suggested a tolerable daily intake (TDI) at 300 μg trivalent chromium per kg bodyweight per day based on a NOAEL in a rat study and an uncertainty factor at 1000. Due to uncertainty in the available data on developmental and reproduction toxicity, the EFSA Panel applied an uncertainty factor of 10 in addition to the default uncertainty factor of 100 for the extrapolations from rodents to humans and for human variability.

The chromium intake in Norway is not known, since Norwegian food composition data are not available. VKM has therefore based this evaluation upon intake data from EFSA. Values from EFSA are likely to be valid also for Norway. Median dietary chromium intakes were 28.6 -44.0 μg/day (medians of lower and upper bound) in the category toddlers (1 to < 3 years), 55.4-76.2 μg/day in other children (3 to < 10 years), 52.1-69.4 μg/day in adolescents (≥10 to <14 years), 73.6-98.1 in adolescents (≥14 to <18 years) and 63.0-84.0 μg/day in adults (18-65 years) (EFSA, 2014b). These values are 80-300 times lower than the suggested tolerable daily intake (TDI).

To illustrate the consequences of amending maximum limits for chromium to 50, 125, 200 or 300 μg per daily dose in food supplements, VKM has compared these levels and various intakes from food to the TDI at 300 μg/kg bw per day.

Even with the highest level of supplemental intake and additional median levels as well as the 95 percentile intakes from food, the estimated exposure will be 16-48 times lower than the TDI of 300 μg/kg bw per day in all age groups except for the 95 th percentile intake in toddlers, where it will be about nine times lower.

VKM emphasises that the current assessment of maximum limits for Cr(III) in food supplements is merely based on published reports concerning upper levels from the WHO (1996), IOM (2001, USA), SCF (2003, EU), EVM (2003, UK), NNR (2012, Nordic countries), and EFSA (2014b). 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; chromium; food supplement; upper level; exposure.

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**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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